United States Department of Agriculture

1910
George Washington National Forest

2010
George Washington National Forest

Environmental Impact Statement Appendices

for the Revised Land and Resource Management Plan

Forest Service | Region 8 | George Washington National Forest | R8-MB 143 E | November 2014

Supervisor's Office
5162 Valleypointe Parkway
Roanoke, VA 24019

540-265-5100

www.fs.fed.us/r8/gwj

James River Ranger District
810A East Madison Avenue
Covington, VA 24426
540-962-2214

Glenwood-Pedlar Ranger District
27 Ranger Lane
Natural Bridge Station, VA 24579
540-291-2188

Lee Ranger District
95 Railroad Avenue
Edinburg, VA 22824
540-984-4101

North River Ranger District
401 Oakwood Drive
Harrisonburg, VA 22801
540-432-0187

Warm Springs Ranger District
422 Forestry Road
Hot Springs, VA 24445
540-839-2521

Appendices
Final Environmental Impact Statement for the George Washington National Forest Land and Resource Management Plan

Alleghany, Amherst, Augusta, Bath, Botetourt, Frederick, Highland, Nelson, Page, Rockbridge, Rockingham, Shenandoah, and Warren Counties in Virginia.
Hampshire, Hardy, Monroe and Pendleton Counties in West Virginia.

Responsible Agency:	USDA Forest Service
Responsible Official:	Ken Arney, Regional Forester Southern Region 1720 Peachtree Road, NW Atlanta, GA 30309
Cooperating Agency:	DOI Bureau of Land Management
For Information Contact:	H. Thomas Speaks, Jr., Forest Supervisor George Washington & Jefferson National Forests 5162 Valleypointe Parkway Roanoke, VA 24019

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APPENDIX A – SUMMARY OF PUBLIC INVOLVEMENT

INTRODUCTION

This document is included to show the public involvement effort for the revision of the 1993 Final Revised Land and Resource Management Plan for the George Washington National Forest (GWNF), herein referred to as the Plan. All comments received through the plan revision process are available in the project file located at the Supervisor's Office in Roanoke, Virginia.

ENGAGING INTERESTED INDIVIDUALS AND ORGANIZATIONS

Public Workshops

Public Workshops in March 2007

Public involvement was initiated when the Forest Supervisor invited the public to a series of meetings to comment on whether there was a need for change to the 1993 Final Revised Land and Resource Management Plan for the George Washington National Forest.

Over 900 organizations, groups, county governments, state governments, and individuals were sent a post card the third week of February 2007 inviting them to a series of meetings to begin dialogue on what needed to change.

Forest Plan Revision Workshops

Please join us and others interested in the management of the George Washington National Forest at one of the following workshops. We would like to hear your thoughts on what worked well in the previous plan and suggestions on what needs to be changed in the new plan.

- Monday, March 5 — Time: 6-9 p.m.
  Hot Springs Presbyterian Church
  7433 Sam Snead Hwy. — Hot Springs, VA 24445
- Tuesday, March 6 — Time: 6-9 p.m.
  Rockbridge High School
  143 Greenhouse Road — Lexington, VA 24450
- Wednesday, March 7 — Time: 7-10 p.m.
  National Guard Armory
  451 Hoover Road — Woodstock, VA 22664
- Thursday, March 8 — Time: 6-9 p.m.
  9212 Winterberry Ave. — Covington, VA 24426
- Saturday, March 10 — Time: 1-4 p.m.
  Rockingham County Government Office Building
  20 E. Gay Street — Harrisonburg, VA 22802

Please visit our website for important information and draft documents prior to the meetings:

www.fs.fed.us/r8/gwj

Or call

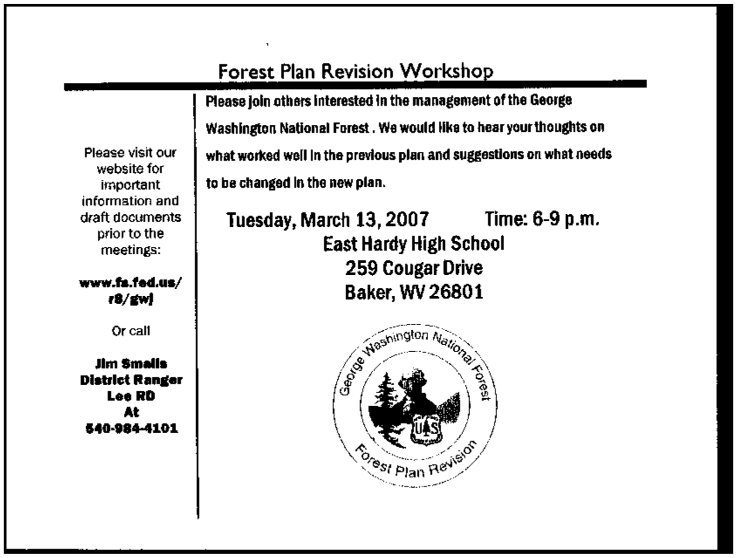
540-265-5100

On February 15, 2007 the Federal Register contained the Forest's Notice of Intent to revise the Forest Plan [72 FR 7390-7391]. This officially started the GW Revision process. A Legal Notice also appeared in the Forest's newspaper of record, the *Roanoke Times*, on March 31, 2007.

In addition, a news release was sent on February 16, 2007 to all newspapers, TV stations and radio stations that serve the counties where the GWNF is located.

Given the amount of land in West Virginia, the agency decided to hold two West Virginia meetings. A news release was sent to various media on February 22, 2007 that a meeting would be held in Brandywine, WV on March 9, 2007.

Likewise, a news release was sent to various media on February 28, 2007 that a meeting would be held in Baker, WV on March 13, 2007, and reminded people of the Brandywine meeting. Furthermore, all persons from West Virginia on the Forest's planning mailing list (about 72 individuals or organizations) were sent a postcard announcing the Baker WV meeting.



Forest Plan Revision Workshop

Please visit our website for important information and draft documents prior to the meetings:

www.fs.fed.us/r8/gwj

Or call

Jim Smalls
District Ranger
Lee RD
At
540-984-4101

Please join others interested in the management of the George Washington National Forest . We would like to hear your thoughts on what worked well in the previous plan and suggestions on what needs to be changed in the new plan.

Tuesday, March 13, 2007 Time: 6-9 p.m.
East Hardy High School
259 Cougar Drive
Baker, WV 26801

George Washington National Forest
Forest Plan Revision

Attendance at the public meetings is shown in the following table.

Meeting Date	Meeting Location	Approximate Attendance
March 5, 2007	Warm Springs, VA	56
March 6, 2007	Lexington, VA	112
March 7, 2007	Woodstock, VA	250+
March 8, 2007	Covington, VA	35
March 9, 2007	Brandywine, WV	22
March 10, 2007	Harrisonburg, VA	135+
March 13, 2007	Baker, WV	25

Meeting Presentation

For all meetings except Brandywine, the following program was given. The Brandywine meeting was an informal discussion of these same topics.

The overview was a PowerPoint presentation on the 2005 planning rule.

Attendees were distributed randomly among numerous groups and each group was asked the same following two questions about on-the-ground management of their National Forest:

1) What do you like about the current management of the GWNF?
2) What do you think needs to change in how the GWNF is managed?

Comments were captured on flip charts. All comments were then typed and posted to the Forest's internet site. Comment forms were also given to meeting attendees and comments written at the meeting could either be placed into a comment box or sent at a later date to the Forest Supervisor's office.

Summary

The summary of this effort was then used as an addendum to the Comprehensive Evaluation Report (CER).

Availability of the Draft Comprehensive Evaluation Report

The public was notified of the availability of the initial February 15, 2007 version of the Comprehensive Evaluation Report (CER) by three methods. First notification was posted on February 15, 2007 to the Forest's internet "Planning" page stating that an initial draft of the CER was available for downloading or available on a CD-ROM upon request. Secondly, this report was also mentioned in the agency's 2/15/07 Federal Register Notice. Thirdly, the agency's initial 2/22/07 news release mentioned that the CER was on the world-wide-web at http://www.fs.fed.us/r8/gwj. Business cards showing the WWW address were available for the public at all of the public meetings.

The agency also accepted public comments on the draft CER.

Postponement and Resumption of GW Planning Process

Postponement of GW Planning Process

On March 30, 2007, a federal judge enjoined (prohibited) the Forest Service from implementation of the 2005 Planning Rule. The GWNF's planning process, including the workshops, was initiated under this 2005 Rule. On April 3, 2007, the agency posted a letter on its web site postponing the planned public meetings scheduled in late April and early May 2007 because of the federal court decision.

As the Forest Supervisor stated in this letter "We have decided to wait until our Agency has time to assess the situation and provide us with some guidance on how to proceed with the revision. We hope that this will be a short postponement. We will keep you updated with information on this web page."

Resumption of GW Planning Process

On April 10, 2008 the Forest posted a letter to the Internet that work on a new nationwide planning rule had been completed. The letter also announced that public meetings would start in early summer 2008.

On April 21, 2008 the Forest Service adopted a new planning rule by announcement in the Federal Register. This rule (36 CFR 219 (2008)) was adopted following completion of an environmental impact statement and consultation under the Endangered Species Act. This new planning rule explicitly allowed the resumption of plan revisions started under the previous rule (36 CFR 219 (2005)) based on a finding that the revision process conforms to the new planning rule (36 CFR 219.14(b) (3) (ii)).

On June 24, 2008 the Federal Register [73 FR 35632-35633] contained the Forest's "Notice of Adjustment for Resuming the Land Management Plan Revision Process" to revise the GW Plan. This officially restarted the GW revision process. A Legal Notice also appeared in the *Roanoke Times*, on June 25, 2008. The Federal Register notice also requested additional public comments on the Draft CER of February 15, 2007. Comments were requested to be postmarked within 45 days after publication in the Federal Register. Thus, comments on the draft Comprehensive Evaluation Report were requested to be postmarked or received by August 8, 2008.

Public Workshops in July 2008

Topic – Place-Based Desired Conditions

On June 26, 2008 a letter announcing the dates and times of the meetings was posted on the Internet.

To resume the process and notify people without internet access, a post card was also sent the first week of July 2008 to over 1,200 organizations, groups, county governments, state governments, and individuals inviting them to a series of meetings to begin a place-based dialogue on where management on-the-ground needed to change.

The meetings had small groups discussing what they would like to see changed on the Forest. The meetings were place-based with attendees reviewing district maps in small groups.

Forest Plan Revision Workshops

Please join us and others interested in the management of the George Washington National Forest at one of the following workshops. We would like to hear your thoughts on what needs to be changed in our Forest Management Plan.

Please visit our website for workshop details and draft documents prior to the meetings:

www.fs.fed.us/r8/gwj

Or call

540-265-5100

- **Monday, July 14** Time: 7-9 p.m.
  Peter Muhlenberg Middle School
  1251 Susan Ave. Woodstock, VA 22664
- **Tuesday, July 15** Time: 7-9 p.m.
  Rockbridge County High School
  143 Greenhouse Rd. Lexington, VA 24450
- **Wednesday, July 16** Time: 7-9 p.m.
  East Hardy Middle School
  238 Cougar Drive Baker, WV 26801
- **Friday, July 18** Time: 7-9 p.m.
  Augusta County Government Center
  18 Government Ctr Lane Verona, VA 24482
- **Monday, July 28** Time: 7-9 p.m.
  Hot Springs Presbyterian Church
  7433 Sam Snead Hwy. Hot Springs, VA 24445

Attendance at the July 2008 public meetings is shown in the following table.

Meeting Date	Meeting Location	Approximate Attendance
July 14, 2008	Woodstock, VA	125
July 15, 2008	Lexington, VA	64
July 16, 2008	Baker, WV	29
July 18, 2008	Verona, VA	69
July 28, 2008	Hot Springs, VA	33

Meeting Presentation

A short PowerPoint presentation occurred that repeated what was done for the first round of planning and gave attendees a summary of the key topics from that first round of meetings. A framework was presented from the Forest's perspective of what resources were important in the planning process. The agency discussed some topics that are outside the planning process such as user fees and law enforcement.

The agency displayed the sideboards within which the decisions will be made on approving the revised plan. These sideboards are that the GW will continue to be a multiple use forest with managing for an emphasis on high quality water, wildlife habitat, diversity of recreation settings, timber harvest for vegetation management and production of wood, minerals resources, threatened and endangered species, and fire for vegetation management.

Participants were divided into small groups and gathered around tables that were covered with maps of the forest (by ranger district) showing the management areas under the current 1993 Forest Plan. The groups were asked the following questions:

1) What areas of the GWNF would you like to see managed in a different way and how would you like them to be managed?
2) Why?

Participants were asked to record their ideas directly on the maps, highlighting specific areas of interest. Comment sheets were also provided to capture responses.

Public Workshops in September 2008

Topic – Potential Wilderness Areas and Roadless Areas

Given that the intent of these meetings were to start focusing more on individual issues, only two locations were selected for discussing the topic of the potential wilderness inventory and inventoried roadless areas. The July workshops were held in five locations but there were a large number of people that came to more than one, even though the agenda was the same at each location. This time, there were no postcards mailed out since the public had been told at the July workshops that we would post the September workshop information on our website and we thought we would be able to save postage. However, this resulted in some people not receiving proper notification of the meetings. It was discussed how we could improve notification in the future without a costly mailing each time, including the possibility of sending a postcard with the option of sending an e-mail to the electronic Revision Comments inbox so an electronic mailing list could be initiated or with the option of receiving a postcard in the future.

The purpose of the September workshops was to discuss the 37 Potential Wilderness Areas (370,000 acres) and the two Inventoried Roadless Areas (14,000 acres) not part of the current inventory. Each participant was given a list of the areas and the table where the area would be discussed.

Meeting Presentation

The Planning Staff Officer gave a 20 minute presentation on the history of roadless area inventory and wilderness designation at the national level and on the forest level, the definition of various terms related to wilderness and roadless, and described the process used to go from an inventoried potential wilderness area to a congressionally-designated Wilderness. The participants were then asked to visit tables that had detailed maps of the areas and discuss the following three questions:

1) What are the characteristics that might make this area a good wilderness?
2) What are the resource uses that might be foregone if this area became wilderness?
3) If not wilderness, how would you like to see this area managed?

Each table was hosted either by a District Ranger or someone who was familiar with the areas on the maps. Each table also had a poster showing a table highlighting other resource information for each area, such as the amount of timber currently suitable, presence of structural improvements, presence of acidified streams, etc. Participants were asked to record their ideas directly on the maps, highlighting specific areas of interest. Boundary adjustments were also encouraged to show where needs of other resources could be met. Comment sheets were also provided to capture responses.

Attendance at the September 2008 public meetings is shown in the following table. The second meeting was held on a Saturday and there was a general consensus that Saturdays were not an ideal day for a public meeting.

Meeting Date	Meeting Location	Approximate Attendance
Sept. 11, 2008	Bridgewater, VA	94
Sept. 13, 2008	Lexington, VA	39

Public Workshops in October 2008

Topic – Access (Roads and Trails)

Postcards were mailed out to announce the two workshops for access and to update the Revision mailing list. The purposes of the meeting was to discuss management of the road and trail systems on the Forest and to discuss options for any needed changes in desired conditions, suitability, objectives, and guidelines regarding roads and trails.

Forest Plan Revision Workshops

Please join us and others interested in the management of the George Washington National Forest at one of the following workshops. We would like to hear your thoughts on road and trail access.

- Wednesday, October 29 Time: 7-9 p.m.
  National Guard Armory
  451 Hoover Rd Woodstock, VA 22664
- Thursday, October 30 Time: 7-9 p.m.
  Rockbridge Co. High School
  143 Greenhouse Rd. Lexington, VA 24450

See the inside of this mailing for more information.....

Please visit our website for workshop details and draft documents prior to the meetings:

www.fs.fed.us/r8/gwj

Or call

540-265-5100

We will post information for all of our workshops at http://www.fs.fed.us/r8/gwj/forestplan/revision. However, in an effort to keep you informed while reducing the use of paper and postage, we would like to update our Forest Plan mailing list. We are also looking at options for e-mail notification so let us know if you are interested in that option if it becomes available.

Please check the following boxes as applicable and return to us. You may either respond by return of the detachable portion of this postcard, call us at 540-265-5175, or send us an e-mail to comments-southern-georgewashington-jefferson@fs.fed.us.

☐ Keep me on the Forest Plan mailing list.

☐ Send me postcards about upcoming Forest Plan Revision workshops.

☐ If e-mail notification becomes available, send me e-mails about upcoming Forest Plan Revision workshops. My e-mail address is ______________________.

Meeting Presentation

The Planning Staff Officer gave a 15 minute presentation on road and trail access issues. The participants were then asked to visit tables to discuss the road and trail access concerns on the Ranger District. They were asked to discuss the following questions:

Road Group Questions Asked:

1) What areas of the Forest should be suitable for road construction?
2) Are there areas of the Forest that should be high priority for decommissioning existing roads? What should the objective be for decommissioning roads?
3) Are there key areas where roads should not be decommissioned in order to maintain OHV opportunities?
4) Are there guidelines that need to be added to the plan to address road access issues?

Trail Group Questions Asked:

1) Are there areas of the forest where additional trails are needed (hiking, biking, horseback riding) or should be emphasized? Are there trails that could be decommissioned so that maintenance funding can be used to higher priority trails?
2) Are there guidelines that need to be added to the plan to address trail access issues?

Attendance at the October 2008 public meetings is shown in the following table.

Meeting Date	Meeting Location	Approximate Attendance
Oct. 29, 2008	Woodstock, VA	55
Oct. 30, 2008	Lexington, VA	50

Public Workshops in November and December 2008

Topic – Vegetation Management (Timber harvest, Prescribed fire, Non-native Invasive Species)

Postcards were mailed out to announce the two workshops.

Purpose

Discuss management of vegetation on the forest including timber harvest, prescribed fire, wildlife habitat, non-native invasive plants, and special biologic areas.

Items to discuss

Spatial concerns about prescribed fire and timber harvest (Where are we managing?)
Level of activity or objectives for prescribed fire and timber harvest (How much are we managing?)
Concerns with the effects of prescribed fire and timber harvest
Rationale for vegetation management (What are we managing for?)

The Planning Staff Officer gave a 30 minute presentation on the purpose of vegetation management and current vegetation management activities. The participants were then asked to visit tables to discuss the vegetation management concerns on the Ranger District. They were asked to discuss the following question:

Question for the small groups:

1) What is important to you about managing vegetation on the Forest?

Attendance at the November and December 2008 public meetings is shown in the following table.

Meeting Date	Meeting Location	Approximate Attendance
Nov. 13, 2008	Verona, Va	43
Dec. 3, 2008	Lexington, VA	32

Public Workshops in January and February 2009

Topic – Forest Plan Components

Purpose

Inform people of how the Forest Service has evaluated the discussions to date and putting the information into the Forest Plan components
Provide a forum to discuss options that should be considered differently than above
Identify monitoring or guidelines to improve the Plan

Meeting Format

The first meeting in Lexington was done with a 30-40 minute presentation on the Plan Components, followed by small group discussions that focused on topics identified by the public. A handout was provided that summarized the highlights of where we are headed with the revised plan, such as the areas we are seriously considering for wilderness recommendation and the objectives for timber harvest. The group discussions at the first meeting were good but many people wanted to talk about more than two topics. Therefore the second meeting, in Woodstock, used a different format where the presentation was followed by opening up the discussion to questions, answers, comments to the entire group. This format suited the discussions much more and was more appropriate for the place we were at in the revision process.

Meeting Date	Meeting Location	Approximate Attendance
Jan. 29, 2009	Lexington, VA	54
Feb. 5, 2009	Woodstock, VA	79

Postponement and Resumption of GW Planning Process

Postponement of GW Planning Process

On June 30, 2009, the 2008 planning rule was enjoined by the United States District Court for the Northern District of California (*Citizens for Better Forestry* v. *United States Department of Agriculture*, No. C 08–1927 CW (N.D. Cal. June 30, 2009)) and the revision of the GWNF Forest Plan was again suspended. The Forest Supervisor posted a letter on its website on July 8, 2009 informing the public of the postponement.

Resumption of GW Planning Process

The Department determined that the 2000 planning rule was back in effect. The 2000 Rule's transition provisions (36 CFR 219.35), amended in 2002 and 2003 and clarified by interpretative rules issued in 2001 and 2004, and reissued on December 18, 2009 [74 FR 67059–67075] allow use of the provisions of the National Forest System land and resource management planning rule in effect prior to the effective date of the 2000 Rule (November 9, 2000), commonly called the 1982 planning rule, to amend or revise plans. The GWNF elected to use the provisions of the 1982 planning rule, including the requirement to prepare an EIS, to complete its plan revision. The Notice of Intent was published in the Federal Register on March 10, 2010 [75 FR 11107-11111]. The Notice requested comments on the Forest Plan by May 7, 2010.

On March 7, 2010 the Forest posted a letter to the Internet that the Notice of Intent to prepare an Environmental Impact Statement and Forest Plan had just been published in the Federal Register. The letter also announced public meetings in the following locations:

Monday, April 12, 2010
Valley Elementary School
98 Panther Drive
Hot Springs, VA

Wednesday, April 14, 2010
East Hardy High School
Baker, WV

Monday, April 19, 2010
Rockbridge Co. High School
143 Greenhouse Rd.
Lexington, VA 24450

Wednesday, April 28, 2010
Woodstock National Guard Armory
541 Hoover Road
Woodstock, VA 22664

Thursday, April 29, 2010
Augusta County Government Center
18 Government Lane
Verona, VA

The letter also reiterated the public comment period and identified a number of documents available for review on the GWNF website.

An additional meeting was added on Tuesday, April 27 at the Fairfax County Government Center in Fairfax, Virginia.

Public Workshops in April 2010

Topic – Scoping for the Notice of Intent

Postcards were mailed out to announce the two workshops for the five meetings. The Fairfax meeting was posted on the website.

Purpose

The Notice of Intent was published in the Federal Register on March 10, with a 60 day comment period ending May 7, 2010. The purpose of these meetings was to scope issues and potential alternatives for preparation of the EIS.

Meeting Format

The meeting began with a 30-minute powerpoint presentation that described how we are starting the revision again for the third time, this time under the 1982 planning regulations. However, it was stressed that we are not discarding any public input from the past three years. Information regarding preliminary issues and three potential alternatives was presented. These alternatives included the current 1993 Forest Plan, the Need for Change (that was presented at Jan/Fed 2009 meetings), and a Remote Habitats and Access alternative. The presentation was followed by small group discussions that answered two questions:

1) What issues would you like to see addressed in the Forest Plan
2) How would you like to see that issue addressed in the Forest Plan?

Meeting Date	Meeting Location	Approximate Attendance
April 12, 2010	Hot Springs, VA	25
April 14, 2010	Baker, WV	20
April 19, 2010	Lexington, VA	51
April 27, 2010	Fairfax, VA	44
April 28, 2010	Woodstock, VA	51
April 29, 2010	Verona, VA	53

Public Workshop with Interdisciplinary Team in July 2010

Topic – Alternative Refinement

A notice was posted on the GWNF website on June 18, 2010 announcing a workshop to be held on July 14 in the Supervisor's Office.

Purpose

The purpose of the workshop was to give interested parties the opportunity to review the current list of alternatives and suggest modifications or additions to the alternatives.

Meeting Format

The meeting was conducted as an interactive meeting with the public and the IDT actively engaged in discussion. Twenty-one members of the public attended the meeting and engaged in discussion with the IDT on the alternatives and ways to improve them.

Public Workshop in October 2010

Topic – Alternatives

Postcards were mailed out to announce the workshop to be held on October 5, 2010 at the Augusta County Government Center in Verona, Virginia. The workshop was held from 6:30 until 8:30.

Purpose

The purpose of the workshop was to describe the six alternatives developed for the Draft Environmental Impact Statement and to discuss the alternatives and effects analysis with GWNF staff.

Meeting Format

The meeting began with a 30 minute presentation by the Planning Staff Officer about the alternatives. Then there was an hour for attendees to discuss the alternatives and review the alternative maps with GWNF staff. The attendees then broke into groups to discuss the following questions:

> You have heard and participated in a number of discussions about how the Forest Plan should address a variety of issues. If you were going to pick an alternative that appropriately balances the varied interests,
>
> a. What are the key criteria you would use to make your decision?
> b. What are the important benefits or consequences in the six alternatives that are under consideration and how would these affect your decision?

About 77 people attended the workshop.

Public Workshops in June and July 2011

Topic – Comments on Draft Plan and Draft EIS

Letters were mailed out and documents or cd's were sent to those who requested them. The meetings were posted on the website.

Purpose

The Notice of Availability was published in the Federal Register on June 3, 2011 with a 90 day comment period ending September 1, 2011. The comment period was extended to October 17, 2011. The purpose of these meetings was to present the Draft Plan, answer questions about the Plan and EIS and accept comments on these documents.

Meeting Format

The meeting began with a powerpoint presentation that described the planning process and how the Draft Plan addressed the issues. The presentation was followed by an opportunity to ask questions and to discuss what people would like to see changed from the Draft Plan.

Meeting Date	Meeting Location	Approximate Attendance
July 27, 2011	Hot Springs, VA	42
July 12, 2011	Baker, WV	18
June 30, 2011	Lexington, VA	37
June 20, 2011	Fairfax, VA	35
June 22, 2011	Woodstock, VA	50
July 18, 2011	Verona, VA	109

Topic – Extension of Comment Period

Letters were mailed out and information was posted on the website acknowledging that comments had indicated some errors in the draft documents. These errors were corrected and updated versions were posted on the website. The comment period was extended to October 17, 2011 to allow people to respond to these corrected documents. The extension of the comment period was posted in the Federal Register on August 26, 2011 [76 FR 53453-53454].

Participation in Other Collaborative Efforts

In September 2010 a group of individuals and representatives of various groups interested in management of the Forest began meeting independently to develop recommendations for a preferred alternative. This group became the George Washington National Forest Stakeholder Group. Representatives from the Forest were invited to attend and participated in the following meetings held by the Stakeholders Group.

September 1, 2010
September 29, 2010
February 11, 2011
March 30, 2011
May 27, 2011
June 15, 2011
June 30, 2011
February 2, 2012

State and Local Governments & Federal Agency Coordination and Assistance

Federal Agency Coordination and Assistance

Correspondence

Date	From	To	Subject
11/16/06	Forest	VA USFWS	Request for Accuracy of Forest T&E species
11/16/06	Forest	WV USFWS	Request for Accuracy of Forest T&E species
1/4/07	VA USFWS	Forest	List of Forest T&E species accurate
3/14/07	VA USFWS	Forest	At this point, Revised Plan may be to general to conduct Section 7 Consultation
5/9/10	Forest	BLM	Request to be a cooperating agency
5/12/10	Forest	VA USFWS	Restarting revision and request for review of species to consider
5/12/10	Forest	WV USFWS	Restarting revision and request for review of species to consider
5/12/10	USGS	Forest	USGS will assist in providing information for the Reasonably Foreseeable Development Scenario

Meetings

Date	With	Subject
4/10/06	Shenandoah & Cedar Cr. / Belle Grove NP	Revising the GW Plan
5/25/06	Various State and Federal Agencies (USFWS, WV & VA Heritage, WVDNR, VDGIF)	Introduce the 2005 Planning Regulations
12/6/06	Virginia Partners (USFWS, Shenandoah NP, VDGIF, VDOF, VDCR, VT)	Update on Plan Revision
3/26/07	VA Department of Forestry	Update on Plan Revision
10/07/07	West Virginia Cooperative Stamp Meeting (WVDNR, Monongahela NF)	Update on Plan Revision
10/18/07	Virginia Partners (USFWS, Shenandoah NP, VDGIF, VDOF, VDCR, VT)	Update on Plan Revision
10/01/08	West Virginia Cooperative	Update on Plan Revision

Date	With	Subject
	Stamp Meeting (WVDNR, Monongahela NF)	
10/29/08	Virginia Partners (USFWS, Shenandoah NP, VDGIF, VDOF, VDCR, VT)	Update on Plan Revision
5/13/09	US F&WS	Update on Plan Revision
9/9/09	Virginia Partners (USFWS, Shenandoah NP, VDGIF, VDOF, VDCR, VT)	Update on Plan Revision
10/27/09	West Virginia Cooperative Stamp Meeting (WVDNR, Monongahela NF)	Update on Plan Revision
9/28/10	Virginia Partners (USFWS, Shenandoah NP, VDGIF, VDOF, VDCR, NRCS, VT	Update on Plan Revision
7/19/11	WV DNR, VDGIF, VDCR	Update on Draft Plan and ecological analysis

NPS representatives participated in the Woodstock workshop of March 7, 2007.

State Government Coordination and Assistance

Correspondence

Date	From	To	
1/3/07	USFS	VA & WV State Game Agencies	Informal Review of Draft Working Copy of GW Comprehensive Evaluation Report

Meetings

Date	With	Subject
4/17/06	WVDNR & VDGIF	Revising the GW Plan
5/25/06	Various State and Federal Agencies (USFWS, WV & VA Heritage, WVDNR, VDGIF)	Introduce the 2005 Planning Regulations
12/6/2006	Virginia Partners (USFWS, Shenandoah NP, VDGIF, VDOF, VDCR, VT)	Update on Plan Revision
12/14/06	WVDNR	Introduce Agency to Draft CER
1/22/07	VDGIF	Introduce Agency to Draft CER
10/07/07	West Virginia Cooperative Stamp Meeting (WVDNR, Monongahela NF)	Update on Plan Revision
10/18/07	Virginia Partners (USFWS, Shenandoah NP, VDGIF, VDOF, VDCR, VT)	Update on Plan Revision
8/27/08	VA Dept of Game and Inland Fisheries	Update on Plan Revision
9/10/08	VDGIF and VDNH	Update on the Plan Revision process
10/01/08	West Virginia Cooperative Stamp Meeting (WVDNR, Monongahela NF)	Update on Plan Revision
10/29/08	Virginia Partners (USFWS, Shenandoah NP, VDGIF, VDOF, VDCR, VT)	Update on Plan Revision
11/07/08	VA Natural Heritage Program	Special Biological Areas
9/9/09	Virginia Partners (USFWS, Shenandoah NP, VDGIF, VDOF, VDCR, VT)	Update on Plan Revision

Date	With	Subject
10/27/09	West Virginia Cooperative Stamp Meeting (WVDNR, Monongahela NF)	Update on Plan Revision
6/23/10	VDGIF	Review of ecological sustainability analysis
6/24/10	WVDNR	Review of ecological sustainability analysis
9/28/10	Virginia Partners (USFWS, Shenandoah NP, VDGIF, VDOF, VDCR, NRCS, VT	Update on Plan Revision

VDGIF and WV DNR representatives participated in many of the public workshops, as did VA DOF personnel.

Local Government Coordination and Assistance

Correspondence

Date	From	To	Subject
6/22/05	USFS	Var. Cty Planning Districts	
8/2/05	USFS	Var. County Planning Dept	Request for County Master Plans, Land Use Maps
8/4/05	Page County	USFS	Response to Request for County Master Plan
8/15/05	Shenandoah Cty	USFS	Response to Request for County Master Plan

Meetings

Date	With	Subject
9/22/08	Augusta County Board of Supervisors	Update on the Planning Process
10/08/08	Amherst County Planning Director	Update on the Planning Process
10/08/08	Nelson County Administrator and Planning Director	Update on the Planning Process
10/09/08	Alleghany County Administrator	Update on the Planning Process
11/3/08	Page County Planner	Update on the Planning Process
11/6/08	Shenandoah County Property and Public Works Committee	Update on the Planning Process
10/8/08	Rockingham County Board of Supervisors	Update on the Planning Process
12/2/08	Hardy County planner and a member of the County Commission	Update on the Planning Process
1/26/09	Bath County Planning Commission	Update on the Planning Process
2/10/09	Bath County Board of Supervisors	Update on the Planning Process
1/29/09	Rockbridge County Planner and Administrator	Update on the Planning Process
4/13/09	Rockbridge County Board of Supervisors	Update on the Planning Process
6/22/09	Bath County Planning Commission	Update on potential wilderness
6/22/09	Augusta County Administrator	Update on potential wilderness
5/22/09	Rockbridge County Administrator	Answer questions about wilderness
7/27/09	Rockbridge County Board of Supervisors	Answer questions about wilderness
5/31/11	Augusta County Administrator	Update on Draft Plan
6/1/11	Rockingham County Administrator	Update on Draft Plan
6/4/11	Bath County Board of Supervisors	Update on Draft Plan
8/18/11	Shenandoah County Administrator	Update on Draft Plan

Representatives of various counties, including planners and members of the Board of Supervisors, participated in the public workshops either held in their counties or near their counties. For example, representatives from Augusta and Botetourt Counties participated in the Lexington meeting of March 6, 2007.

Tribal Government Consultation

The Eastern Band of Cherokee and the Cherokee Nation of Oklahoma were contacted through mailings of post cards about the March 2007 meetings.

Furthermore, the Forest was contacted by the Tribal Historic Preservation Officer of the Eastern Band of Cherokee in February 2007 that the George Washington National Forest was not in the Cherokee's aboriginal territory and that the tribe no longer needed to be consulted for projects or activities on the GWNF.

The following eight Virginia-recognized tribes were contacted through mailings of post cards about the March 2007 meetings. The United Keetoowah Band of Cherokee Indians and the Virginia Council on Indians were also contacted.

Virginia-Recognized Tribes
Chickahominy Tribe
Eastern Chickahominy Tribe
Mattaponi Tribe
Monacan Indian Nation
Nansemond Tribe
Pamunkey Tribe
Rappahannock Tribe
Upper Mattaponi Tribe

Letters were sent on October 20, 2010 to the Virginia Council on Indians, the Eastern Shawnee, the Shawnee Tribe and the Absentee-Shawnee Tribe of Indians in Oklahoma inviting them to participate in the forest plan revision.

Official Public Notification

Federal Register and Newspaper of Record Notifications

Required Notices	Federal Register Publication Date
Initiation of Plan Revision	2/15/07
Notice of Readjustment and Resumption	6/24/08
Notice of Intent	3/10/10
Notice of Availability of Environmental Impact Statement	6/3/11
Notice of Extension of Comment Period	8/26/11

Presentations to Organizations

An overview of the Revision process and timelines was presented to representatives of various environmental groups, including, Wildlaw, Southern Environmental Law Center, Virginia Wilderness Committee, Southern Appalachian Forest Coalition, Virginia Forest Watch, Wild Virginia, and the Sierra Club.

Date	From	To	Subject
2/7/07	Planning Staff Officer	Various Environ. Groups	Revision Process and Timeline
2/16/07	Planning Staff Officer	Virginia Chapter of The Wildlife Society	Plan Revision Update
2/24/07	Planning Staff Officer	Virginia Council Trout Unlimited	
3/31/07	Planning Staff Officer	Virginia Loggers Association	
9/10/08	Planning Staff Officer, Forest Planner	Various wilderness-interest groups	Question and answer regarding Potential Wilderness Areas at their request
12/10/08	Planning Staff Officer	Regional Water Resources Policy Committee	Drinking water protection
3/12/09	Planning Staff Officer	Various Groups in northern Virginia – held in Arlington, VA	Plan Revision, summary of recent meetings
11/17/11	Planning Staff Officer	Waynesboro Game and Fish Protective Association	Update on Draft Plan
5/9/12	Planning Staff Officer	Middlebrook Ruritan Club	Update of Draft Plan

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APPENDIX B – ANALYSIS PROCESS

INTRODUCTION

Land and resource management planning requires that processes formerly used to make individual resource decisions be combined into integrated management decisions. It also requires that mathematical modeling techniques be used to identify the most economically efficient solution to meet the goals and objectives of any alternative. Appendix B presents a technical discussion of the analysis process and computer models used in the Revision planning effort. The appendix focuses on the quantitative methods used to perform the analysis and documents how the analysis was done. The results from the modeling processes are estimates of what can be expected if alternatives are implemented and facilitate comparison of alternatives.

The Forest's major analysis goal is to provide enough information to help decision-makers and the public determine which combination of goods, services, and land allocations will maximize Net Public Benefits (NPB). The regulations (36 CFR 219, 1982 regulations) developed under the National Forest Management Act (NFMA) provide the analytical framework within which these decisions are made.

The NFMA and its regulations also state that the requirements of the National Environmental Policy Act (NEPA) and its regulations (40 CFR 1500-1508) must be applied in this analytic process. The NEPA regulations require that the environmental effects of a proposed action and alternatives to that proposed action must be disclosed in an Environmental Impact Statement (EIS).

Information presented in this chapter supplements the broader and less technical descriptions included in the body of the EIS. This discussion includes basic assumptions, modeling components and inputs, rules, methods, and constraints. Additional information and documents used in the analysis process are contained in the planning process records. The planning record in its entirety is incorporated here by reference.

FRAMEWORK OF THE PLANNING PROCESS

The general planning process described in 36 CFR 219.12 (1982 regulations) was used to guide the revision of the George Washington National Forest Land and Resource Management Plan. This 10-Step process is described briefly below, followed by a more detailed discussion of Steps 2, 3, 4, and 6.

STEP 1, Identification of Purpose and Need: Issues, Concerns, and Opportunities. The Forest Interdisciplinary Team assessed changes in public issues, management concerns, and resource use and development opportunities since the Plan was initially developed and subsequently amended. To gain an understanding of public issues, 40 workshops were held for collaboration on issues and management options, as described in Appendix A of this EIS. In addition, information was reviewed and evaluated from numerous assessments, reports, action plans and initiatives from state and local government entities, such as the Virginia and West Virginia Statewide Forest Assessments, State Wildlife Action Plans, the Southern Appalachian Assessment, and County Comprehensive Plans for the counties with National Forest System lands.

STEP 2, Planning Criteria. Criteria are designed to guide the collection and use of inventory data and information; the analysis of the management situation; and the design, formulation, and evaluation of alternatives. This step establishes guidelines for accomplishing the next five steps. Planning criteria are based on:

- Laws, executive orders, regulations and agency policy as set forth in the Forest Service Manual
- Goals and objectives in the USDA Forest Service's Strategic Plan 2007-2012
- Recommendations and assumptions developed from public issues, management concerns, and resource use and development opportunities
- The plans and programs of other federal agencies, state and local governments, and Indian tribes
- Ecological, technical and other factors
- The resource integration and management requirements in 36 CFR 219.13 through 219.27

Alternatives that are technically possible to implement
Alternatives that meet management requirements or standards
Various levels of multiple-use objectives and outputs achieved

STEP 3, Inventory Data and Information Collection - The kind of data and information needed is determined in Step 3 based on the issues, concerns, and opportunities identified and the resulting assessment of the management situation and determination of what needs to change. Data collection is part of normal Forest operations. Existing data is used whenever possible and supplemented with new data, when practicable. Data accuracy is continually evaluated. Much of this data and background documentation is on file in the planning records on file in the Supervisor's Office.

STEP 4, Analysis of the Management Situation - This step describes the existing situation on the Forest and determines if there is a need to change current management direction. It examines supply potentials and market assessments for goods and services, assesses demand for goods and services from National Forest lands, and determines suitability and feasibility for meeting needs. This information provides the basis for formulating an appropriate range of reasonable alternatives.

STEP 5, Formulation of Alternatives - A reasonable range of alternatives is formulated according to NEPA procedures. Alternatives are formulated to assist in identifying one that comes nearest to maximizing net public benefits (NPB). They provide for the resolution of significant issues and concerns identified in Step 1. Chapter 2 of the EIS describes the formulation of alternatives for the George Washington National Forest in more detail.

The alternatives reflect a range of resource management programs. Each identified major public issue and management concern is addressed in different ways in the alternatives. The programs and land allocations in each alternative represent the most cost-efficient way of attaining the goals and objectives for that alternative. Both priced and non-priced goods and services (outputs) are considered in formulating each alternative.

STEP 6, Estimated Effects of Alternatives - The physical, biological, economic and social effects of implementing each alternative are described in Chapter 3 of the EIS to evaluate how well each alternative responds to issues, concerns and opportunities and what the potential impacts to resources might be.

STEP 7, Evaluation of Alternatives - Physical, biological, economic and social effects of implementing alternatives are used to evaluate each alternative and compare them with one another. Typically, each alternative can be judged on how it addresses the significant issues identified in Chapter 1 of the EIS.

STEP 8, Preferred Alternative - The Forest Supervisor reviews the Interdisciplinary Team evaluation of each alternative and the public issues and concerns. The Forest Supervisor then recommends a preferred alternative to the Regional Forester. The Regional Forester either selects the Forest Supervisor's recommendation, another alternative, or modifies the alternative recommended by the Forest Supervisor. This alternative is described as the Selected Alternative in this EIS and is displayed as the Proposed Revised Forest Plan. Public comments are solicited and will be considered in the finalizing of the Revised Forest Plan and EIS.

STEP 9, Plan Approval and Implementation - After the Interdisciplinary Team has reviewed public comments and incorporated any necessary changes into the Final EIS and the Revised Forest Plan, the Regional Forester reviews and approves the Revised Forest Plan and Final Environmental Impact Statement. A Record of Decision documents this step.

STEP 10, Monitoring and Evaluation - The Revised Forest Plan establishes a system of measuring, on a sample basis, actual activities and their effects, and compares these results with projections contained in the Revised Forest Plan. Monitoring and evaluation comprises an essential feedback mechanism to ensure the Revised Forest Plan is dynamic and responsive to change. Chapter 5 of the Revised Forest Plan displays the Monitoring and Evaluation program.

PLANNING CRITERIA (STEP 2)

Laws

Alternatives should meet the intent of the Organic Administration Act and Weeks Law identifying the purpose of the National Forest to improve and protect the forest, to secure favorable conditions of water flows, and to furnish a continuous supply of timber for the use and necessities of citizens of the U.S.

Alternatives should meet the intent of the Multiple-Use Sustained-Yield Act of 1960 to administer the National Forest for outdoor recreation, range, timber, watershed, and wildlife and fish purposes. These resources are utilized in the combination that will best meet the needs of the American people; making the most judicious use of the land for some or all of these resources or related services over areas large enough to provide sufficient latitude for periodic adjustments in use to conform to changing needs and conditions; that some land will be used for less than all of the resources; and harmonious and coordinated management of the various resources, each with the other, without impairment of the productivity of the land, with consideration being given to the relative values of the various resources, and not necessarily the combination of uses that will give the greatest dollar return or the greatest unit output.

Alternatives should meet the intent of the Forest and Rangeland Renewable Resources Planning Act of 1974 as amended by the National Forest Management Act of 1976 including requirements to provide for multiple use and sustained yield of the products and services obtained therefrom in accordance with the Multiple-Use Sustained-Yield Act of 1960, and, in particular, include coordination of outdoor recreation, range, timber, watershed, wildlife and fish, and wilderness.

Alternatives should comply with the Clean Water Act, Endangered Species Act and other applicable laws. Protection of water quality to provide for current and future beneficial uses will be a high priority in all alternatives.

National Direction (formerly RPA Program)

The goals and objectives of the Forest Service Strategic Plan 2007-2012 will be addressed as applicable to the George Washington National Forest. These include:

Goal 1. Restore, Sustain, and Enhance the Nation's Forests and Grasslands
- Objective 1.1 Reduce the risk to communities and natural resources from wildfire
- Objective 1.2 Suppress wildfires efficiently and effectively
- Objective 1.3 Build community capacity to suppress and reduce losses from wildfires
- Objective 1.4 Reduce adverse impacts from invasive and native species, pests, and diseases
- Objective 1.5 Restore and maintain healthy watersheds and diverse habitats

Goal 2. Provide and Sustain Benefits to the American People
- Objective 2.1 Provide a reliable supply of forest products over time that (1) is consistent with achieving desired conditions on NFS lands and (2) helps maintain or create processing capacity and infrastructure in local communities
- Objective 2.3 Help meet energy resource needs

Goal 4. Sustain and Enhance Outdoor Recreation Opportunities
- Objective 4.1 Improve the quality and availability of outdoor recreation experiences
- Objective 4.2 Secure legal entry to national forest lands and waters
- Objective 4.3 Improve the management of off-highway vehicle use

Goal 5. Maintain Basic Management Capabilities of the Forest Service
- Objective 5.1 Improve accountability through effective strategic and land management planning and efficient use of data and technology in resource management
- Objective 5.2 Improve the administration of national forest lands and facilities in support of the agency’s mission

Public Issues
The significant issues, as described in Chapter 1 of the EIS, will be addressed in the development and evaluation of alternatives.

Management Concerns and Resource Use and Opportunities
The Analysis of the Management Situation will identify management concerns, recommendations on the need to change the Forest Plan, and resource opportunities.

Plans and Programs of Other Agencies and Governments
Plans and programs of Federal agencies, State and local governments, and Indian tribes will be reviewed as required in 36 CFR 219.7(c). This will include county comprehensive plans, state wildlife action plans and state forest assessments.

Ecological Factors
The forest plan and alternatives will consider the effects of climate change on forest resources and the effects of forest activities on climate change. The management actions needed to restore, sustain, and/or enhance the composition, structure, and function of the ecological communities within the Forest will be evaluated.

Economic Factors
As addressed in 36 CFR 219.1(a), the plan shall provide for multiple use and sustained yield of goods and services from the National Forest System in a way that maximizes long-term net public benefits in an environmentally sound manner. Budget constraints based on past funding trends will be used in the development of desired conditions and objectives to provide meaningful measures that can reasonably be expected.

Resource Integration: Timber resource land suitability
During the forest planning process, lands which are not suited for timber production shall be identified in accordance with the criteria in 36 CFR 219.14.

Resource Integration: Vegetation management practices
When vegetation is altered by management, the methods, timing, and intensity of the practices determine the level of benefits that can be obtained from the affected resources. The vegetation management practices chosen for each vegetation type and circumstance shall be defined in the forest plan with applicable standards and guidelines and the reasons for the choices as identified in 36 CFR 219.15.

Resource Integration: Timber resource sale schedule
In a forest plan, the selected forest management alternative includes a sale schedule which provides the allowable sale quantity. The sale schedule of each alternative, including those which depart from base sale schedules, shall be formulated in compliance with 36 CFR 219.16.

Resource Integration: Evaluation of roadless areas
Unless otherwise provided by law, roadless areas within the National Forest System shall be evaluated and considered for recommendation as potential wilderness areas during the forest planning process, as provided in 36 CFR 219.17. The first step in the evaluation of potential wilderness is to identify and inventory all areas within National Forest System (NFS) lands that satisfy the definition of wilderness found in section 2(c) of the 1964 Wilderness Act. Areas of potential wilderness identified through this process are called potential wilderness areas. Follow the "Guidance on How to Conduct the Potential Wilderness Area Inventory for the Revision to the Revised George Washington National Forest Plan." Carefully evaluate potential wilderness areas as potential additions to the National Wilderness Preservation System to determine the mix of land and resource uses that best meet public needs. An area recommended as suitable for wilderness must meet the tests of capability, availability, and need. In addition to the inherent wilderness quality it possesses, an area must provide opportunities and experiences that are dependent upon or enhanced by a wilderness environment. Also consider the ability of the Forest Service to manage the area as wilderness. (FSH 1909.12 CHAPTER 70 - WILDERNESS EVALUATION)

Resource Integration: Wilderness management
Forest planning shall provide direction for the management of designated wilderness and primitive areas in accordance with the provisions 36 CFR 219.

Resource Integration: Fish and wildlife resource
Fish and wildlife habitat shall be managed to maintain viable populations of existing native and desired non-native vertebrate species in the planning area. For planning purposes, a viable population shall be regarded as one which has the estimated numbers and distribution of reproductive individuals to insure its continued existence is well distributed in the planning area. In order to insure that viable populations will be maintained, habitat must be provided to support, at least, a minimum number of reproductive individuals and that habitat must be well distributed so that those individuals can interact with others in the planning area. Each alternative shall establish objectives for the maintenance and improvement of habitat for management indicator species as identified in 36 CFR 219.19.

Resource Integration: Grazing resource
Grazing may be used as a tool to meet habitat diversity objectives or recreation objectives.

Resource Integration: Recreation resource
To the degree consistent with needs and demands for all major resources, a broad spectrum of forest and rangeland related outdoor recreation opportunities shall be provided for in each alternative. Planning activities to achieve this shall be in accordance with 36 CFR 219.2. The identification of recreation opportunities will include an updated inventory of Recreation Opportunity Spectrum classification. The Scenery Management System will be used in planning to identify visual resources and guide management of these resources. The plan will provide a diversity of recreation opportunities on the Forest including motorized and non-motorized recreation.

Resource Integration: Mineral resource
Mineral exploration and development in the planning area shall be considered in the management of renewable resources as identified in 36 CFR 219.22. Private mineral rights will be considered in all decisions made in the planning process. The environmental analysis will evaluate alternatives for oil and gas leasing availability and the Record of Decision will include a decision on the designation of those lands administratively available for federal oil and gas leasing (36 CFR 228.102).

Resource Integration: Water and soil resource
Forest planning shall provide for protection and management of the water and soil resource as identified in 36 CFR 219.23. The identification of water uses will highlight public drinking water supplies on the Forest and nearby sources that rely on waters of the National Forest. It will also discuss the potential for future requests for water withdrawals.

Resource Integration: Cultural and historic resources
Forest planning shall provide for the identification, protection, interpretation, and management of significant cultural resources on National Forest System lands. Planning of the resource shall be governed by the requirements of Federal laws pertaining to historic preservation, and guided by 36 CFR 219.24.

Resource Integration: Research natural areas
There are no new Research Natural Areas (RNAs) currently being considered for identification.

Resource Integration: Diversity
Forest planning shall provide for diversity of plant and animal communities and tree species consistent with the overall multiple-use objectives of the planning area. Such diversity shall be considered throughout the planning process. Inventories shall include quantitative data making possible the evaluation of diversity in terms of its prior and present condition. For each planning alternative, the interdisciplinary team shall consider how diversity will be affected by various mixes of resource outputs and uses, including proposed management practices as identified in 36 CFR 219.26. The diversity analysis should be based on processes readily identifiable with other state or national systems, such as NatureServe. The analysis will address both ecosystem and species diversity. The diversity analysis will include karst.

Management Requirements

The minimum specific management requirements to be met in accomplishing goals and objectives for the National Forest System are set forth in this section. These requirements guide the development, analysis, approval, implementation, monitoring and evaluation of forest plans.

Resource protection. All management prescriptions shall--

(1) Conserve soil and water resources and not allow significant or permanent impairment of the productivity of the land;

(2) Conserve geologic resources to minimize geologic hazards and protect sensitive karst areas and their related groundwater and biodiversity resources;

(3) Consistent with the relative resource values involved, minimize serious or long-lasting hazards from flood, wind, wildfire, erosion, or other natural physical forces unless these are specifically excepted, as in wilderness;

(4) Consistent with the relative resource values involved, prevent or reduce serious, long lasting hazards and damage from pest organisms, utilizing principles of integrated pest management. Under this approach all aspects of a pest-host system should be weighed to determine situation-specific prescriptions which may utilize a combination of techniques including, as appropriate, natural controls, harvesting, use of resistant species, maintenance of diversity, removal of damaged trees, and judicious use of pesticides. The basic principle in the choice of strategy is that, in the long term, it be ecologically acceptable and compatible with the forest ecosystem and the multiple use objectives of the plan;

(5) Protect streams, streambanks, shorelines, lakes, wetlands, and other bodies of water as provided under paragraphs (d) and (e) of this section;

(6) Provide for and maintain diversity of plant and animal communities to meet overall multiple-use objectives, as provided in paragraph (g) of this section;

(7) Provide for adequate fish and wildlife habitat to maintain viable populations of existing native vertebrate species and provide that habitat for species chosen under 36 CFR 219.19 is maintained and improved to the degree consistent with multiple-use objectives established in the plan;

(8) Be assessed prior to project implementation for potential physical, biological, aesthetic, cultural, engineering, and economic impacts and for consistency with multiple uses planned for the general area;

(9) Include measures for preventing the destruction or adverse modification of critical habitat for threatened and endangered species;

(10) Provide that existing significant transportation and utility corridors and other significant right-of-ways that are capable and likely to be needed to accommodate the facility or use from an additional compatible right-of-way be designated as a right-of-way corridor. Subsequent right-of-way grants will, to the extent practicable, and as determined by the responsible line officer, use designated corridors;

(11) Provide for the acquisition, disposition and exchange of National Forest System lands to address access needs, trespass, fragmentation, and management needs;

(12) Ensure that any roads constructed through contracts, permits, or leases are designed according to standards appropriate to the planned uses, considering safety, cost of transportation, and effects upon lands and resources;

(13) Provide that all roads are planned and designed to re-establish vegetative cover on the disturbed area within a reasonable period of time, not to exceed 10 years after the termination of a contract, lease or permit, unless the road is determined necessary as a permanent addition to the National Forest Transportation System; and

(14) Be consistent with maintaining air quality at a level that is adequate for the protection and use of National Forest System resources and that meets or exceeds applicable Federal, State and/or local standards or regulations.

(15) Meet the (b) Vegetative manipulation; (c) Silvicultural practices; (d) Even-aged management; (e) Riparian area; (f) Soil and water; and (g) Diversity requirements of 36 CFR 219.27.

INVENTORY DATA AND INFORMATION COLLECTION (STEP 3)

Several Interdisciplinary Team meetings were held to evaluate what data were needed to address the significant issues, concerns and opportunities identified in Chapter 1 of the EIS. Existing inventories were reviewed and updated and new information needs were identified and collected, if available. Most of the information was stored in databases, spreadsheets and a geographic information system (GIS).

GIS Data Layers

A geographic information system (GIS) was used to develop the primary Forest Plan revision database. GIS links natural resource tabular information with spatial (map) information. This linkage enabled complex spatial analyses and rapid display for many different physical, biological or administrative resources. The resulting database was used to preliminarily map the allocation of the management area prescriptions, analyze suitable timber lands, build the forest planning model Spectrum analysis areas, and perform other analyses for the revision. To develop the database, the following layers were used in GIS:

1. **The Field Sampled Vegetation database (FSVEG, previously known as CISC)** – the Southern Region's primary forest vegetation and stand inventory information that relates to forest cover type, age, site index, and land classification. The mapping of the management prescriptions for each alternative and the identification of Spectrum analysis areas used FSVEG data from 2006 (the latest update).
2. **Land Status** – This layer contains information on Forest surface ownership and subsurface mineral rights. The latest update for mapping of management prescriptions and Spectrum analyses was the spring of 2010.
3. **Watersheds** – This layer included Hydrologic Unit Code (HUC) mapping at both the fifth and sixth levels.
4. **Riparian** – This layer is an approximation of the riparian habitat on the forest. It is impossible to map the true riparian corridor through the use of GIS due to the complexity of slope, vegetation and other factors that help define the corridor. This coverage was generated by buffering perennial streams, lakes and other water bodies by 100 feet and intermittent streams were buffered by 50 feet on each side.
5. **Potential Wilderness Areas** - Appendix C of the EIS incorporates all the data used in the potential wilderness area identification and evaluation.
6. **Developed Recreation Sites**
7. **Scenery Management System (SMS)** – This layer addressed the visual resources and included attributes related to scenic integrity, distance zone, scenic attractiveness, and concern level.
8. **Recreation Opportunity Spectrum (ROS)** – This layer represented the recreation experience expected in a particular area and included attributes such as rural, roaded natural, semi-primitive motorized and semi-primitive non-motorized. The ROS inventory was updated in 2009.
9. **Transportation** – This layer included state and Forest Service roads and trails within the Forest boundary.
10. **Special Biological Areas** – This layer included known areas with special biological or zoological resources or rare communities.
11. **Current Plan Management Areas** – This layer included all of the management areas and prescription areas from the 1993 George Washington National Forest Plan.
12. **Soils** – This layer included soil types and their characteristics.
13. **Geology -** This layer included geologic formations and lithology, such as limestone, shale, sandstone, granite, etc.
14. **Cultural Resources** – This layer included areas with special historical or cultural emphases.

15. **Streams and Watercourses** – This layer included intermittent and perennial streams, lakes, rivers and ponds.
16. **Special Uses** – This layer included existing special use permits and utility corridors.
17. **LANDFIRE -** (also known as Landscape Fire and Resource Management Planning Tools, www.landfire.gov) is an interagency vegetation, fire, and fuel characteristics mapping program, sponsored by the United States Department of the Interior (DOI) and the United States Department of Agriculture, Forest Service. LANDFIRE produces a comprehensive, consistent, scientifically credible suite of spatial data layers for the entire United States. LANDFIRE data products consist of over 50 spatial data layers in the form of maps and other data that support a range of land management analysis and modeling. Specific data layer products include: Existing Vegetation Type, Canopy, and Height; Biophysical Settings; Environmental Site Potential; Fire Behavior Fuel Models; Fire Regime Classes; and Fire Effects layers based on regional models and sample plot data. The original LANDFIRE Project was designed to use peer-reviewed, consistent, and repeatable scientific methods. Data products are developed through integrating a collection of advanced scientific procedures, including relational databases, georeferenced land-based plots and polygons representing field conditions, satellite-enabled remote sensing, systems ecology, gradient analysis, predictive landscape modeling, and vegetation and disturbance dynamics.
18. **Ecological Zones** – see following description.

Ecological Zones Mapping

Ecological Zones are units of land that can support a specific plant community or plant community group based upon environmental and terrain factors that control vegetation distribution. They may or may not represent existing vegetation, but instead, the vegetation that could occur on a specific site with historical disturbance regimes. They are basically equivalent to LANDFIRE's Biophysical Settings which "represent the vegetation that may have been dominant on the landscape prior to Euro-American settlement and are based on both the current biophysical environment and an approximation of the historical disturbance regime" (LANDFIRE 2009). Ecological Zones in the Southern Appalachian Mountains, identified from plant community composition and cover data, are associated with unique environmental variables and these variables can be characterized by digital models to predict distribution of ecological zones across the landscape (Simon et al. 2005).

Since 2001, Ecological Zones have been mapped in the Southern and Central Appalachian Mountains on over 10 million acres by applying logistic regression coefficients to digital terrain models within a geographic information system. These areas include portions of eastern Kentucky, western North Carolina, northeastern Tennessee, eastern West Virginia, and western Virginia. Much of this work was done in cooperation with The Nature Conservancy (TNC) under the Fire Learning Network (FLN) program. Using the same methodology and framework, ecological zone mapping of the GWNF was completed and reported in *Ecological Zones on the George Washington National Forest First Approximation Mapping* (Simon 2011). The results of that mapping have been included in the analysis for the EIS.

Mapping Methodology Ecological Zone Mapping

Development of the individual Ecological Zone models for the GWNF began with the creation of a spatial database that described the study area environment using landform and environmental variables. The following 25 landform/environmental models (DTMs) were used to characterize these variables:

Elevation (10 meter DEM)
Aspect (degrees)
Aspect (cosine of slope direction)
Surface curvature
Surface curvature profile (direction of slope)
Surface curvature planiform (perpendicular to slope)
Slope steepness

Solar radiation (yearly), Solar radiation (growing season)
Relative slope position (from Wilds 1997)
Terrain relative moisture index (from Iverson et al. 1997)
Landform index (from McNab 1993)
Distance to stream
Distance to limestone lithology
Distance to acidic shale lithology
Distance to non-acidic shale lithology
Distance to sandstone lithology
Average annual precipitation
Difference in elevation from nearest stream
Local relief
Valley position
Surface curvature roughness
Distance to high snowfall zones
Distance to rivers
Difference in elevation from nearest river
River influence

Results

The relationships between Ecological Zone field plots and environmental variables were analyzed and predictive equations developed. Field plots (3,765) were used as reference data to evaluate the accuracy of the final Ecological Zone map. The relationship between plant community type and the environments in which they occur (and hence the Ecological Zone) can be evaluated by examining the relative importance of environmental variables found to be the best predictors of Ecological Zone location. Some of these relationships were fairly straight-forward, others were not. For example, elevation was the primary environmental factor to define the Spruce and Northern Hardwood distribution but for Shale barrens & Acidic woodlands, it was their association with acidic shale lithology primarily and secondarily with aspect (acidic woodlands) and rivers (shale barrens). Similarly, the primary environmental factor that drove the distribution of Pine-oak heath, on both sides of major ridges, is aspect but for Alluvial forests, it is the distance above streams and valley position. Geologic substrate strongly influenced the distribution of Rich cove and Dry-mesic calcareous forests, i.e., both are centered on limestone lithologies, while elevation and valley position explained nearly three-quarters of the variation in the High elevation red oak model. These relationships were all obvious in the field and from viewing digital terrain data in comparison to individual Ecological Zone models. Not so obvious in the field was the influence of high snowfall areas and the distribution of Northern hardwood coves or why multiple lithologic types contribute information for so many types.

Use of the Ecological Zones in the Forest Plan

Twenty-one different Ecological Zones were identified and mapped in the study area. This mapping was compared with ecological mapping from LANDFIRE, mapping of forest types from the FSVEG database, and mapping from the Virginia and West Virginia GAP datasets. Although the FSVEG database includes forest types as an attribute of stand delineation, there are several reasons why it is not always the best indicator of the ecosystem on the ground. Not all lands on the Forest have received the same level of inventory (e.g. land suitable for timber production versus Wilderness) and stand examinations do not cover as much area as they did in the past. Therefore, it was concluded that the ecological zone mapping was a more adequate representation of the current condition of ecosystems across all lands on the Forest, since it was based on field plots and models with high correlation from key terrain and environmental variables. However, the conditions predicted using the models were adjusted to reflect known on the ground conditions, such as areas planted to white pine, wildlife openings, other types of permanent openings, etc. It was also concluded that the ecological zone mapping did the best at identifying the ecosystem that could occur on a specific site, given historical disturbance regimes. The assumptions used in determining the existing conditions for the ecological indicators used in Chapter 3, Section B of the EIS are in the process paper "Process for Mapping the Existing Ecological Systems and Indicators for the GWNF Revision." The ecological zones were then crosswalked to NatureServe Ecological Systems and Virginia Natural Heritage Program Ecological Groups or Community Types. The NatureServe Ecological Systems were the basis for the models used in LANDFIRE for the Biophysical Settings. These models formed the basis for developing desired attributes and indicators for the GWNF ecosystems used in the Ecological Sustainability Evaluation (ESE) analysis tool, which were translated into the ecosystem plan components.

Transportation Analysis Process (TAP)

As defined in 36 CFR 212.5(b)(1), each national forest must identify the minimum road system needed for safe and efficient travel and for administration, utilization, and protection of National Forest System lands. The minimum system is the road system determined to be needed to meet resource and other management objectives adopted in the relevant land and resource management plan (36 CFR 219), to meet applicable statutory and regulatory requirements, to reflect long-term funding expectations, and to ensure that the identified system minimizes adverse environmental impacts associated with road construction, reconstruction, decommissioning, and maintenance. In 36 CFR 212.5(b)(2), it states that roads no longer needed to meet forest resource management objectives must be identified and therefore, should be considered for decommissioning or for other uses, such as for trails.

A Travel Analysis Process (TAP) was completed in April 2011 for the George Washington National Forest, concurrent with the Plan revision analysis, to identify the minimum road system. The TAP is intended to be a broad scale comprehensive look at the transportation network across the Forest. It is important to note that the TAP does not make any decisions related to roads or motorized trail systems, but it will be used to inform travel management decisions made for individual roads or motorized trails, which will be subject to site-specific environmental analysis through the NEPA process.

The TAP established Forest and District Interdisciplinary Teams (IDTs). The Forest IDT consisted of staff specialists who provided science-based evaluations and coordination with the development of the Revised Forest Plan. The Forest IDT accomplished the following:

- utilized a science based approach prescribed by 36 CFR 212.5(b)(1), addressing the questions at the forest level that are listed in Publication FS-643, "Roads Analysis: Informing Decisions About Managing the National Forest Transportation System;"
- identified indicators that are most relevant to the George Washington National Forest to help determine what risks and benefits should be used to analyze each road. Risks identified included impacts to, or from: 1) Wildlife, 2) Sediment Delivery, 3) Invasive Plants, 4) Aquatic Passage, 5) Public Safety, and 6) Law Enforcement. Benefits identified included: 1) Resource access; 2) Recreation access; 3) Fire/Emergency access; and 4) Wildlife/Plants;
- established criteria for each risk and benefit category based on a high, medium, or low metric. See the following example.

INDICATOR: INVASIVE SPECIES RISKS	
Risk assessment for new introduced populations of undesirable plant or animal species. Vehicles can carry and spread plant parts or seeds or animals into disturbed areas along roads or in the road bed.	HIGH RISK: Roads accessing or within Special Biological Areas Roads accessing/bordering Wilderness Roads along known infestations of highly invasive species which co-occur with known TES locations Roads accessing campgrounds and heavily used dispersed recreation areas MEDIUM RISK: Roads along known infestations (including fishing access in known locations of aquatic invasives) Roads in riparian areas for less than 500 feet (includes crossings) LOW RISK: Other Roads

The District IDTs evaluated each road as to its purpose and its rankings related to the risk and benefits metrics for each indicator. The purpose(s) for each road could include: future resource program needs; current resource program needs; dispersed recreation access; developed recreation access; private property access; arterial roads that are a major through road or highly used spur road that a joins with collector roads; long-term special use access; or could be a potential forest highway (arterial connecting state roads with adjacent private property, used for commuting or recurrent non-forest commercial traffic, etc.). Budget information, maintenance costs, and strategies to mitigate risks and reduce costs were evaluated as well.

Although the TAP identified a final score and recommendation for each road and motorized trail on the GWNF that led to a determination as to whether it should be part of the minimum road system, actual travel management decisions will be made on a project level with site-specific environmental analysis and public involvement. However, the cumulative results of the TAP were used to identify the minimum road system miles needed to implement each alternative, including the amount of new construction and the amount of decommissioning.

ANALYSIS OF THE MANAGEMENT SITUATION (STEP 4)

In addition to the emerging issues, the need for change was identified through the Analysis of the Management Situation for the George Washington National Forest (AMS). This analysis considered the results of monitoring and evaluation, other policy and direction since the previous Plan, the current condition of the resources, and supply and demand factors to determine the need for change in management direction, and the need to change from the 1993 Forest Plan, as well as the ability of the planning area covered by the Forest Plan to supply goods and services. It provided a basis for formulating a broad range of reasonable alternatives. The processes and results for the supply and demand analyses are briefly discussed below. The process records contain the full supply and demand analyses.

Determination of Demand Estimates

Recreation

Estimates for the demand of various recreation opportunities came from several sources, including the National Visitor Use Monitoring (NVUM) data collected in 2006 on the Forest, the 2000-2004 National Survey on Recreation and the Environment (NRSE), the outdoor Recreation participation projections 2010 to 2060 as provided in Outdoor Recreation Trends and Futures: Technical Document Supporting the Forest Service 2010 RPA Assessment, the *2007 Virginia Outdoors Plan* and the *2006 Virginia Outdoors Survey,* and the *2009 Statewide Comprehensive Outdoor Recreation Plan (SCORP) for West Virginia.* Results of the developed and dispersed recreation supply and demand analysis can be found in Appendix A of the Analysis of the Management Situation report.

Range

The range program on the George Washington NF is so small in scope that supply and demand conditions were not considered necessary.

Timber

Estimates for the demand for timber products came from Forest Product Directories for the counties included in the market area, the George Washington and Jefferson National Forests Appraisal Schedule, research done for the Jefferson National Forest, and Forest Inventory and Analysis (FIA) data. Results of the timber supply and demand analysis can be found in Appendix A of the Analysis of the Management Situation report.

Minerals

Future projections of the kind and amount of oil and gas activity that could be reasonably anticipated were identified in the Reasonable Foreseeable Development Scenario (RFD) report prepared by the Bureau of Land Management (BLM). The RFD is based on the assumption that all lands on the Forest would be available for oil and gas leasing under standard lease terms and conditions, except for those areas withdrawn from leasing by law (Wilderness and National Scenic Area). It covers a time period of 15 years and includes all lands within the boundaries of the George Washington National Forest (GWNF) regardless of mineral estate ownership. The RFD was revised by BLM after the Draft EIS and is found in Appendix K of the EIS.

Wilderness

Appendix C of the EIS contains the potential wilderness area inventory and evaluations. The criteria for identifying wilderness candidates for the inventory came from Forest Service Handbook 1909.12, Chapter 70, Amendment 1909.12-2007-1. The Forest's application of these criteria are described in "Guidance on How to Conduct the 'Potential Wilderness Area Inventory' for the Revision to the Revised George Washington Forest Plan," dated August 21, 2008.

Wildlife and Fisheries

Projections for hunting and fishing are included in the analysis for Recreation in Appendix A of the Analysis of the Management Situation Report.

Benchmark Analysis

Benchmark analysis is specified in the NFMA regulations in 36 CFR 219.12(e) as part of the Analysis of the Management Situation. This analysis is in Appendix B of that report. Benchmarks approximate maximum economic and biological resource production opportunities and are useful in evaluating the compatibilities and conflicts between individual resource objectives and in defining the range within which integrated alternatives can be developed.

Minimum Level of Management Benchmark - 36 CFR 219.12(e)(1)(i). This benchmark represents the minimum level of management needed to maintain and protect the GWNF as part of the National Forest System. This level of management does involve some activities and costs in order to meet the following minimum management requirements:

- Protect the life, health, and safety of incidental users;
- Prevent environmental damage to the land or resources of adjoining lands of other ownerships or downstream users;
- Conserve soil and water resources;
- Prevent significant or permanent impairment of the productivity of the land; and
- Administer unavoidable non-Forest Service special uses and mineral leases, licenses, permits, contracts, and operating plans.

Alternative C in the EIS embodies most of the elements of a minimum level of management; however some activities are allowed in this alternative to make it a more realistic and viable option. The activities in Alternative C that involve more than a minimum level of management include: the continued operation of three ATV use areas; more of an emphasis on non-motorized recreation that would include an increase in trail miles; and continued operation of some developed recreation sites.

Maximum Physical and Biological Production Potential Benchmarks - 36 CFR 219.12(e)(1)(ii). These benchmarks identify the maximum physical and biological production potentials of significant individual goods and services together with associated costs and benefits. For ecological systems, the maximum biological production is represented by the desired conditions for the Cove, Spruce, Northern Hardwood, Oak and Pine systems in Chapter 2 of the Plan.

Maximum Timber Benchmark. This benchmark is used to identify the maximum timber production potential of the Forest, subject to these specifications:

The objective function maximizes timber volume in the first five decades, with a rollover to maximize present net value for 15 decades.

All tentatively suitable acres are included, without any management prescription allocations, so every tentatively suitable acre is eligible for harvest.

No successional habitat constraints are applied.

Several key results of the maximum timber benchmark are:

910,000 tentatively suitable acres are allocated to timber production

Annual harvest is 19.68 MMCF (98.4 MMBF)

Annual harvest is 10,331 acres

Cumulative Present Net Value over five decades is $117,447,000

Long-term sustained yield is 23.66 MMCF

Maximum Wilderness Benchmark. This benchmark is used to identify the maximum potential of the Forest to provide areas that meet the definition of wilderness according to the 1964 Wilderness Act. In Chapter 2 of the EIS, Alternative C represents this benchmark, with the recommendation for wilderness study all of the 37 areas in the Potential Wilderness Area inventory as well as Southern Massanutten Mountain and the Friars Inventoried Roadless Areas. This benchmark represents 386,800 acres recommended for wilderness study and 20,000 existing Wilderness acres.

Maximum Natural Gas Production Benchmark. This benchmark is used to identify the maximum potential for the Forest for natural gas production. This benchmark is represented by the Reasonably Foreseeable Development (RFD) prepared by the Bureau of Land Management that is based on the assumption that all lands on the Forest would be available for oil and gas leasing under standard lease terms and conditions, except for those areas withdrawn from leasing by law. The RFD is described in more detail in Chapter 3 of the EIS. This benchmark represents the construction of 20 vertical exploration/evaluation wells and 50 vertical and 249 horizontal development wells.

Present Net Value Benchmarks – The following benchmarks are described in the 36 CFR 219 regulations.

36 CFR 219.12(e)(1)(iii) Monetary benchmarks which estimate the maximum present net value of those resources having an established market value or an assigned value;

36 CFR 219.12(e)(1)(iii)(A) For forest planning areas with major resource outputs that have an established market price, monetary benchmarks shall include an estimate of the mix of resource uses, combined with a schedule of outputs and costs, which will maximize the present net value of those major outputs that have an established market price;

36 CFR 219.12(e)(1)(iii)(B) For all forest planning areas, monetary benchmarks shall include an estimate of the mix of resource uses, combined with a schedule of outputs and costs, which will maximize the present net value of those major outputs that have an established market price or are assigned a monetary value;

36 CFR 219.12(e)(1)(iii)(C) For forest planning areas with a significant timber resource, estimates for paragraphs (e)(1)(iii)(A) and (B) of this section shall be developed both with and without meeting the requirements for compliance with a base sale schedule of timber harvest, as described in s 219.16(a)(1), and with and without scheduling the harvest of even-aged stands generally at or beyond culmination of mean annual increment of growth, as described in s 219.16(a)(2)(iii). The George Washington NF does not have a significant timber resource.

Timber Maximum PNV Benchmark. This benchmark was established to estimate the schedule of outputs and costs that would maximize the present net value of timber production without any constraints, subject to these specifications:

The objective function maximizes net present value over the entire planning horizon.

All tentatively suitable acres are included, without any management prescription allocations.

No successional habitat constraints are applied.

Several key results of the maximum timber benchmark are:

910,000 tentatively suitable acres are allocated to timber production

Annual harvest is 17.66 MMCF (88.3 MMBF)

Cumulative Present Net Value over five decades is $112,392,000

Long-term sustained yield is 19.53 MMCF

Maximum Present Net Value Benchmarks were not modeled for resources other than timber since use of the Spectrum Model (linear programming model that determines the best mix of outputs and activities to maximize an objective function, such as present net value) was confined to timber harvest outputs and activities. There is no method to maximize the present net value of other resources but the present net values of several resource programs under each alternative that was evaluated in the EIS is presented in Chapter 3, Section C and also discussed later in this appendix.

Lands Suitable for Timber Production

During forest land and resource management planning, the Forest Service is required to identify lands unsuited for timber production (16 USC 1604(k); 36 CFR 219.14). This identification process involves three stages of analysis. Stage I analysis identifies lands tentatively suitable for timber production. Stage II analysis is designed to explore the financial aspect of varying intensities of timber management on lands identified as tentatively suitable for timber production from Stage I. Stage III analysis identifies lands as unsuited for timber production based upon the management objectives of the various alternatives.

Stage I: Physical Suitability

The first stage of the timber suitability analysis addresses the administrative and physical suitability of the land to be managed for the production of timber. Stage I lands unsuitable for timber production included:

Lands that do not meet the definition of forest land.

Lands that have been administratively or congressionally withdrawn from timber production by an act of Congress, the secretary of agriculture, or the chief of the Forest Service.

Forest lands incapable of producing industrial wood.

Lands where technology is not available to ensure timber production from the land without irreversible soil and water resource damage.

Lands where there is no reasonable assurance that they can be adequately restocked.

Lands where there is inadequate information, primarily due to recent acquisition.

The codes in Table B-1 from the Field Sampled Vegetation database (FSVEG) were used to define the five categories used to determine the Stage I tentatively suitable lands.

Table B-1. Stage I Acres Tentatively Suitable for Timber Production

Categories of Stage I Unsuitable Lands	Defining Information	Current Net Acres
Total National Forest System Lands:		1,065,000
1. Non Forest Land	FSVeg Land Class Codes: 110-Lake 120-Reservoir 140-River 210-Cemetery 220-Powerline 230 Road/Railroad 240-Special Use 250-Wildlife Clearing	(7,000)
2. Withdrawn	Designated Wilderness (1A) Mt. Pleasant National Scenic Area (4F) Research Natural Areas (4B)	(53,000)
3. Irreversible Damage	Land Class Code: 826 - Physical barriers AND Site Index < 70	(28,000)
4. Can't Restock	Forest Type: 99 – Brush AND Stand Condition Class: 15 – Non Stocked	(1,000)
5. Incapable of producing industrial wood	Land Class Code: 900 – Incapable of Industrial Wood OR Site Index < 40	(65,000)
Tentatively Suitable Forest Lands		**911,000**

Stage II: Financial Analysis

The second stage analysis is designed to explore the financial efficiency of different timber intensities on the lands identified as tentatively suitable for timber production in Stage I. It does not identify any lands as unsuitable for timber production. Stage III analysis considers the results of these financial efficiencies in making the final determination of lands suited for timber production.

The financial analysis identifies the present net value (PNV) for the different Spectrum analysis areas. For the purpose of this analysis, PNV is a measure of the discounted timber benefits less the discounted timber management costs, using a 4 percent discount rate. The actual PNV analysis consisted of a Spectrum run which examined all of the silvicultural prescriptions for all of the Spectrum analysis areas. There are many factors that determine the economic efficiency of a timber sale that cannot possibly be modeled using a landscape level planning model such as Spectrum. However, based on this financial analysis, the following primary conclusions were made:

Clearcutting with natural regeneration has the highest PNV for all analysis areas.

The analysis areas with the lowest PNV were site index 50 in yellow pine.

All site index 40 lands were economically inefficient.

Site index 50 lands that had slopes greater than 55%, with the exception of forest types 48, 53, 56 and 81 (northern red oak-hickory-yellow pine, white oak-northern red oak-hickory, yellow poplar-white oak-red oak, and sugar maple-beech-yellow birch) were economically inefficient.

Stage III: Identification of Suitable Acres

The third stage analysis is accomplished during the formulation of alternatives (Table B-2). Several criteria were used during this stage to identify lands as unsuitable for timber production:

Based upon consideration of multiple-use objectives for an alternative, the land is proposed for resource uses that preclude timber production. However, in some management prescriptions that are classified as unsuitable for timber production, timber harvest may occur to meet the desired condition of other resources.

Other management objectives for an alternative may limit timber production activities to the point where management requirements set forth in 36 CFR 219.27 cannot be met.

The lands are not cost-efficient, over the planning horizon, in meeting forest objectives, which includes timber production.

Table B-2. Stage III Suitability for All Alternatives

Alternative	Acres Unsuitable for Production	Acres Suitable for Production	Percent Suitable for Production
A	715,000	350,000	33%
B	566,000	499,000	47%
C	1,065,000	0	0%
D	570,000	495,000	46%
E	698,000	367,000	34%
F	784,000	281,000	26%
G	616,000	449,000	42%
H and I	613,000	452,000	42%

ESTIMATED EFFECTS OF ALTERNATIVES (STEP 6)

Analysis Tools Used

The primary tools used to estimate the effects of alternatives include several established computer models, numerous spreadsheets and GIS.

Pre-Suppose

Pre-Suppose is a program used to query and sort Forest Inventory and Analysis (FIA) data for use in the growth and yield model. The program allows the user to evaluate, select or discard plots that fit desired criteria and create support files to directly be linked into the Suppose interface for the Forest Vegetation Simulator model.

Forest Vegetation Simulator Model

The primary tool for estimating growth and yield used in the Spectrum model is the Forest Vegetation Simulator (FVS) model. FVS is an individual-tree, distance-independent, growth and yield model. It has its structural roots in the Stand Prognosis Model developed by Albert Stage from the Intermountain Research Station. Staff at the USFS Forest Management Service Center in Fort Collins have now calibrated many variants of the model to specific geographic areas throughout the United States. Each variant used different species-specific growth and yield equations and assumptions. The Southern Variant was used for developing yield tables for the Spectrum model. The Southeastern and Northeastern Variants were also evaluated for use but the Southern Variant provided the best fit for tree species on the George Washington National Forest. The yield tables developed for the Jefferson Forest Plan were used for the GWNF.

FVS allows the user to calculate estimates of forest stand structure and species composition over time and quantify this information to: 1) describe current and future forest stand conditions; 2) simplify complex concepts of forest vegetation into user-defined indices, attributes, etc.; and 3) allow the manager to ask better questions about growth and yield of forested stands and complete analyses to answer those questions. For the purposes of the Southern Appalachian Forest Plan Revisions, Forest Inventory and Analysis (FIA) data for the Southern Region was converted into a format that FVS could use. This data is collected by the Forest Inventory and Analysis Unit of the Southern Research Station for each State on a 10 year cycle in order to provide unbiased, accurate, current, and relevant forest resource information that meets the diverse needs of land stewardship.

Stratification of FIA data was performed based on geological province, forest type, and site index. The dataset from which FIA data could potentially be selected was limited to the Blue Ridge, Ridge and Valley, and/or Cumberland Plateau provinces of Virginia, Kentucky, North Carolina, Tennessee, South Carolina, and Georgia. Forest Type was used to group the data into one of four working groups; upland oak, cove hardwoods, white pine/hemlock, and southern yellow pine. These working groups correspond to analysis area identifiers used in the Spectrum model. Three categories of site indices were used to further stratify the data within these working groups; 50 to 65, 66 to 85, and 86 t0 100. Whenever possible, data selected for a simulation was limited to FIA plots on National Forest System lands in Virginia to simulate conditions on the George Washington National Forest as closely as possible. For common working group/site index combinations (e.g. upland oak in the 66 to 85 site index group) this resulted in an adequate number of stands to provide statistically sound conclusions. However, in some cases (e.g. southern yellow pine on site index 86 to 100) very few FIA plots were found within those constraints. In such cases, selection criteria were broadened to include first, all of Virginia, then to all of the remaining States until an adequate number of FIA plots meeting the working group/site index criteria were selected.

The FVS model structure contains modules for growing trees, predicting mortality, simulating growth reductions due to stocking, calculating tree volumes, and producing reports. Extensions that simulate the effects of Oak Decline and the Southern Pine Beetle on forested stands are also available for use with the Southern Variant. These Pest Extensions predict the number of events, expected mortality, and residual stand structure and composition. In addition to providing input for the Spectrum model, FVS was used in combination with these pest extensions to disclose impacts to the Forest expected from Oak Decline and the Southern Pine Beetle.

Development of the Forest Planning Model (Spectrum)

Land management planning is the major mechanism for making large-scale and long-term forest land allocations and resource management decisions. Planning consists largely of exploring a national forest's productive potential and experimenting with various allocation choices. Modeling is an important planning tool because it permits studying the consequences of choices without actually committing valuable resources to experimentation or having to wait many years to observe an outcome. It can also evaluate whether desired future conditions are feasible when taking all resource management goals and objectives into consideration. However, decisions about land allocations, choosing and pursuing trade-offs, and accepting one result instead of another are made by people, not the model. The model is merely a device for organizing elements of the decision problem, discovering possible choices and identifying potential conflicts. The Spectrum model is an evolved version of FORPLAN, a linear programming model that solves for an overall objective, such as maximizing present net worth of benefits and costs or maximizing the amount of certain yields. It is an excellent tool for determining the most cost-efficient way to reach some objectives and for analyzing the impacts to vegetative conditions over time from various management activities.

In the past, this model has been used to make land allocation decisions; however, for this Forest Plan, those land allocations were essentially determined through the mapping of the management area prescriptions that varied for each alternative. Therefore, within Spectrum, the land allocation/management prescription assigned to every acre was already made in the model through the use of analysis areas. Because silvicultural treatments are one of the primary means of managing vegetation and wildlife habitat, and are easily modeled, the Spectrum model was constructed principally to examine how timber management could be used to achieve the goals and objectives for each alternative and for the individual management prescriptions. The George Washington Spectrum model was therefore constructed to be a timber harvest allocation model, i.e. it was used to model management constraints and determine the most efficient way of meeting management objectives through the use of silvicultural prescriptions. Only benefits and costs pertaining to the timber program were included in the model. The effects from other type treatments on vegetation and other resources, as well as other resource benefits and costs, were addressed outside of the model, based on the timber-related outputs from the Spectrum model.

Spectrum Model Overview

The model was designed and solved in the following steps:

Model creation - Designing a Spectrum model was the most intensive of the four steps. In this step the modeler input resource data, specified resource interactions, set goals and objectives, outlined management actions, defined activities and outputs, set the planning horizon, stratified the landscape into similar response areas, and input economic data.

Matrix Generation - Generating the matrix was the process of converting the input from step one to a matrix of rows and columns that the optimization software could solve.

Optimization of the Solution - The commercial software C-Whiz was used to solve the matrix. The linear programming solver found the best mix of management actions to meet the management objectives.

Interpretation of the Solution- The final step in the modeling process was to use the reports created in Spectrum and spreadsheets to interpret the results of the optimization and perform sensitivity analyses.

The eight basic components of the Spectrum model include the following and are discussed individually in this section:

1) the planning horizon;
2) land stratification;
3) silvicultural prescriptions;
4) activities and outputs and their associated costs and benefits;
5) rotation ages;
6) yield coefficients;
7) constraints;
8) the overall management objectives.

Planning Horizon

Each Spectrum model has a specified time frame called a 'planning horizon' that may be as short or long as desired and is broken into time periods of 10 years each. The George Washington Spectrum model used a planning horizon of 200 years, with 20 time periods, or decades. Activities and outputs are primarily represented in Spectrum on a decadal basis, occurring at the midpoint of the decade.

Land Stratification (Analysis Areas)

Analysis areas are defined as units of land, not necessarily contiguous, which can be considered to be homogeneous with respect to responses to treatment in terms of yields, costs, and values received for resource outputs. Management objectives or constraints are also expected to be relatively the same throughout an analysis area. In Spectrum, each analysis area is allowed up to six stratification categories to identify its unique responses to treatments, yields, costs, values and constraints. Table B-3 describes the six strata used to determine the analysis areas. The George Washington used a combination of Geographic Information System (GIS) data layers to construct its analysis areas. Initially, a polygon layer of stand information from the Field Sampled Vegetation database (FSVEG) was intersected with layers representing slope, the Recreational Opportunity Spectrum (ROS), the Scenery Management System (SMS), the Ecological Zones, and the allocation of the Forest Plan management prescriptions mapped for each alternative. A stratum may have two resource layers combined in order to keep the number of strata to six.

The Old Growth Community Type classification was used to define the forest cover types. This allowed tracking of changes in these vegetation groupings over time. Yield tables were developed for the four aggregate groupings of these community types. Site index was used to differentiate the growth and yield estimates and the appropriate silvicultural prescriptions allowed. Scenic class and the Recreation Opportunity Spectrum (ROS) were incorporated to apply constraints by management prescription. The beginning successional class of an analysis area was used to track the movement of acres, by community type, in the various successional classes over the planning horizon. Only the management prescriptions that are unsuitable for timber production were not included in the model.

Table B-3. Spectrum Analysis Areas

Stratum of Land	Description	Definition or Code
LEVEL 1 - Vegetation	SAA Old Growth Community Type	FSVeg Forest Type(s)
NH	Northern Hardwoods	81
CNH	Conifer-Northern Hardwoods	2, 3, 4, 5, 8, 9, 10
MMWM	Mixed Mesophytics and Western Mesophytics	41, 50, 56, 70, 71, 82
ERH	Eastern Riverfront and River Floodplain	58, 63, 69, 72, 73, 74, 75
DMO	Dry Mesic Oaks	51, 53, 54, 55
DXO	Dry Xeric Oaks	49, 52, 57, 60
XPPO	Xeric Pine and Pine-Oaks	11, 12, 15, 16, 20, 21, 31, 32, 33, 35, 38, 39, 88
DDMO	Dry and Dry Mesic Oak-Pines	42, 43, 44, 45, 46, 47, 48
MSF	Montane Spruce-Fir	6, 7, 17
SCOAK	Scarlet Oak	59
LEVEL 1 *AGGREGATES	Working groups for timber yield tables	Combinations of Community Types
*CVH	Cove Hardwoods	NH, MMWM, ERH
*UPH	Upland Hardwoods	DMO, DXO, DDMO, SCOAK
*YPN	Yellow Pines	XPPO, MSF

Stratum of Land	Description	Definition or Code
*WPN	White Pines	CNH
	Ecological system	Combinations of Community Types
* COVESYS	Cove Forests	CNH, MMWM
UPH	Oak Forests	DMO, DXO, DDMO
XPPO	Pine Forests	XPPO
NH	Hemlock-Northern Hardwoods	NH
MSF	Appalachian Spruce-Fir	MSF
LEVEL 2 – Site Productivity and Scenery	Site Index and Scenic Class	FSVeg and Scenery Mgmt System
SI4	Very low productivity	Site Index 40
SI5	Low to moderate productivity	Site Index 50-60
SI7	Moderate to high productivity	Site Index 70-80
SI9	High productivity	Site Index 90 and higher
SC1	Very high scenic class	Scenic Class 1
SC2	High scenic class	Scenic Class 2
SC37	Moderate to low scenic class	Scenic Classes 3 through 7
LEVEL 3 – Recreation Experience and Slope	Recreation Opportunity Spectrum and Slope	Recreation Opportunity Spectrum and Areas <= 25% Slope suitable for Group Selection
SPNM	Most primitive	Semi-primitive Non-motorized
SPM	Somewhat primitive	Semi-primitive Motorized
RN	Roaded	Roaded Natural
G	Gentle slopes and accessible, suitable for group selection	Slope <=25%, near existing roads
LEVEL 4 – Management Prescription that are Suitable for Timber Production	Primary Management Emphasis	Description
7A1	Scenic	Highlands Scenic Byway
7B	Scenic	Scenic Corridors and Viewsheds
7C	Recreation	OHV Use Areas
7E2	Recreation	Dispersed Recreation
7F	Scenic	Blue Ridge Parkway
8A1	Wildlife	Mid- to Late-Successional Habitat
8B	Wildlife	Early Successional Habitat
8C	Wildlife	Black Bear Habitat
8E4b	Wildlife	Indiana Bat Secondary Cave Areas
10B	Timber	High Quality Forest Products
13	Wildlife, Timber	Mosaics of Habitat
LEVEL 5 – Successional Stage	Successional Stage	Description
EARLY	Early Successional	Age 0-10, All community types

Stratum of Land	Description	Definition or Code
SAP1	Sapling/Pole Succ.	Age 11-40, Community types NH, CNH, MMWM, DMO, DXO, DDMO, MSF
SAP2	Sapling/Pole Succ.	Age 11-20, Community types ERH, XPPO, SCOAK
MID1	Mid Successional	Age 41-80, Community types NH, CNH, MMWM, DMO, DXO, DDMO, MSF
MID2	Mid Successional	Age 21-60, Community types ERH, XPPO, SCOAK
LATE1	Late Successional	Age 81-100, Community type NH
LATE2	Late Successional	Age 81-110, Community type DXO
LATE3	Late Successional	Age 81-120, Community types MMWM, DDMO, MSF
LATE4	Late Successional	Age 81-130, Community type DMO
LATE5	Late Successional	Age 81-140, Community type CNH
LATE6	Late Successional	Age 61-100, Community types ERH, XPPO, SCOAK
OLD1	Old Successional	Age 101+, Community types NH, ERH, XPPO, SCOAK
OLD2	Old Successional	Age 110+, Community type DXO
OLD3	Old Successional	Age 120+, Community types MMWM, DDMO, MSF
OLD4	Old Successional	Age 130+, Community type DMO
OLD5	Old Successional	Age 140+, Community type CNH
LEVEL 6 - ELEVATION	Description	
HIELEV	Elevation above 3,000 feet	

Silvicultural Prescriptions

The array of potential vegetative treatments applied to an analysis area is represented in the model by sets of actions known as management actions. Generally, a management action in Spectrum refers to a set of treatments or practices designed to develop or protect some combination of resources on a particular land type.

In addition to the 'no action' management action, the management actions incorporated in the George Washington's Spectrum model were the various silvicultural treatments that could be used to meet vegetation manipulation objectives and are referred to as the *silvicultural prescriptions* in Table B-4. All lands were given the option of being assigned to a minimum level of management where no timber harvest would occur.

Table B-4. Spectrum Silvicultural Prescriptions

Management Prescription	Scenic Class	Minimum Level/No Action	Clearcut	SW-CWR	SW-2ST	SW-2A2	SW-2A4	Thin Only	GS
7A1 Scenic Byway	1-2	X			X	X	X	X	X
	3-7	X		X	X	X	X	X	X
7B Scenic Corridors and Sensitive Viewsheds	1-7	X				X	X	X	X
7C ATV Use Area	1	X			X	X	X	X	X
	2-7	X		X	X	X	X	X	X
7E2 Dispersed Recreation Areas - Suitable for Timber	1	X					X	X	X
	2	X				X	X	X	X
	3-7	X		X	X	X	X	X	X
7F Blue Ridge Parkway Corridor	1-2	X					X	X	X
	3-7	X		X	X	X	X	X	X
8A1 Mix of Successional Habitats	1-2	X		X	X	X	X	X	X
	3-7	X		X	X	X	X	X	X
8B Early-Successional Habitat Emphasis	1-2	X			X	X	X	X	X
	3-7	X	X	X	X	X	X	X	X
8C Black Bear /Remote Habitat	1-7	X		X	X	X	X	X	X
8E4b Indiana Bat Secondary Conservation Area	1	X					X	X	X
	2-7	X			X	X	X	X	X
9A1 Source Water Watershed Protection Area	1	X					X	X	X
	2-7	X			X	X	X	X	X
10B Timber Production	1	X		X	X	X	X	X	X
	2-7	X	X	X	X	X	X	X	X
13 Mosaics of Habitat	1	X		X	X	X	X	X	X
	2-7	X	X	X	X	X	X	X	X

SW-CWR – Shelterwood Coppice with Reserves where the preparatory cut leaves 20 square feet of basal area of primarily non-commercial species which are later removed at a commercial thinning of the new stand or at the final rotation of the new stand.
SW-2ST – Shelterwood 2-Step with a residual basal area of 40-50 square feet left after the preparatory cut. The overstory removal occurs 10-20 years later.
SW-2A2 – Shelterwood 2–Aged with a residual basal area of 20 square feet left after the preparatory cut. The overstory removal occurs 30-40 years later.
SW-2A4 – Shelterwood 2-Aged with a residual basal area of 40 square feet left leaving 8-14 inch trees after the preparatory cut. The overstory removal occurs 40-60 years later.
GS – Group Selection, uneven-aged management.

Activity Costs and Output Benefits

Management of a national forest yields a variety of public goods and services, many of which can be assigned cost and benefit values, such as timber and minerals. Environmental settings and maintaining or protecting long-term biological productivity of forested lands are examples of public goods created through forest management that cannot be assigned monetary values. Table B-5 and Table B-6 show activity and output variables used in the George Washington Spectrum model and their assigned activity unit costs and priced output benefits. Since Spectrum was designed to model timber management, other resource activity costs and output values were estimated outside of the model.

Costs for timber activities were derived by examining historical budget costs and target attainment estimates and comparing these with the costs used in the Jefferson Plan Spectrum model. In 2004, the timber program was examined in detail during a realignment study and an effort was made to quantify the actual costs per timber activity. Because the relationship between budgets and targets can contain inconsistent variables, it was decided that the costs from the timber program realignment study were more accurate.

Table B-5. Spectrum Silvicultural Costs

Spectrum Activity	Unit of Measure	Range of Costs per Unit in the Model
Timber Sale Coordination with Other Resources	MCF (thousand cubic feet)	$309-$340
Harvest Administration	MCF	$31-40
Pre-commercial Thinning	Acre	$161
Timber Sale Preparation	MCF	$139-174
Site Preparation	Acre	$213-245
Timber Stand Improvement	Acre	$161-186

Timber revenues were estimated from a review of volume weighted average high bid values by species from 1997-2009. From this data, species were grouped into the following appraisal groups with similar revenues: high value hardwood sawtimber, moderate value hardwood sawtimber, low value hardwood sawtimber, white pine sawtimber, southern yellow pine sawtimber, hardwood pulpwood and softwood pulpwood. Examples of high value hardwood sawtimber included white oak, northern red oak, ash, and yellow poplar. Moderate value included hickory, chestnut oak, and birch.

Table B-6. Spectrum Revenues

Spectrum Output	Unit of Measure	Value per Unit in the Model
High Value Hardwood Sawtimber	MCF (thousand cubic feet)	$1,432
Moderate Value Hardwood Sawtimber	MCF	$926
Low Value Hardwood Sawtimber	MCF	$632
Southern Yellow Pine Sawtimber	MCF	$527
White Pine Sawtimber	MCF	$675
Hardwood Roundwood	MCF	$53
Pine Roundwood	MCF	$86

The amounts of road construction and reconstruction needed to access future timber harvests were not calculated in the Spectrum model for several reasons. Permanent road construction for the alternatives analyzed in the EIS ranged from 0 to 4.1 miles per year. Spectrum is not a spatial model; therefore it is difficult to address accessibility. However, costs of roads were included in the Present Net Value analysis in Chapter 3, Section C of the EIS.

Timber Yields

Since the yield tables that were developed for the Jefferson Forest Plan were used for this Forest Plan, the following describes the development of those tables. There were several steps in building the growth and yield tables. The first step was to select the Forest Inventory and Analysis (FIA) stands to be used in simulations in the Forest Vegetation Simulator (FVS model). Stratification of this data was performed based on geological province, forest type, and site index. The dataset from which FIA data could potentially be selected was limited to the Blue Ridge, Ridge and Valley, and/or Cumberland Plateau provinces of Virginia, Kentucky, North Carolina, Tennessee, South Carolina, and Georgia. Forest Type was used to group the data into one of four working groups: upland oak, cove hardwoods, white pine/hemlock, and southern yellow pine. These working groups correspond to analysis area identifiers used in the Spectrum model. Three categories of site indices were used to further stratify the data within these working groups: 50 to 60, 70 to 80, and 90 to 100.

Whenever possible, data selected for a simulation was limited to FIA plots on National Forest System lands in Virginia to simulate local conditions as closely as possible. For common working group/site index combinations (e.g. upland oak in the 70-80 site index group) this resulted in an adequate number of stands to provide statistically sound conclusions. However, in some cases (e.g. southern yellow pine on site index 90 to 100) very few FIA plots were found within those constraints. In such cases, selection criteria were broadened to include first, all of Virginia, then to all of the remaining southern states until an adequate number of FIA plots meeting the working group/site index criteria were selected.

The summary statistics for individual plots meeting the selection criteria were then reviewed for any obvious outliers. Stocking (basal area), trees per acre, and average diameter values were compared to published stocking charts (USDA Forest Service Agricultural Handbook 355) to identify selected FIA plots that were understocked. These understocked plots were eliminated from the simulation as needed.

The next step was to calibrate FVS to provide growth rates, volumes yielded, and mortality due to competition based on past and professional experience. Through a number of parameters, FVS can be customized to reflect local conditions. Based on volumes yielded from past harvesting data on the Forest coupled with professional experience with the average stand densities and diameters commonly found on the Forest, FVS was calibrated to simulate the forest stand dynamics that can be expected on the forests in this area.

The selected sets of FIA plots within these working group/site index combinations were then run through the calibrated FVS Southern Variant to show present volumes and predict growth and yield 150 years into the future. These were termed the “grow only” simulations. While the total volume output by FVS matched historical yield data from past timber harvests quite well, the allocation of that total volume between sawtimber and pulpwood volumes was not acceptable based on past harvest yield data. Therefore, the total volume output by FVS was then imported into a spreadsheet that allocated the division of pulpwood and sawtimber based on past harvest data considering working group and site index. For each of the four working groups, the spreadsheet also summarized the volume into the six appraisal groups that were modeled in Spectrum (high value hardwood sawtimber, moderate value hardwood sawtimber, low value hardwood sawtimber, white pine sawtimber, southern yellow pine sawtimber, hardwood pulpwood and softwood pulpwood). It also converted cubic feet, the unit output by FVS, into thousand cubic feet, the unit required by Spectrum. A comma-delimited file was then taken from the spreadsheet and imported into Spectrum.

The impact of some harvesting practices in growth and yield were also simulated using FVS. While the even-aged regeneration harvest methods (shelterwoods) were simulated simply by taking a percentage of the total standing volume from the grow only yield tables, partial harvests such as thinnings needed to be simulated in FVS. This is because thinning a stand significantly alters the growth and yield of the residual stems that would then be captured in a final harvest. While the same is true for shelterwood harvests, the length of time elapsing from the first entry to the final harvest is too small for this effect to be meaningful. In the case of the shelterwood with reserves and coppice with reserves treatments, so little standing volume is left and is not harvested in this rotation, that any growth accrued on those stems was deemed inconsequential. Three thinning regimes were modeled; a pre-commercial thinning at age 15, a commercial thinning at age 55, and a combination of both the pre-commercial and commercial thinning. Separate yield tables were produced following a similar process described above for each of these regimes. The plots selected for these simulations were further stratified by age; only stands less than 15 years old were selected for the pre-commercial and combined simulations and only stands less than 55 years old were used in the commercial thinning simulations. Uneven-aged management was also simulated for a subset of the working group/site index combinations in the form of group selection. When we compared these outputs to the grow only runs, it was apparent that simply taking a percentage (i.e. 10% of the volume for a 10 year entry cycle and 100 year rotation scenario) yielded results very close to those produced by FVS. Based on this comparison and in the interest of simplifying the modeling process, it was decided to simulate uneven-aged management by simply taking a percentage of the ‘grow only’ yield tables. The prescription of managing open woodland conditions was simulated by initiating a shelterwood harvest, including a pre-commercial thinning costs and eliminating the final overstory removal harvest.

Timber yields were also used to determine the culmination of mean annual increment (CMAI) for the working groups. CMAI is the age at which the average rate of annual tree growth stops increasing and begins to decline. Mean annual increment is expressed in cubic feet measure and is based on expected growth. The planning regulations at 36 CFR 219.16(a)(2)(iii) state that all even-aged stands scheduled to be harvested during the planning period will generally have reached the culmination of mean annual increment of growth. The CMAI for the working groups were determined as follows:

Working Groups CMAI Ages

Working Group	CMAI Age
White Pine	55
Cove Hardwoods	50
Upland Hardwoods	65
Southern Yellow Pine	45

Constraints

The land allocation mapping of management area prescriptions for each alternative essentially applied that alternative’s overall goals, objectives and resource constraints to the land base. Therefore the Spectrum models constructed for each alternative were initially identical, with the exception of a new set of analysis areas for each alternative that resulted from a different mix of management prescriptions and a few constraints. The same set of silvicultural prescriptions, costs, benefits, yields, rotation ages and constraints related to successional stages, scenery and recreation opportunity spectrum were used for each alternative.

Constraints identified as “management requirements” (36 CFR 219.27) were applied to all alternatives. Additional constraints common to all alternatives were applied to insure an implementable solution. These common constraints fell into four categories: 1) constraints which assign congressionally and administratively designated areas to specific prescriptions, 2) constraints which ensure that the management requirements are met in each alternative, 3) timber scheduling constraints, and 4) operational constraints which constrain timber harvest to a realistic solution.

The following requirements, or constraints, were applied to all Spectrum model alternatives:

Silvicultural prescriptions were not modeled within the riparian habitat within any of the management prescriptions.

Although lands with a site index below 50 were represented in the model for growth and yield estimates, those lands were not allowed to be scheduled for harvest (financially inefficient).

Group selection was prohibited from occurring in yellow pine stands and old successional stage stands.

The Long-Term Sustained Yield (LTSY) constraint was used to ensure that the harvest of timber in the last decade is not greater that the long-term timber production capacity of the Forest. Long-term sustained yield capacity was computed using the acreage scheduled to each regeneration prescription applied in the model.

The perpetual timber harvest constraint was used to ensure that the remaining timber inventory would allow achievement of non-declining harvest levels beyond the modeling horizon. To achieve this condition the constraint required that the Forest contain as much timber inventory volume at the end of the last period as the Forest would have, on the average, under the management intensities selected in the analysis. Without this constraint the Spectrum model would have no reason to leave enough inventory at the end of the planning period to sustain timber harvest levels into perpetuity.

The non-declining yield constraint was used to ensure that the harvest of timber in a decade was greater than or equal to the harvest of timber in the previous period. This constraint indirectly limited the model to a lower present net value and reduced flow of timber in the early decades but also provided community economic and social stability through the controlled flow of timber.

Timber harvests on lands classified as suitable for timber production were not scheduled for regeneration before the culmination of mean annual increment (CMAI). This constraint, indirectly applied through the harvest timing options allowed, ensured that relatively large sawtimber would be produced and ensured that smaller trees were not harvested before the site was completely utilized.

The Allowable Sale Quantity (ASQ) was constrained to be no greater or less than 10 percent of that in the previous decade in order to provide a more even flow.

The amount of clearcutting was constrained to a maximum of 5% of the total acres harvested.

The proportion of harvest between the Oak, Pine and Cove hardwoods ecological systems was constrained to reflect the desired conditions and objectives for each of those systems.

The amount of thinning was constrained between 200-400 acres per year to meet open canopy desired conditions.

For each alternative Spectrum was constrained to be within the range of annual acres of regeneration by timber harvest according to the following alternative objectives. The Allowable Sale Quantity (ASQ) was determined from the model run at the highest end of the range since ASQ represents a ceiling of volume that may be sold.

Alternative						
A	B	D	E	F	G	H and I
2400	1800-3000	3000-5000	1800-3000	1000-1800	1800-3000	1800-3000

Objective Functions

The objective function allows specification of an overall objective of the alternative to be met in a given run of the model while all constraints otherwise specified are met. The objective function chosen for Alternative A was to maximize present net value. The objective function chosen for Alternative B, E, F, G, H and I was to maximize the amount of early successional habitat. The objective function chosen for Alternative D was to maximize volume.

Ecological Sustainability Evaluation Process and Tool (ESE)

The Forest Service developed a relational database, the Ecological Sustainability Evaluation (ESE) tool, based on the structure used by The Nature Conservancy (TNC) in their Conservation Action Planning Workbook (TNC 2005). The ESE tool served as the primary process record for ecological sustainability analysis. It included documentation of scientific and other sources consulted, uncertainties encountered, and strategic choices made during development of the database. In addition, the tool documented the many relationships among parts of the framework. For example, species were often related to one or more characteristics of ecosystems, and a given plan component frequently contributed to multiple ecological systems or species.

The following steps were used to build an ecological sustainability framework, with each step documented within the ESE tool. Although these steps are presented sequentially, the process required much iteration.

1. Identify and define ecological systems

To define terrestrial ecosystem diversity, all terrestrial ecological systems on the GWNF were identified using NatureServe's International Ecological Classification Standards (NatureServe 2004). Each system was defined in terms of existing Forest Service forest types and in terms of the LANDFIRE Vegetation Dynamic Models. Current acreage of each system was calculated using Forest Service GIS data. All identified terrestrial ecological systems were included in the ecological sustainability framework. These systems were also crosswalked with the Virginia Department of Conservation and Recreation Natural Heritage Program Vegetation Community types. The framework for diversity of aquatic ecological systems is described in the Aquatic Ecological Sustainability Analysis (Appendix G of the EIS).

2. Identify species

To assess species diversity, a comprehensive list of plant and animal species was compiled by combining species lists from a variety of sources. These sources included federally-listed threatened and endangered (T&E) species obtained from the U.S. Fish and Wildlife Service; species that are tracked by the Virginia Department of Conservation and Recreation Natural Heritage Program and the West Virginia Division of Natural Resources; species identified in the Virginia and West Virginia State Comprehensive Wildlife Conservation Strategies as species of conservation concern: the Birds of Conservation Concern list compiled by the U.S. Fish and Wildlife Service; and the Regional Forester's list of sensitive species for the Southern Region. Species were then screened for inclusion in the framework. The criteria and process for identifying, screening and grouping species are detailed in the Species Diversity Report (Appendix F of the EIS).

3. Identify and define characteristics of ecosystem diversity and related performance measures

To identify key characteristics and performance measures for terrestrial ecological systems, Forest Service biologists reviewed information in NatureServe, LANDFIRE, Virginia Department of Conservation and Recreation Natural Heritage Program community types, and other information.

4. Link species to the ecological systems and identify any additional needs of species

Species were then linked to terrestrial ecological systems. Where useful, species were grouped before linking them to systems. Where ecological conditions for these species were not covered by the ecosystem diversity framework, additional characteristics, performance measures, and rating criteria were added to the framework to cover these needs. All species have at least some of their needs covered by ecosystem diversity, but some species required additional plan components based on their major limiting factors. The ways in which individual species needs were addressed by ecosystem diversity components and additional Plan provisions are described in the Species Diversity Report.

5. Assess current condition of performance measures

Current values and ratings of all performance measures were estimated using a variety of methods. Many current values were derived through analysis of existing GIS databases. Assumptions and methods for determining current values and ratings are recorded in the ESE tool.

6. Develop plan components

In this step, plan components were proposed that would be expected to provide for characteristics of ecosystem diversity and ecological conditions for species. These plan components were then linked with characteristics and conditions within the ESE tool. In some cases, we identified where relevant provisions are made outside of plan components through other current requirements and processes. We ensured that all elements of the framework were addressed by appropriate management direction.

Aquatic Ecological Sustainability Analysis

The GWNF developed an aquatic habitat classification to facilitate the Aquatic Ecological Sustainability Analysis. The methods used in this classification follow the basic structure of The Nature Conservancy (TNC) aquatic community classification, and the Virginia and West Virginia Comprehensive Wildlife Action Plans, yet habitat classifications were focused on land managed by the GWNF.

As described in Appendix G of the EIS, this habitat classification is hierarchical and is based on an understanding of how habitat influences the composition and distribution of aquatic biological communities. It is based on four assumptions (Higgins et al. 1998):

1. Physiographic and climatic patterns influence the distribution of organisms, and can be used to predict the expected range of biological community types (Jackson and Harvey 1989; Tonn 1990; Maxwell et al. 1995; Angermeier and Winston 1998; Burnett et al. 1998).

2. The physical structure of aquatic habitats (or ecosystems) can be used to predict the distribution of aquatic communities (Gorman and Karr 1978; Schlosser 1982).

3. Aquatic habitats are continuous; however, generalizations about discrete patterns in habitat use can be made (Vannote et al. 1980; Schlosser 1982).

4. Using a nested classification system, (i.e. stream reach habitat types within species ranges), we can account for community diversity that is difficult to observe or to measure (taxonomic, genetic, or ecological) (Frissell et al. 1986; Angermeier and Schollsser 1995).

Sediment Effects Analysis

The most important soil resource issue/concern regarding the effects from the management activities proposed in the various alternatives of the Forest Plan Revision is soil productivity. The impacts to soil productivity are determined by estimates of areal extent (acres) that is affected. Some of the impacts will be short-term (<100 years) and some will be long-term.

A significant impact to soil productivity would be a fifteen percent reduction in productivity in areas that are actively managed. The threshold for allowable impacts to soil productivity has been identified by most regions of the Forest Service as 15 percent of an activity area. Long-term soil productivity must be maintained on at least 85 percent of an activity area. The activity area varies by alternative since each one has different levels of management on different areas of the Forest. When long-term soil productivity is reduced on fifteen percent or more of an area, then this would not be in compliance with the laws and policy guiding FS protection of soil productivity and ecosystem sustainability.

Table B-7. Activity Area for Sedimentation Analysis

	Alt A	Alt B	Alt C	Alt D	Alt E	Alt F	Alt G	Alts H and I
GW Acres included in Activity Area*	1,021,551	1,002,447	636,140	1,008,299	998,601	910,782	1,002,612	995,202

*Activity Area: The area on the Forest where soil disturbing management activity can occur.

By determining the acres of long-term effects to soil productivity for each alternative, we can compare the alternatives and show how extensive the effects are. Each alternative affects long-term soil productivity to some degree. Key indicators used for determining effects to the soil resource were:

- Acres of timber harvest
- Miles of road construction and decommissioning
- Acres of prescribed burning
- Miles of trail construction
- Acres of watershed improvement work
- Mineral development
- Acres of dispersed recreation use

Within each of the key indicators, the following activities were assumed to affect the long-term productivity of the soils for this effects analysis.

- Temporary roads - long-term effect is width of travel way, 12 feet.
- Skid roads have 10 feet of travel way with long-term effects.
- 25% of log landing areas are long-term impact to soil productivity due to blading.
- 75% of the total proposed and existing trail system is a long-term effect to soil productivity due to soil displacement and land use change.
- The acres of developed recreation that is cleaned and checked for trash is used for total existing acres of developed recreation which have long-term effects on soil productivity.
- Construction of oil and gas well sites - all acres are long-term impacts to soil productivity, due to blading.
- Access roads and parallel pipeline construction
- Long-term effects from oil and gas development are due to well pad and road construction.
- Existing oil and gas long-term effects resulting from existing well sites.
- Fire lines constructed with dozer have 8' width with long-term effects.
- Constructed road long-term effect is width of travel way and ditchline/cutslope, 19 feet
- New road right-of-way is 40 feet.

For each alternative a spreadsheet was prepared to show proposed management activities, types of effects, long and short-term effects, existing long-term effects, cumulative long-term effects and the percent of the GWNF area that would be affected long-term.

Other assumptions specific to each indicator include the following, where LT=long-term effect to soil productivity and ST=short-term effect to soil productivity:

Timber management assumptions

- Temp road LT is width of travel way= 12 feet.
- Temp road ST is ROW-12' travel way= 18 feet.
- Skid roads are bladed. Skid trails are not.
- Skid roads have 10 feet of travel way and 12 feet cleared right-of-way.
- Log landings are long-term impact to soil productivity due to blading.
- Skid trails are unbladed, 10 feet wide and are short-term impact due to compaction.
- Effects from a temporary timber road are the same as a FS system road.

Recreation management assumptions

- 100% of the total proposed and existing trail system is a long-term effect to soil productivity due to soil displacement and land use change.
- Existing new trail construction includes motorized and non-motorized trails.
- Long-term impact on 20 acres of dispersed recreation use per District assumed.
- Trails widths: motorized-6 feet, non-motorized-3 feet.

Mineral development assumptions

Construction of well sites, all acres are long-term impacts to soil productivity, due to blading.
Pipeline construction, short-term impact due to replacement of topsoil over pipe.
Existing roads for oil and gas development are included in the effects of FS system roads.
Long-term effects from oil and gas development are due to well pad and road construction.

Prescribed burning assumptions

Fire lines constructed with dozer have 8' width, estimates based on 1998, 1999, 2000 on GW and JNFs.
During a 10-year period, 50% P-burned acres are new and the rest is reburned using existing dozer fire lines.

Watershed improvement assumptions

Existing soil improvement acres are calculated using 1993-2009 @ 40 per year.

Road management assumptions

New road ROW is 40 feet. LT 15 feet, ST 25 feet.
System road long-term effect is width of travel way and ditchline/cutslope= 19 feet
System road short-term effect is ROW-19' travel way= 21 feet. (40’-19’)
Existing road system is 1818 miles.
Roads decommissioned have 19 feet width for calculating acres of soil improvement.

Wildlife management assumptions

Long-term effects from wildlife management are covered in skid road and log landing estimates.

Grazing management assumptions

No long-term effects to soil productivity from grazing.

Present Net Value Analysis

The 1982 National Forest Management Act (NFMA) implementing regulations (36 CFR 219.1) state that forest plans must “...provide for multiple-use and sustained yield of goods and services from the National Forest System in a way that maximizes long-term net public benefits in an environmentally sound manner.” Net public benefits is defined as the overall value to the Nation of all outputs and positive effects (benefits) less all associated inputs and negative effects (costs) whether they can be quantitatively valued or not. Present net value (PNV) is one of the criteria used to determine net public benefits (NPB) in benchmarks and alternatives. It is the difference between the discounted value of all outputs which were assigned a price in the revision and all Forest Service management and investment costs over the analysis period. The PNV converts all costs and benefits over a 50 year planning period to a common point in time. Other benefits of public land management cannot be measured using dollar values. These non-priced benefits are another criteria used to determine NPB. Each alternative was determined and analyzed to achieve its goals and objectives in a manner that produced the greatest PNV while meeting all specified costs and objectives for non-priced benefits. Thus, the PNV of each alternative estimated the highest value of priced benefits while accounting for the costs of producing priced benefits, non-priced benefits, and meeting management requirements. The PNV of each alternative can then be compared directly, even though the actual costs and benefits occur at different times. Two parameters were used in PNV analysis: Base year dollars – All monetary values entered into Spectrum and the PNV analysis were in 2010 dollars; Discount rate – A four percent discount rate was used. It approximates the return on long-range investments above the rate of inflation. All costs and benefits were discounted from the midpoint of each decade.

The output estimates for timber, minerals, recreation and wildlife under each alternative were identified in Chapter 3 of the EIS for the effects analysis and the PNV for each alternative is presented in Chapter 3, Section C. The benefit values for each of these resources came from different sources and are displayed in Table B-8.

Timber benefits were the same as used in Spectrum (from historical timber sale data). The mineral benefits were from market prices for minerals from the Minerals Management Agency. Recreation, hunting and fishing benefits were estimated from J. Michael Bowker et al. (2009), Estimating the Net Economic Value of National Forest Recreation: An Application of the National Visitor Use Monitoring Database, FS 09-02, September 2009, The University of Georgia.

Table B-8. Economic Benefits and Financial Revenue Values used in the PNV Analysis (year 2010 dollars)

Output	Unit	Value
Timber		
Sawtimber-Softwood Price	$/MCF	$650.64
Sawtimber-Hardwood-Price	$/MCF	$1,031.39
Roundwood-Softwood-Price	$/MCF	$52.60
Roundwood-Hardwood-Price	$/MCF	$85.50
Minerals		
Dimension Stone (Limestone)	$/Short Ton	$8.15
Natural Gas-Petroleum	$/Thousand Cubic Meter	$4.50
Recreation/Wilderness		
Camping	$/Visit	$51.26
Driving/Motorized	$/Visit	$43.84
General	$/Visit	$80.03
Hiking	$/Visit	$51.26
Nature/Historical	$/Visit	$51.26
Off-Highway Vehicles	$/Visit	$51.26
Primitive Camping	$/Visit	$76.10
Picnicking	$/Visit	$90.55
Trails (bicycling, horseback riding)	$/Visit	$205.34
Viewing Scenery	$/Visit	$60.01
Wilderness	$/Visit	$76.10
Wildlife Watching	$/Visit	$60.01
Hunting	$/Visit	$140.53
Fishing	$/Visit	$45.96

Socio-Economic Analysis

Much of the social and economic data presented in the Affected Environment section came from the Economic Profile System-Human Dimensions Toolkit (EPS-HDT at www.headwaterseconomics.org). EPS-HDT is a free software application that runs in Excel and accesses published statistics from multiple federal data sources, including the Bureau of Economic Analysis and Bureau of the Census, U.S. Department of Commerce; Bureau of Labor Statistics, U.S. Department of Labor; and others. It generates 14 reports for any part of the nation using any combination of states and counties. The program has been approved for agency use by the USDA Forest Service and the Bureau of Land Management.

IMPLAN

The Forest Service uses IMPLAN (impact for planning analysis) software and FEAST (forest economic analysis spreadsheet tool) to estimate socio-economic impacts and contributions. IMPLAN is an economic model originally developed by the Forest Service, Federal Emergency Management Agency and the Bureau of Land Management. IMPLAN has since been privatized and is now provided by Minnesota IMPLAN Group (MIG). IMPLAN uses a database of economic statistics obtained from major government sources such as the Regional Economic Information System (REIS), Bureau of Economic Analysis, Bureau of Labor Statistics and US Census Bureau. The database in IMPLAN represents 528 economic sub-sectors. The industries are defined by North American Industry Classification System (NAICS) Sectors. A Forest Service-developed spreadsheet known as FEAST was used to apply the IMPLAN results to each alternative, expressed in units of output. FEAST transformed the dollar impact for a given industry from IMPLAN to the various resource outputs by alternative into a specific employment and dollar output.

The input/output analysis is based on the interdependencies of the production and consumption elements of the economy within an impact area. The assumption used in this modeling process was that the impact area comprised the counties within the forest's designated county boundaries. Industries purchase from primary sources (raw materials) and other industries (manufactured goods) for use in their production process. These outputs are sold either to other industries for use in their production process or to final consumers. The structure of interdependencies between the individual sectors of the economy forms the basis of the input/output model. The flow of industrial inputs can be traced through the input/output accounts of the IMPLAN model to show the linkages in the impact area economy. This allows the determination of estimated economic effects (in terms of employment and income).

The IMPLAN model identifies direct, indirect and induced effects associated with an output activity. Direct effects are those economic effects associated with economic activity (e.g., amount of sawtimber sold or recreation use) that occurs in industries tied to forest outputs. Examples of direct industries are the local hotel, which provides lodging to recreationists or the local sawmill that processes National Forest timber. Indirect effects are economic effects associated with spending by industries that provide goods and services to the direct industries. An example is the utility company that provides electricity to the local hotel or sawmill. Induced effects are economic effects associated with household spending caused by changes in activity in the direct and indirect industries. Examples are the local grocery stores and restaurants that supply goods and services to the local economy.

Direct, indirect and induced impacts on jobs and income were estimated from six major Forest-level outputs on the GWNF: recreation use, hunting and fishing use, the amount of timber volume and type of product to be harvested, mineral extraction, payments to states (counties), and Forest Service expenditures (salaries, equipment, contracts). Due to substitution effects from competing non-government sources (such as volume of timber harvesting which may occur on private lands if national forest timber is not offered to the market to meet local demand), these jobs are characterized as being associated with local economic activity initiated by Forest Service programs and activities, rather than directly caused by these activities.

TIMBER PROGRAM ASSUMPTIONS. For Forest Service timber, we have looked at the sawmill and pulpwood industries where our timber goes as the first processing step in manufacturing. Impacts include all those industries initially impacted as well as those industries linked with supplying inputs to production, as well as workers in those industries who then spend wages in their households (known as direct, indirect and induced effects, respectively). Sales data was determined by using timber revenue values multiplied by estimated production levels for each alternative. Hardwood and softwood sawtimber were processed through the sawmill industry (about 70% of the sawtimber volume was processed in the study area). Hardwood and softwood roundwood were processed at the pulp mill (about 30% of the roundwood was processed in the study area). Impacts represent the economic activity occurring in all backward linking sectors associated with the final demand output of the timber industries described above.

RECREATION and WILDLIFE/FISH PROGRAMS ASSUMPTIONS. Recreation and Wildlife and Hunting trips were derived from the National Visitor Use and Monitoring survey, 2006 (NVUM). The resulting calculations yielded trips for Resident and Non-resident Day Use, On National Forest Overnight Use, and Off National Forest Overnight Use. These use metrics were entered into FEAST to link with IMPLAN impact response coefficients to yield an impact for recreation and wildlife resources. Local economic impacts from recreation, hunting and fishing use were determined using non-local use only because there may be substitution opportunities for local residents to spend their discretionary dollar. If some people choose not to recreate on national forest system lands, they may recreate in another manner such as go to sporting events or a movie. The dollars would still be spent in the local economy causing a similar impact, but the provider of recreation would be a different party. Local residents are defined as recreation users within 50 miles of the forest boundary.

Spending Segments

The spending that occurs on a recreation trip is greatly influenced by the type of recreation trip taken. For example, visitors on overnight trips away from home typically have to pay for some form of lodging (e.g., hotel/motel rooms, fees in a developed campground, etc.) while those on day trips do not. In addition, visitors on overnight trips will generally have to purchase more food during their trip (in restaurants or grocery stores) compared to day-use visitors. Visitors who have not traveled far from home to the recreation location usually spend less money than visitors traveling longer distances, especially on items such as fuel and food. Analysis of spending patterns has shown that a good way to construct segments of the visitor market with consistent spending patterns is to use the following seven groupings:

1. local visitors on day trips,
2. local visitors on overnight trips staying in lodging on the national forest,
3. local visitors on overnight trips staying in lodging off the national forest,
4. non-local visitors on day trips,
5. non-local visitors on overnight trips staying in lodging on the national forest,
6. non-local visitors on overnight trips staying in lodging off the forest, and
7. non-primary visitors (visits to the GWNF were not the primary destination for the visit).

The table below shows the distribution of visits by spending segment (data from the National Forests in GWNF NVUM Report 2006). A National Forest visit is defined as the entry of one person onto a national forest to participate in recreation activities for an unspecified period of time. A National Forest Visit can be composed of multiple site visits. The market segments shown here relate to the type of recreation trip taken. A recreation trip is defined as the duration of time beginning when the visitor left their home and ending when they got back to their home. "Non-local" trips are those where the individual(s) traveled greater than approximately 50 miles from home to the site visited. "Day" trips do not involve an overnight stay outside the home, "overnight on-forest" trips are those with an overnight stay outside the home on National Forest System (NFS) land, and "overnight off-forest" trips are those with an overnight stay outside the home off National Forest System land. "Non-primary" trips are those where the primary recreation destination of the trip was somewhere other than the national forest under consideration.

Table B-9. Distribution of Recreation Visits to GWNF by Spending Segment

	Non-local			Local			
	Day	Overnight on NF	Overnight Off NF	Day	Overnight on NF	Overnight Off NF	Total
Percent of NF Visits	5.7%	8.6%	2.7%	77.2%	4.4%	1.4%	100%

MINERAL PROGRAM ASSUMPTIONS. There are two outputs related to the minerals program that were used in the IMPLAN model and estimating present net values: dimension stone (limestone) and natural gas. The value/short ton for dimension stone is $8.15 and the value/million cubic feet (MMCF) for natural gas is $4500.00. The natural gas volumes include what would be developed on federal leases as well as on GWNF land with private mineral rights.

Table B-10. Mineral Program Outputs by Alternative

	Alt A	Alt B	Alts C and I	Alt D	Alt E	Alt F	Alt G	Alt H
Dimension Stone (short tons)								
Each Decade	5,236	4,090	0	4,090	3,671	3,197	3,770	3,770
Natural Gas (MMCF)								
1st Decade	380,060	282,685	70,255	282,685	90,720	232,190	91,330	225,415
2nd Decade	357,620	308,970	60,170	308,970	75,350	241,955	75,730	200,915
3rd Decade	49,320	48,345	7,575	48,345	8,930	36,855	8,940	26,670
Total Natural Gas	787,000	640,000	138,000	640,000	175,000	511,000	176,000	453,000

PAYMENTS TO STATES ASSUMPTIONS. The estimate for Payments to States/Counties was based on a three-year average from 2007-2009.

Projects Approved under the 1993 Forest Plan

Many decisions to conduct management actions were made before the effective date of the Revised Forest Plan, but will not be fully implemented before the Revised Forest Plan goes into effect. These “pre-existing actions” (made under the 1993 Amended Forest Plan) were treated as a part of the baseline for the Environmental Impact Statement and the Revised Forest Plan. The projected effects of these pre-existing actions are part of the cumulative effects analysis documented in the FEIS and Biological Assessment for the Revised Plan. A separate analysis (contained in the project records) was also conducted where it was confirmed that the continued implementation of these previously decided actions would not foreclose the ability to meet the desired conditions and objectives of the new Revised Forest Plan. One particular aspect of the transition between implementing the 1993 Plan and the new Revised Plan worth noting involves projects in watersheds that support the James spinymussel, which is a federally-listed endangered species. For these particular projects, the GWNF and the USFWS had previously agreed to incorporate the more restrictive riparian management requirements found in the Revised Jefferson Plan into those project decisions as mitigation measures. The riparian management directions of the Revised Jefferson Plan are now incorporated into the new Revised GWNF Plan. So in this particular instance, even though those decisions were made before the new Revised Plan goes into effect, they will, in effect, already be implementing the direction of the new Revised Plan.

Table B-11 provides a list of major project decisions containing timber harvest and other management activities that may not be completed until after the 2014 Revised Forest Plan goes into effect.

Table B-11. Projects Approved Under the 1993 Forest Plan That Will Continue to be Implemented

Ranger District	Project Name
Lee	Prescribed Burns (Catback, Church Rock, Indian Grave Ridge, Moody Tract, Second Mountain, Waonaze) Barb Timber Sale Church Rock Timber Sale Breakneck Timber Sale Trout Pond Trail Relocation Squirrel Gap Trail Relocation Gerhard Shelter Trail Relocation Trout Pond Recreation Area Rehabilitation
North River	Special Uses (Todd Lake dam, Briery Branch dam, Hone Quarry dam, Hearthstone dam) Prescribed burns (Augusta Springs, Buck Mountain, Dunkle Knob, Elkhorn, Evick Knob, Gate Ridge, Gauley Ridge, Grindstone, Gum Lick, Hall Springs, Heavener Mountain, Hone Quarry II, Little Fork, Marshall Tract, North New Road Run, North River, Rail Hollow, Slate Lick Fields, Slaty Lick, Turner Run, Walker Mountain, Wallace Tract) Timber Sales (Wallace Marshall, Moffat Creek, Rocky Spur, Back Draft, Sugar Run, Hodges Draft, Big Run, Grindstone, Chestnut Oak Knob, Sidling Hill, Falls Hollow, Tom Lee Draft) Rockingham Timber Stand Improvement Pendleton Timber Stand Improvement Road Maintenance North River Trails Enhancement Phase II Wallace Marshall Stewardship Project
James River & Warm Springs	Central Alleghany Project Humpback Project Back Creek Mountain Vegetation Management Project Warm Springs Mountain Restoration Project Tri County Vegetation Management Project Mares Run Vegetation Management Project Neals Run Prescribed Burn Peters Mountain Access Little Mountain/Mad Anne Vegetation Management Border Restoration Project Brattons Run
Pedlar	Big Bend Vegetation Project Robinson Hollow Vegetation Project Poplar Cove Vegetation Project Mill Creek Dam Rehabilitation Big Piney Vegetation Project Pedlar Timber Stand Improvement Coles Run Dam Rehabilitation and Waterline Replacement

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APPENDIX C – POTENTIAL WILDERNESS AREA EVALUATIONS

CHAPTER 1. POTENTIAL WILDERNESS AREA INVENTORY

The following inventory identifies areas meeting certain criteria for potential wilderness areas (PWAs). Only the Congress can make the decision to designate wilderness. The responsible official is to consider all NFS lands possessing wilderness characteristics for recommendation as potential wilderness areas during plan revision.

Identification of potential wilderness areas and wilderness recommendations has always been an integral part of the NFS planning process. The first step in the evaluation of potential wilderness is to identify an inventory of all areas within National Forest System lands that satisfy the definition of wilderness. This study identifies those NFS lands possessing wilderness characteristics.

The Forest Service directives (FSH 1909.12, Chapter 70, 1/31/2007) provide the detailed criteria for the identification of potential wilderness areas. These criteria are summarized in Table C-1. The Forest's interpretation of these criteria is contained in "Guidance on How to Conduct the 'Potential Wilderness Area Inventory' for the Revision to the Revised George Washington Forest Plan" in the administrative record for the plan revision.

Table C-1. Summary of Inventory Criteria as Provided in FSH 1909.12, Chapter 70, Section 71

FSH 1909.12 Chapter 70	Potential Wilderness Criteria
71.1 Par. (1)	1) Areas contain <u>5,000 acres or more</u>, OR
71.1 Par. (2)	2) Areas contain <u>less than 5,000 acres,</u> but can meet one or more of the following criteria: a. Areas can be preserved due to physical terrain and natural conditions; b. Areas are self-contained ecosystems, such as an island, that can be effectively managed as a separate unit of the National Wilderness Preservation System; c. Areas are contiguous to existing Wilderness, primitive areas, Administration-endorsed Wilderness, or potential Wilderness in other Federal ownership, regardless of their size.
71.1 Par. (3)	3) Areas do not contain forest roads (36 CFR 212.1) or other permanently authorized roads, except as permitted in areas east of the 100th meridian (sec. 71.12), (Less than 1/2 mile of system road per 1000 acres).
71.12 Par. (4) (1995 R8 Guidance)	4) Areas have semi-primitive (SP) core solitude greater than 2500 acres on NFS lands or otherwise provide solitude (e.g. topography). Eliminates smaller and/or narrower areas with small SP cores (limited solitude). Smaller or narrower SP core areas often indicate private land influenced core.
71.11 Par. (6)	5) Areas are not excessively fragmented by interior private land. (Greater than 70% NFS land).
71.11 Par. (6)	6) Areas are not excessively fragmented by interior private mineral rights. (Greater than 70% NFS mineral rights and not currently leased).
71.12 Par. (3,4)	7) Area boundaries are less than 60% private.

The PWA inventory includes 26 standalone potential areas and 11 potential additions to existing Wildernesses for a total of 37 areas containing 378,229 acres. Table C-2 lists the Potential Wilderness Areas (PWAs) identified in 2008, using the criteria provided in FSH 1909.12. Of these, 23 "inventoried roadless areas" (IRAs) totaling 239,784 acres are included that were identified at the time of implementation of the 1993 George Washington National Forest Plan (1993 GWNF Plan). Two of the IRAs are now designated Wilderness (Priest and Three Ridges) and one IRA is now designated National Scenic Area (Mount Pleasant) and therefore were not inventoried or evaluated as Potential Wilderness Areas. One IRA, The Friars, at only 2,035 acres does not meet the requirements provided in FSH 1909.12, Section 71.1 paragraph (2) for areas less than 5,000 acres in size. Another IRA, Southern Massanutten Mountain (11,941 acres) has less than 70% of federal minerals ownership. Therefore, these IRAs were not given further evaluation.

The inventory criteria for PWAs are less restrictive than the inventory criteria for identifying IRAs that were used during the 1993 GWNF Plan. PWAs were identified for areas that did not qualify as IRAs. There is significant overlap of IRAs and PWAs, with the IRAs often being a core area within the PWA. Table C-2 lists all of the PWAs that were inventoried in 2008 as well as the 1993 IRAs.

Table C-2. Inventoried Potential Wilderness Areas (PWAs) with Crosswalk of 1993 Inventoried Roadless Areas (IRAs)

Potential Wilderness Area	2008 PWA Acres	1993 IRA Acres
Adams Peak	8,226	7,133
Archer Knob	7,110	
Beards Mountain	10,152	7,501
Beech Lick Knob	14,087	
Big Schloss	28,347	20,755
Crawford Knob	14,851	9,889
Dolly Ann	9,524	7,850
Duncan Knob (Massanutten South IRA)	5,973	11,966
Elliott Knob	11,070	9,377
Galford Gap	6,689	
Gum Run	14,547	12,617
High Knob (Dry River and Skidmore IRAs)	18,447	12,971
Jerkemtight	27,314	16,680
Kelley Mountain	12,892	7,589
Laurel Fork	10,236	9,961
Little Alleghany	15,395	10,208
Little Mare Mountain	11,918	
Little River	30,227	27,285
Massanutten North	16,530	9,448
Oak Knob - Hone Quarry Ridge	16,343	10,880
Oliver Mountain	13,049	13,081
Paddy Knob	5,987	
Potts Mountain	7,863	
Ramseys Draft Addition	19,072	12,777
Rich Hole Addition (Mill Mountain IRA)	12,165	10,834
Rich Patch	5,625	
Rough Mountain Addition	2,063	1,385
Saint Mary’s North	3,006	
Saint Mary’s South	1,651	1,451
Saint Mary’s West	278	

Potential Wilderness Area	2008 PWA Acres	1993 IRA Acres
Shaws Ridge	7,268	
Shawvers Run Addition	84	
Three Ridges Addition North	83	
Three Ridges Addition South	187	
Three Ridges Addition SW	9	
Three Ridges Addition West	90	
Three Sisters	9,871	8,146

Table C-3. George Washington NF Potential Wilderness Area Inventory

Potential Wilderness Area Name	Total GWNF and Jefferson NF Acres	Jefferson NF Acres	Road Mileage Per 1,000 Acres	Total Miles of Road	Subsurface Federal Minerals Percentage	Subsurface Private Mineral Rights Acres
Adams Peak	8,226	0	0.45	3.7	100	0
Archer Knob	7,110	0	0.32	2.3	100	0
Beards Mountain	10,152	0	0.26	2.6	100	0
Beech Lick Knob	14,087	0	0.46	6.5	92	1,158
Big Schloss	28,347	0	0.5	14.1	75	7,118
Crawford Knob	14,851	0	0.21	3.1	100	0
Dolly Ann	9,524	0	0.48	4.6	100	0
Duncan Knob	5,973	0	0.46	2.8	100	0
Elliott Knob	11,070	0	0.39	4.3	100	0
Galford Gap	6,689	0	0.3	3.3	100	0
Gum Run	14,547	0	0.37	5.4	83	2,529
High Knob	18,447	0	0.46	8.6	100	0
Jerkemtight	27,314	0	0.46	12.5	90	2,617
Kelley Mountain	12,892	0	0.15	2	84	2,126
Laurel Fork	10,236	0	0.21	2.1	100	0
Little Alleghany	15,395	0	0.18	2.8	98	374
Little Mare Mountain	11,918	0	0.5	6	100	0
Little River	30,227	0	0.4	12.1	90	3,128
Massanutten North	16,530	0	0.49	8.1	91	1,465
Oak Knob - Hone Quarry Ridge	16,343	0	0.44	7.3	96	617
Oliver Mountain	13,049	0	0.19	2.4	100	0

Potential Wilderness Area Name	Total GWNF and Jefferson NF Acres	Jefferson NF Acres	Road Mileage Per 1,000 Acres	Total Miles of Road	Subsurface Federal Minerals Percentage	Subsurface Private Mineral Rights Acres
Paddy Knob	5,987	0	0.28	1.7	100	0
Potts Mountain	7,863	844	0.33	2.6	99	91
Ramseys Draft Addition	19,072	0	0.29	5.6	70	5,784
Rich Hole Addition	12,165	0	0.38	4.6	100	0
Rich Patch	5,625	4,754	0.04	0.2	100	0
Rough Mountain Addition	2,063	0	0.3	0.6	100	0
Saint Mary's North	3,006	0	0	0	79	630
Saint Mary's South	1,651	0	0	0	80	333
Saint Mary's West	278	0	0	0	100	0
Shaws Ridge	7,268	0	0.39	2.8	100	4
Shawvers Run Addition	84	0	0	0	100	0
Three Ridges Addition North	83	0	0	0	100	0
Three Ridges Addition South	187	0	0	0	100	0
Three Ridges Addition Southwest	9	0	0	0	100	0
Three Ridges Addition West	90	0	0	0	100	0
Three Sisters	9,871	0	0.44	4.4	95	491
TOTAL GWJEFF ACRES	378,229	5,598				
TOTAL GWNF ACRES ONLY	372,631					

Table C-4. Potential Wilderness Area Inventory with Recreation Opportunity Spectrum Settings

Potential Wilderness Area Name	Total GWJEFF Acres	Jeff NF Acres	Roaded Natural Acres	Semi-Primitive Motorized Acres	Semi- Primitive Non- Motorized Acres	Semi-Primitive Core Total Acres
Adams Peak	8,226	0	3,801	407	4,018	4,425
Archer Knob	7,110	0	2,669	4,441	0	4,441
Beards Mountain	10,152	0	3,173	1,851	5,128	6,978
Beech Lick Knob	14,087	0	4,585	3,775	5,726	9,502
Big Schloss	28,347	0	8,632	9,974	9,741	19,715
Crawford Knob	14,851	0	3,023	2,522	9,306	11,828
Dolly Ann	9,524	0	3,491	1,361	4,672	6,033
Duncan Knob	5,973	0	2,741	3,232	0	3,232
Elliott Knob	11,070	0	3,978	3,402	3,691	7,093
Galford Gap	6,689	0	1,770	1,132	3,787	4,919
Gum Run	14,547	0	3,750	6,631	4,166	10,797
High Knob	18,447	0	6,686	8,032	3,729	11,761
Jerkemtight	27,314	0	11,473	8,574	7,268	15,841
Kelley Mountain	12,892	0	5,103	2,792	4,997	7,789
Laurel Fork	10,236	0	3,240	631	6,365	6,996
Little Alleghany	15,395	0	6,613	1,501	7,280	8,782
Little Mare Mountain	11,918	0	6,934	3,043	1,941	4,984
Little River	30,227	0	9,727	4,385	16,116	20,500
Massanutten North	16,530	0	5,382	4,563	6,585	11,148
Oak Knob - Hone Quarry Ridge	16,343	0	7,539	4,273	4,531	8,804
Oliver Mountain	13,049	0	3,852	20	9,176	9,197
Paddy Knob	5,987	0	2,703	1,259	2,026	3,284
Potts Mountain	7,863	844	3,372	4,491	0	4,491
Ramseys Draft Addition	19,072	0	8,075	1,717	9,280	10,997
Rich Hole Addition	12,165	0	5,072	480	6,613	7,093
Rich Patch	5,625	4,754	1,617	0	4,008	4,008
Rough Mountain Addition	2,063	0	1,311	498	254	752
Saint Mary’s North	3,006	0	1,020	1,983	3	1,986
Saint Mary’s South	1,651	0	762	0	889	889
Saint Mary’s West	278	0	278	0	0	0

Potential Wilderness Area Name	Total GWJEFF Acres	Jeff NF Acres	Roaded Natural Acres	Semi-Primitive Motorized Acres	Semi- Primitive Non- Motorized Acres	Semi-Primitive Core Total Acres
Shaws Ridge	7,268	0	3,315	1,878	2,076	3,954
Shawvers Run Addition	84	0	84	0	0	0
Three Ridges Addition North	83	0	79	3	0	3
Three Ridges Addition South	187	0	131	0	56	56
Three Ridges Addition Southwest	9	0	9	0	0	0
Three Ridges Addition West	90	0	90	0	0	0
Three Sisters	9,871	0	3,647	1,249	4,975	6,224
TOTAL GWJEFF ACRES	378,229	5,598				
TOTAL GW ACRES ONLY	372,631					

Areas Excluded from the Potential Wilderness Area Inventory

Fourteen areas were reviewed and subsequently excluded from the inventory for not having attainable federal subsurface ownership patterns that could ensure perpetuation of identified Wilderness characteristics. Each of these areas has less than 70% federal ownership of mineral rights. These areas are Long Mountain, Great North Mountain, Church Mountain, and Massanutten South (Lee RD); Cow Knob, Dunkle Knob, Radar Mountain, Kretchie Mountain, Hog Pen, Feedstone Mountain, and Hankey Mountain (North River RD); Priest Addition (Pedlar RD); Back Creek Mountain East (Warm Springs RD); and Panther Ridge (James River RD).

Six additional areas were identified that exceed 5,000 acres in size and meet the road density requirement, but were not included in the inventory due to a lack of outstanding opportunities for solitude or a primitive and unconfined type of recreation. In addition, the location of these areas is not conducive to the perpetuation of Wilderness values. These areas are Dyers Knob, Sidling Hill (North River RD); Warm Springs Mountain, Back Creek Mountain West (Warm Springs RD); Middle Mountain (Warm Springs and James River RDs); and Jerry’s Run (James River RD).

Dyers Knob (WV) is 5,057 acres in size and is surrounded by Forest Service Roads. It is long and narrow. For about one-third of its length, the width between the boundary roads is less than 1 mile and is only 2 miles wide at its widest. It is located along the side of Shenandoah Mountain and does not encompass an entire watershed or mountain. It is entirely in a Roaded Natural ROS class. There is no core area of semi-primitive setting. The sights, sounds and other impacts of the adjacent roads would reduce the wilderness visitors’ sense of solitude and diminish opportunities for a primitive and unconfined recreation experience. The location of this area is not conducive to the perpetuation of wilderness values.

Sidling Hill is 5,204 acres in size but it is long and extremely narrow, only 1.5 miles wide at its widest section. In addition, over half its boundary is shared with private lands. The area has some core semi-primitive ROS class (2,310 acres) but its long, narrow shape and adjacency to private land are limiting factors that reduce opportunities for solitude and impede managing it as an enduring resource of wilderness.

Warm Springs Mountain is 6,194 acres in size with 2,220 acres of core semi-primitive ROS setting. While this area currently has some relatively good opportunities for solitude, private development is encroaching along the southwest border adjacent to the area of core solitude. Additional future development is expected for this area by Bath County. As this development increases, the opportunities for solitude in this area will further diminish.

Back Creek Mountain West is 5,906 acres in size but is nearly bisected by undeveloped private land which divides this area into two parcels connected only by a narrow strip (700 feet) of National Forest land. This configuration constrains the Forest's ability to permanently manage this area as an enduring wilderness resource that provides opportunities for solitude in a remote setting.

Middle Mountain is a 5,959 acre area situated to the west of Douthat State Park. It is long and very narrow which severely limits opportunities for solitude. The northern portion is less than ½ mile wide at its narrowest and never exceeds 1 mile in width with no opportunities for solitude. The southern portion provides some semi-primitive recreation experience, but it is only a small (1,169 acres) portion of the area. The growing popularity of Douthat State Park for accessing dispersed recreation opportunities, as we heard in numerous public meetings, diminishes opportunities for solitude in this area.

Jerry's Run is 5,450 acres in size but is entirely within the Roaded Natural ROS class with no semi-primitive ROS core that provides opportunities for solitude. The northern portion is long and very narrow, rarely exceeding ½ mile in width and is bordered by seasonally open roads and Interstate 64. The southern portion also borders I-64 and has a long, undulating border with private land which further diminishes opportunities for solitude and unconfined recreation.

Nine areas between 4,000 and 5,000 acres in size were reviewed to determine if they can be preserved due to physical terrain and natural conditions or are self-contained ecosystems that can be effectively managed as separate units of the National Wilderness Preservation System. Three of these areas have cores larger than 2,500 acres in size that provide a semi-primitive recreation experience. These areas are Green Mountain (Lee RD); Elliott Knob South (North River RD); and Mud Run Mountain (James River RD). Green Mountain and Mud Run were not included in the inventory since their ownership pattern cannot ensure perpetuation of identified Wilderness characteristics. At Elliott Knob South there are no terrain features that can make up for the lack of acreage in managing for Wilderness. In addition, the lower portion of the area is where the roads are concentrated and it has been actively managed.

Green Mountain is a 4,506 acre area. It is long and narrow and more than half of its boundary is an undulating border with private lands where development is occurring in the Fort Valley area. The western portion is adjacent to Peters Mill ATV/OHV area. These factors severely limit opportunities for solitude and therefore eliminate this area from further consideration.

Elliott Knob South is a 4,718 acre area bounded largely by administrative use roads. Hog Back Road and Elliott Knob Road (and fire tower) separate this area from the adjacent Elliott Knob North area to the north. Within Elliott Knob South are multiple administrative and seasonally open roads including Chapin Draft, Chapin Draft Spur, Elliott Springs, Trout Branch, Daniel, Montgomery Run and Augusta Springs Road. Hite Hollow Spur Road also comes to the boundary of the area. Hite Hollow Shooting Range is just outside of the southwest boundary. The upper elevations of this area provide some opportunities for solitude however the southern portion of this area with its density of roads, active management in recent years and sounds from the shooting range does not provide opportunities for solitude.

Mud Run is a 4,295 acres area which is entirely surrounded by private lands. With a 2,929 acre semi-primitive core, there are good opportunities for solitude and unconfined recreation. However, the public entry into this parcel is very limited, accessible only from a short section of State Route 619 across Hays Creek into steep terrain. There are no rights-of-way across private lands. There would be issues with trespass across private land to enter the area and the Forest would not be able to adequately enforce against illegal ATV use into the area. This presents a situation where managing the area as Wilderness would be nearly impossible. Future development on private land around the periphery would also diminish opportunities for solitude except perhaps in the central core area.

Four of these areas (between 4,000 and 5,000 acres in size) contain smaller cores (less than 2,500 acres in size) providing a semi-primitive recreation experience: Signal Knob (Lee RD); Dameron Mountain (James River RD); Short Mountain (Warm Springs RD); and North Mountain (James River RD). None of these areas have terrain features or natural conditions that adequately enable preserving Wilderness characteristics or effectively managing them as separate Wilderness units. Their size, shape, and location in relation to roads, railroads and private lands are not conducive to perpetuating Wilderness values, particularly the value of providing outstanding opportunities for solitude or unconfined recreation.

Signal Knob is a 4,908 acre area with a core of 2,340 acres of semi-primitive recreation experience. The southern portion, south of Little Passage Creek, is narrow (not exceeding 1 mile in width) and is separated from the northern portion by a 30-foot Shenandoah Valley Electric Cooperative transmission line authorized by special use permit.

Dameron Mountain is a 4,092 acre area with a core of 2,378 acres of semi-primitive ROS class. The majority of the area is surrounded by private lands and illegal ATV use is an ongoing problem. The upper elevations of this area offer some core areas that provide opportunities for solitude but the long and somewhat narrow shape of the area limit unconfined recreation opportunities that are desired for Wilderness recommendation.

North Mountain is 4,764 acre area which is long and narrow having a width that rarely exceeds 1 mile. Most of the eastern boundary of this area is adjacent to private land and the southern portion of the area has been actively managed in recent years. With only 1,751 acres of semi-primitive core, opportunities for solitude are limited and would be further diminished if the private land is ever developed.

The last three areas between 4,000 and 5,000 acres in size are **Snake Run Ridge** (James River RD); **Short Mountain** (Warm Springs); and **Whites Run** (Pedlar RD) and they contain no semi-primitive core areas. These areas are small, narrow, bounded by roads, and lack any measurable core areas offering solitude.

CHAPTER 2. EVALUATION OF POTENTIAL WILDERNESS AREAS

Existing Situation

There are six congressionally-designated Wildernesses that lie wholly within the GWNF. The small portions of Barbours Creek (20 acres) and Shawvers Run Wildernesses (95 acres) that lie within the GWNF are managed under the revised Jefferson Forest Plan. The existing Wildernesses on the Forest total about 43,000 acres, comprising about 4 percent of the National Forest System land of 1,065,389 acres. All designated Wildernesses on the GWNF are within the Commonwealth of Virginia. No designated Wilderness on the GWNF is in West Virginia.

The Jefferson National Forest (JNF) in Virginia, with portions in West Virginia and Kentucky, offers 96,787 acres of designated Wilderness. That is about 13.4% of its total area of 723,300 acres. The combined acres of Wilderness for the George Washington & Jefferson National Forests (GW&J) are 139,461, about 7.8% of the total area of these two national forests. In addition, Shenandoah National Park and the Monongahela National Forest administer 195,358 acres of designated Wilderness in Virginia and West Virginia; most are within easy driving distance of the GWNF. Tables C-5 and C-6 provide a summary and details, respectively, of the designated Wildernesses administered by Federal land managing agencies in Virginia and West Virginia. Neither the George Washington National Forest nor the Jefferson National Forest administers any Wilderness in Kentucky. The Daniel Boone National Forest manages two Wildernesses in Kentucky totaling just over 16,000 acres. These are about a day's drive from the GWNF.

Table C-5. Summary of Units and Acres of Existing Designated Wilderness in Virginia and West Virginia Administered by Federal Land Managing Agencies*

Agency	Acres of Wilderness in Virginia	Number of Wilderness Units in VA	Acres of Wilderness in West Virginia	Number of Wilderness Units in WV	Total Acres (VA and WV)
George Washington National Forest	42,674	6	0	0	42,674
Jefferson National Forest	94,066	17	2,721	1	96,787
Monongahela National Forest	0	0	115,779	8	115,779
Shenandoah National Park	79,579	1	0	0	79,579
Grand Total	216,319	24	118,500	9	334,819

* The table does not include the small portions of Barbours Creek and Shawvers Run Wildernesses that occur in the GWNF but are primarily located in the Jefferson National Forest.

Table C-6. Existing Designated Wildernesses in Virginia and West Virginia

WILDERNESS NAME	George Washington National Forest	Jefferson National Forest	Monongahela National Forest	Shenandoah National Park	Total Acres by Agency
Barbours Creek	20*	5,362*			5,382
Beartown		5,609			5,609
Big Draft			5,144		5,144
Brush Mountain East		3,743			3,743
Brush Mountain		4,794			4,794
Cranberry			47,815		47,815
Dolly Sods			17,371		17,371
Garden Mountain		3,291			3,291
Hunting Camp Creek		8,470			8,470
James River Face		8,886			8,886
Kimberling Creek		5,805			5,805
Laurel Fork North			6,055		6,055
Laurel Fork South			5,874		5,874
Lewis Fork		5,926			5,926
Little Dry Run		2,858			2,858
Little Wilson Creek		5,458			5,458
Mountain Lake		16,511			16,511
Otter Creek			20,698		20,698
Peters Mountain		4,531			4,531
Priest	5,963				5,963
Raccoon Branch		4,223			4,223
Ramseys Draft	6,518				6,518
Rich Hole	6,450				6,450
Roaring Plains West			6,792		6,792
Rough Mountain	9,300				9,300
Saint Mary's	9,835				9,835
Shawvers Run	95*	5,591*			5,686
Shenandoah				79,579	79,579
Spice Run			6,030		6,030
Stone Mountain		3,270			3,270
Three Ridges	4,608				4,608
Thunder Ridge		2,344			2,344
Total Acres by Agency	42,674*	96,787*	115,779	79,579	334,819

* The acres of Barbours Creek and Shawvers Run that lie within the George Washington National Forest are included in the Total Acres by Agency for the Jefferson National Forest.

Process for Evaluation and Preliminary Administrative Recommendation

Section 72 of Chapter 70 of FSH 1909.12 provides direction for evaluation of potential Wilderness. This report evaluates Wilderness potential in three main categories: **Capability, Availability, and Need**.

Capability is defined as the degree to which the area contains the basic natural characteristics that make it suitable for Wilderness designation without regard to its availability for or need as Wilderness. There are six basic characteristics to evaluate the capability of an area east of the 100th meridian. These six characteristics are:

Natural - ecological systems are substantially free of modern civilization and are affected primarily by forces of nature;

Undeveloped – degree to which the area is without permanent improvements or human habitation;

Primitive – ability of the area to provide outstanding opportunities for solitude or primitive and unconfined recreation;

Special features or values - ability to provide ecologic, geologic, scientific, educational, scenic, historical, or cultural features or values of significance;

Manageability – the ability of the area to be managed as an enduring resource of Wilderness and be protected for its natural character;

Non-conforming uses (for areas in the East) – ability for non-conforming uses, structures and/or improvements to be effectively mitigated or terminated.

Given the size of the areas, all of them provide some opportunities for solitude or primitive and unconfined recreation. To assist in comparing these areas, the acreage of areas inventoried as providing a semi-primitive recreation experiences have been identified. This represents the acreage that is more than one-half mile away from a road and is referred to as the “semi-primitive core.” Areas further away from existing roads are expected to provide a greater opportunity for solitude and for primitive and unconfined recreation.

Availability for potential Wilderness is an assessment of the value of and need for the area as a Wilderness resource compared to the value of and need of the area for other resources. To be available for Wilderness, the tangible and intangible values of the Wilderness resource should offset the value of resources that formal Wilderness designation would forego. In essence, other resources could be satisfied in the area that may conflict with Wilderness designation.

Constraints, encumbrances and nonconforming uses as well as structures and improvements on lands are considerations in assessing the availability of lands for Wilderness designation. Generally, PWAs that contain subsurface or outstanding mineral rights are deemed a risk for Wilderness designation, as those legal rights could result in the construction of non-conforming facilities such as roads and structures. The need to actively manage for threatened or endangered species in compliance with the Endangered Species Act and its associated regulations often conflicts with some of the restrictions that result from Wilderness designation. Another consideration is the effect of management on adjacent lands outside the area (FSM 1923.03, WO Amendment 1900-2006-2, effective 01/31/2006).

The other resources included in the availability evaluation were chosen due to one or more of the following reasons: (1) they have been discussed historically on this National Forest, internally and with the public, regarding which should take priority – the other resource or the Wilderness resource; (2) comments were received from the public on the need to change the GWNF Forest Plan; and (3) comments were received during or resulting from the plan revision public meetings.

Need is the degree to which an area contributes to the local or regional distribution of Wilderness and to the overall national Wilderness preservation system. The factors considered include: demand based on visitor pressure in existing Wilderness areas; proximity to other designated Wilderness; ability of a PWA to provide solitude, physical and mental challenge, inspiration and research opportunities; improving the quality and characteristics of an existing Wilderness; and expanding the representations of various ecosystems within the region and within the national Wilderness preservation system.

This analysis includes information and data from several sources. One of which is the public involvement done throughout the revision effort. Others include reports of Forest Service social science researchers in collaboration with the University of Tennessee and University of Georgia based on data collected during the last two National Surveys on Recreation and the Environment (NSRE). Also considered is data from gathered during the last two National Visitor Use Monitoring surveys (NVUM). Data for the existing distribution of Wildernesses, their acreages, and relative rankings between states as pertains to Wilderness designation came from www.Wilderness.net. Overall state land area rankings were obtained from the U.S. Census website at www.census.gov. Data on existing level of Wilderness use was obtained from the Southern Appalachian Assessment. The distribution of existing and potential wilderness areas and ecosystems is accomplished using geographic information systems (GIS) data.

Preliminary Administrative Recommendations from the Responsible Official will be documented in the agency's decision (Record of Decision) that approves the Revised Forest Plan. An area must meet the tests of capability, availability, and need (FSH 1909.12, Chapter 72). In addition to the inherent Wilderness quality a potential wilderness area might possess, the area must also provide opportunities and experiences that are dependent upon and enhanced by a Wilderness environment. Furthermore, the area and boundaries must allow the area to be managed as Wilderness.

An area meeting the criteria stated above may be included in a preliminary administrative recommendation that may or may not receive further review and possible modification by the Chief of the Forest Service, Secretary of Agriculture, and the President of the United States. The Congress has reserved the authority to make final decisions on Wilderness designation.

It is important to note that any areas being recommended for wilderness study designation may have their initial Potential Wilderness Area inventory boundaries adjusted as a result of this evaluation process (FSH 1909.12, Chapter 72.5).

Results

A. Capability and Availability Results

Evaluation of each of the 37 PWAs was performed by Forest Supervisor’s Office and District resource specialists with consideration of personal knowledge of the areas and resources, data contained in the forest’s geographic information system (GIS), comments provided by the public (both individuals and groups through public workshops and letters), and information provided in the Virginia Mountain Treasures report.

All six of the basic characteristics for Capability were evaluated for each PWA. Data for all of the characteristics are included in Table C–9 at the end of this Appendix. The following section provides a summary of only the characteristics that most contributed to each PWA’s meeting, or to not meeting, the capability for Wilderness. This includes information such as the size of the semi-primitive core that offers opportunities for solitude; the configuration (size and shape) of the area and physical terrain that contributes to effectively managing for wilderness or to diminished capability for managing wilderness characteristics including opportunities for solitude; adjacency to private land that, if developed, could diminish opportunities for solitude; ongoing issues with illegal ATV use within the area; existence of privately owned mineral rights that, if developed, would be inconsistent with the wilderness resource; and other qualities of each area that support or do not support recommendation as designated Wilderness. In the Availability evaluation, there may be additional other competing uses documented, although not all are included in this summary report. Again, see Table C-9 for the detailed evaluation. Those that caused the most concern to the Forest Service and/or to members of the public are included in this section.

For the purpose of summarizing the evaluations, Capability and Availability are grouped together for each PWA. Each was evaluated individually. The areas are listed alphabetically. The evaluation of Need follows separately as it was evaluated on Forestwide, regional and national levels.

ADAMS PEAK (8,226 acres)

Capability: This area meets the requirements for size and opportunities for remoteness. It has a core of 4, 400 acres of semi-primitive area. The major recreational activities include hunting and hiking and use of the long Whetstone Ridge Trail that begins at Irish Creek and climbs to the Summit of South Mountain and then follows the Whetstone Ridge to the Blue Ridge Parkway. About 68% of the boundary interfaces with private land, including the presence of at least one residential subdivision. Also adjacent to the area is a summer organizational camp under special use permit with the Forest Service. There is known illegal ATV use in the area.

Some of the wilderness attributes of the area identified by public comments include:

- Historic use as a field research area for Nature Camp participants.
- Offers outstanding opportunities for solitude, primitive recreation, the enjoyment of old growth, Blue Ridge flora and fauna, hunting, fishing, and supreme views of the George Washington National Forest and mountains in all directions.
- The Rockbridge Board of Supervisors passed a resolution in favor of a national scenic area designation for Adams Peak.
- Scenic rock outcroppings and pinnacles occur within the area.
- Contains a post road dating from the nineteenth century. A mail carrier on horseback travelled this route delivering mail to several homes located on Big Mary's Creek.

Availability: There are two threatened, endangered, sensitive or locally rare (TESLR) species that would benefit from management activities, and about 1,076 acres of pine species that would benefit from natural or prescribed fire to enhance regeneration. There is heavy mountain bike use on Whetstone Ridge Trail. There are 3.7 miles of road, of which about 1.2 miles are open year round for public access. There is an ongoing issue with illegal ATV use. The Rockbridge County Board of Supervisors passed a resolution supporting Adams Peak for recommended national scenic area designation.

ARCHER KNOB (7,110 acres)

Capability: This area meets minimum requirements for size. Its core of semi-primitive is relatively small at 4,440 acres compared with other PWAs being evaluated. There are opportunities within this area for primitive, unconfined recreation and solitude. About 22% of the boundary is adjacent to private land. Some of the wilderness attributes of the area identified by public comments include:

- A combination with Elliot Knob could create a nearly contiguous wilderness unit of over 12,000 acres. The creation of an Archer Knob/Elliot Knob Wilderness would be similar to the James River Face/Thunder Ridge Wilderness or the recently approved Garden Mountain/Hunting Camp Creek Wilderness on the Jefferson National Forest where they are separated only by a road.
- The Scott Hollow Barrens conservation site lies along the crest of the mountain in the northern part of the area.
- Seven miles of the Great North Mountain Trail pass through the heart of Archer Knob. This trail continues on and through the Elliott Knob and Crawford Mountain Treasures to the north, for a total length of about twenty miles.

Availability: Two TESLR species could benefit from management activities. The Great North Mountain Trail is popular with mountain bikers. About 1,322 acres are suitable for timber production and the area contains 1,734 acres of pine species that could benefit from prescribed burning. There are no privately owned subsurface mineral rights. There are no competitive recreation events that would be displaced and no open roads used for public access. The last timber management activity occurred in 1993 and entailed just one unit.

BEARDS MOUNTAIN (10,152 acres)

Capability: This area contains about 6,978 acres of semi-primitive core. While this is a moderately large area compared to others in this evaluation, the overall area's shape and location are poor for providing Wilderness qualities. The area is narrow and located along a mountainside. Close proximity to Douthat State Park with a connector trail into Wilderness may result in unacceptably high levels of user interaction that diminish opportunities for solitude and/or the mental challenge and need to rely on one's own primitive recreation skills and abilities. Some of the wilderness attributes of the area identified by public comments include:

Adjoins Douthat State Park, and by virtue of this location is a popular recreational destination for folks visiting the park and enables visitors to choose a less developed outdoor experience.

Beards Mountain provides a scenic backdrop for the eastern portion of Douthat State Park

This is one of the few roadless areas on the Forest that can be directly accessed by canoeists.

Hiking is the primary recreational activity of Beards Mountain. The Beards Mountain Trail climbs from the Cowpasture River to the Crest of Beards Mountain and travels south to Douthat State Park. In addition to this trail several short side trails lead down to Wilson Creek.

There is a 743 acre Special Biological Area.

Availability: There are shale barren species, at least one of which is a TESLR, that benefit from management including prescribed burning. There are over 1,400 acres of pine species that also would benefit from fire, and over 1,300 acres are suitable for timber production and have been actively managed since 1993. The Beards Mountain Trail is used by mountain bikers coming out of Douthat State Park. There are no authorized competitive events that would be displaced, no open roads used for public access and no privately owned subsurface mineral rights.

BEECH LICK (14,087 acres)

Capability: Beech Lick is a large area with shape, size and topography that provides outstanding opportunities for solitude and physical challenge as well as for natural processes to dominate within the area. There is a large unbroken core of 9,502 acres of semi-primitive ROS class. About 51% of the PWA boundary interfaces with private land ownership which, if developed, could impact opportunities for solitude. Given the size and configuration of this PWA, this might be mitigated by adjusting the recommended Wilderness boundary. Some of the wilderness attributes of the area identified by public comments include:

It is large and remote, and the area has wild character, relatively free of the effects of man.

A major feature is its 4,000 acres of old growth.

Although the Great Eastern Trail (GET) is being constructed through the area with the intention of being a shared use trail, the area of Beech Lick Knob to the east of Forest Service Road (FSR) 302 and the GET should be recommended for Wilderness study.

A Beech Lick Wilderness would satisfy the need for Wilderness in the northern part of the GWNF, and it is the best candidate to meet this need.

Elevations here range from 1650 to 3150 feet, with a great diversity of topography.

A very large area of "semi-primitive" acreage occurs here where visitors can experience solitude and serenity.

Clay Lick Trail runs north/south through the area for around six miles, connecting County Route 818 at the southern boundary with FSR 1280 at the north.

Availability: About 1,158 acres have private sub-surface mineral rights. This area is near the western boundary and could be excluded. There are no current recreational uses that are incompatible with Wilderness, however plans have been approved and NEPA analysis completed for construction of a trail in the western portion of this PWA intended for use by mountain bikers as well as equestrians and hikers. Beech Lick is currently suitable for wildlife habitat and timber management with past investments made for both of these resources. Almost 5,600 acres of this PWA is suitable for timber production primarily in the eastern portion. There are no known TESLR species that benefit from active management, but there are almost 1,300 acres of pine species that could benefit from prescribed fires. An estimated 51% of the boundary is adjacent to private land. There is only about 0.2 mile of road open to the public for access into this area.

BIG SCHLOSS (28,347 acres)

Capability: This is a huge PWA with a semi-primitive core of 19,715 acres. There are outstanding opportunities in the interior for primitive recreation and physical challenge. Outstanding geologic features exist within this area. A dense system of existing, popular trails results in a high number of encounters with other users, diminishing or eliminating the opportunity for solitude, sense of remoteness and relying on one's own skills and abilities. The odd overall configuration of the PWA along with a high percentage of the boundary being adjacent to private lands is not conducive to the area's capability to provide solitude. Some of the wilderness attributes of the area identified by public comments include:

The location of Big Schloss, its large size, and its popularity as a recreational destination for metropolitan Washington all predicate a high level of protection.

Its extensive ridgeline and unique rock outcrops offer some of the most outstanding and memorable scenery in Virginia.

Big Schloss is a large, popular recreation area for hikers, mountain bikers, and equestrians.

It offers outstanding scenery, unique rock outcrops, and a challenging trail network.

The Big Schloss area has the Salus Spring Special Biological Area and 6,000 acres of old growth.

Big Schloss is one of the largest inventoried roadless areas not only on the George Washington National Forest, but in all of the eastern National Forests.

Availability: There are 7,118 acres of privately owned sub-surface mineral rights and a private inholding near the east boundary. Development of either of these would be detrimental to the wilderness resource. Almost 5,550 acres are suitable for timber production. There have been investments in wildlife habitat (openings and prescribed fire). The Wood turtle exists in the area and some habitat management might be needed. Due to acidification, Little Stony Creek is limed; this can occur in designated Wilderness but requires additional analysis and approval from the Regional Forester. West Virginia has the Cove Deer Management Area. Multiple trails exist throughout the area and some are popular with mountain bikers. Competitive events are currently authorized within this area, which would be displaced if designated as Wilderness. There is a significant amount of current motorized access on 11.2 miles of open, public roads.

CRAWFORD KNOB (14,851 acres)

Capability: This area has the substantial size needed for natural processes to dominate the landscape. The semi-primitive core is about 11,828 acres. Opportunities exist for primitive recreation and physical challenge. The area contains the headwaters for both the James River and Potomac Rivers. There is known illegal ATV use occurring in the area. About 58% of the PWA boundary is adjacent to private land which, if developed, may diminish the Wilderness resource; however due to the size of this PWA, this may be mitigated by adjusting the boundary of a recommended Wilderness. Some of the wilderness attributes of the area identified by public comments include:

Crawford Mountain is a magnificent mountain where one can experience a feeling of remoteness and solitude.

One unique characteristic of Crawford Mountain is Red Oak Spring which has its origin near the summit of the mountain. Due to its high elevation, the stream has created many small rock ledges and waterfalls as it descends the mountain.

Public utilization of Crawford Mountain consists of dispersed recreational activities including hunting, hiking, backpacking, mountain biking, and equestrian trail riding. This use occurs on a trail system that includes the Crawford Mountain Trail, Chimney Hollow Trail, and Crawford Knob Trail. In all, there are approximately 14.5 miles of trail.

During the Civil War, this area played a brief role in the events leading up to the Battle of McDowell in 1862. Jedediah Hotchkiss rode out on Crawford Mountain to spy on Union forces camped along Jennings Branch.

Availability: There is a ridgetop private inholding in southeast portion of the area. It is not very near a boundary; excluding it without cherry-stemming would significantly reduce the size of the area recommended for Wilderness study. There are multiple trails in the southern portion of the area, some used by mountain bikers. There are competitive recreation events authorized under special use permit that would be displaced by Wilderness designation. About 3,800 acres are suitable for timber and there has been active management such as timber harvesting and prescribed burning. Only 0.4 mile of road is open to the public for access within this area.

DOLLY ANN (9,542 acres)

Capability: This is a moderately sized PWA with a core of 6,033 acres of semi-primitive land. Most of the PWA is situated on top of a mountain with potential for scenic views; while there are also opportunities for interior views and finding remoteness. The northern portion of the area is very narrow. The overall size and configuration are not ideal for ecological processes to dominate. Fifty-four percent of the boundary is adjacent to private land and it is in close proximity to an interstate and U.S. highways located on three sides. The prevailing winds often carry the odors of the paper mill in nearby Covington. Some of the wilderness attributes of the area identified by public comments include:

Dolly Ann contains the highest point in Alleghany County.
There is a cliff near the top of the mountain on the west side that provides a wonderful view of Warm Springs Mountain and Falling Springs Valley.
On the summit of Big Knob, there is a flat which presents an open park-like atmosphere with herbaceous ground vegetation.
Dolly Ann Hollow was managed as a primitive area prior to 1986.
This rugged area is characterized by large boulders, rock ledges and several small waterfalls.
In Dolly Ann Hollow, the stream contains native brook trout.
The area around Dry Run is a 2,075 acre Plan designated Special Biological Area.
There is one trail through Dolly Ann - the Dry Run Trail climbs to the summit of Warm Springs Mountain.

Availability: This is the southernmost range for Variable sedge (TESLR) that requires fire, as well as one other TESLR species that may benefit from active management. It has been 15 years since timber and prescribed fire activities, and these activities are due again in the typical cycle. About 3,424 acres are suitable for timber production. Trails exist that are used by mountain bikers, but this use is not estimated to be heavy. There are no privately owned subsurface mineral rights. There are no authorized competitive recreation events that would be displaced. Only about 0.4 mile of road is open to the public for access into this area.

DUNCAN KNOB (5,973 acres)

Capability: This area meets minimum requirements for size. Its core of semi-primitive is small at 3,232 acres. It is comprised of a steep mountaintop with knobs. The entire east boundary is adjacent to private land that if developed, could diminish opportunities for solitude and a sense of remoteness. There is known illegal ATV use. The area is not large or wide enough for natural processes to dominate. Some of the wilderness attributes of the area identified by public comments include:

The density of trails, proximity to northern Virginia, and popularity of the area with recreationists make it a good candidate for wilderness study recommendation.
The area contains the headwaters of Passage Creek.

Availability: One sensitive species exists in the area and it benefits from active management. Approximately 686 acres of pine species are present that would benefit from prescribed burning. Three trails exist within this area and all are used by mountain bikers, including technical trails. There are authorized recreation competitive events that would be displaced if designated as Wilderness. There are no privately owned subsurface mineral rights, and there is only 0.1 mile of road open to the public in this area.

ELLIOTT KNOB (11,070 acres)

Capability: This is a moderately large PWA as compared with other areas in this evaluation, with a semi-primitive area of 7,093 acres. It is very rugged and offers great opportunities for solitude, challenge and a sense of remoteness. It is marginally large enough for ecological processes to dominate. There is only 9% of the PWA boundary adjacent to private, which is very low compared to most of the PWAs, meaning that there is little outside influence that could diminish managing for Wilderness character into the future. Some of the wilderness attributes of the area identified by public comments include:

> Elliott Knob is the summit of Great North Mountain; with an elevation of 4463 feet this behemoth rises high above the surrounding countryside.
>
> It has outstanding wild character.
>
> Buffalo Spring and Chestnut Flat Spring are two clear, cool springs that originate high up the ridge.
>
> Cold Spring bubbles out of the ground on the western flank of the mountain. These springs and others like them feed streams such as Montgomery Run, Fridley Branch, and West Dry Branch.
>
> The Virginia Division of Natural Heritage has identified several threatened and endangered plants along the ridgeline of Elliott Knob.
>
> The mature forest in this unfragmented area has pockets of old growth and several rare wildflowers that thrive in this habitat.
>
> Another attractive quality of the area is its black bear habitat. The dense understory vegetation and species composition makes it a desirable place for black bear.

Availability: There are three TESLR or Forest Service sensitive species that benefit from active management. There is also the Smooth green snake that requires open grassy areas. There are multiple administrative and closed roads as well as some mountain biking trails within the area, and there are authorized competitive recreation events that would be displaced if the area is designated as a Wilderness. There is a stocked trout stream popular with anglers. Active management has occurred around the west, north and northeast perimeter and 3,468 acres are suitable for timber management. There are no privately owned subsurface mineral rights. There are no roads open to the public for motorized access into the area.

GALFORD GAP (6,689 acres)

Capability: This meets the minimum size requirements for Wilderness and has a core of 4,919 acres of semi-primitive land. The area is oddly configured, long and narrow. The PWA is located predominantly on a mountainside and mountaintop at high elevation. Approximately 66% of the boundary is adjacent to privately owned land which, if developed, could diminish opportunities for solitude and a sense of remoteness. Due to size and primarily due to shape and configuration, this area does not provide a great opportunity for ecological processes to dominate. Some of the wilderness attributes of the area identified by public comments include:

> Due to the steep rugged terrain of Scaffold Run, remote recreational opportunities are plentiful. There is no existing trail system.
>
> Mountainside and mountaintop views are certainly acceptable terrain as far as their capability to offer an experience in the Wilderness, especially as there are no trails.
>
> Allegheny Mountain is a special place where ecological processes dominate just as in any other place in the Forest. Ecological processes are not restricted by political or forest boundaries.
>
> Allegheny Mountain is one of Virginia and West Virginia's high mountains with many knobs exceeding 4000 feet.

The area contains significant stands of high elevation old growth with northern red oak, sugar maple, and basswood.

It is also one of the few sites on the George Washington National Forest with red spruce.

Availability: There was active timber and prescribed burning activities from 1993 to 2000 and it is nearing time to return to these areas. About 4,467 acres are suitable for timber management. There are no privately owned subsurface mineral rights. There is little to no mountain biking that occurs in this area and no authorized competitive recreation events that would be displaced. There is 1.8 miles of road open to the public to access this area.

GUM RUN (14,547 acres)

Capability: The semi-primitive core area consists of 10,797 acres. The shape of this area, small percentage of boundary adjacent to private land (a good portion of the eastern boundary is adjacent to the Harrisonburg reservoir), and rugged terrain with large interior drainages provide good opportunities for solitude and primitive or unconfined type of recreation. There is a small private inholding that can be excluded with a boundary adjustment. The area is arguably large enough for ecological processes to dominate. Some of the wilderness attributes of the area identified by public comments include:

With three major ridges, the area is rugged and home to many small drainage streams; the western flank provides ground water protection for Switzer Lake. This reservoir provides water to the City of Harrisonburg.

The area provides a wild backdrop to developed recreation and housing in the Rawley Springs area, is outstanding habitat for black bear with hunter access via FSR 304 and FSR 225, and offers tremendous views from Rt. 33 through Rockingham County.

The large, remote nature of the area with several native brook trout streams provides important primitive recreation opportunities.

Gum Run marks the north end of a complex of nearly contiguous roadless areas that stretch all the way to US 250.

The remote and rugged nature of the area provides critical habitat for the black bear.

The Cow Knob Salamander, endemic to the higher elevations in the vicinity of Shenandoah Mountain, is known to reside on the high ridges of Dundore Mountain where it prefers the late successional and old growth mixed hardwoods forests of this high ridge.

Availability: There are 2,529 acres with private sub-surface mineral rights across the north portion of the PWA. There are acidified streams in the area that would benefit from liming; there are approximately 24 miles of native brook trout streams. There is a mountain bike trail on Chestnut Ridge. There are 2.2 miles of open road currently providing motorized public access into the area.

HIGH KNOB (18,447 acres)

Capability: This large PWA has a core area of 11,761 acres of semi-primitive lands. The area is predominantly located on a mountainside with deep, rugged drainages that offer opportunities for solitude and physical challenge. The area is large enough for ecological processes to dominate. This PWA has about 28% of its boundary interface with private property, which is relatively low by comparison to many other PWAs in this evaluation. However, this PWA has a sizeable cherry stem around the Skidmore Fork Road and an odd boundary configuration around Brandywine Lake Recreation Area and a block of private land. Some of the wilderness attributes of the area identified by public comments include:

Ranging from flat river bottoms to steep mountainsides, this area is bounded by ridges that exceed 4000 feet on Bother Knob, High Knob, and Flagpole Knob. Challenging primitive and unconfined recreation opportunities can be found.

Skidmore Fork, which flows into Switzer Lake, serves as the principle water source for the City of Harrisonburg and needs protection as a critical watershed.

It is home to ten rare, threatened, or endangered species, with five being given the “extremely rare” designation by the state.

A rare amphibian species occurs here, the Cow Knob Salamander. A 3691 acre Forest Plan Special Biological Area is another gem of this special place.

The roadless area is crisscrossed with a significant trail network. With a total of almost eighteen miles, the area is a popular recreation destination. Most trails climb the steep ridge to the summit of Shenandoah Mountain. The Shenandoah Mountain Trail on the crest of the ridge serves to connect these side trails.

Boundaries can be drawn to exclude the Shenandoah Mountain trail which is a segment of the Great Eastern Trail.

In addition to the trail network, the Brandywine Lake Recreation Area is located near the northwest corner of the roadless area.

Black bears also find remote habitat here.

Availability: There are two TESLR or Forest Service sensitive species in the area that benefit from active management. There have been a lot of wildlife management activities (about 15 openings) as well as a large prescribed burn. About half of this area is in West Virginia, and the West Virginia Division of Natural Resources has strong reservations about Wilderness designation. About 4,300 acres are suitable for timber management. Shenandoah Mountain Trail, used by mountain bikers, traverses the ridge of the mountain through the middle of this PWA. There are no competitive recreation events authorized in this area, but there are 2.2 miles of year round or seasonally open roads.

JERKEMTIGHT (27,314 acres)

Capability: This is the third largest PWA in the evaluation. It has a huge core of 15,841 acres of semi-primitive land. It is rugged with multiple ridges and twisting drainages, offering excellent opportunities for solitude, primitive recreation and physical challenge. The area is large enough for ecological processes to dominate. The shape is odd with multiple corners and curves along the boundary, many of them plunging deeply into the PWA. However, a relatively small percent of the boundary (21%) is adjacent to private land and there are no private inholdings. Nevertheless, there is known illegal ATV use within the area. A portion of an eligible National Recreational River runs through the area and nine miles of native brook trout streams. Some of the wilderness attributes of the area identified by public comments include:

Jerkemtight is one of the most outstanding areas being evaluated in the inventory.

Its size and remoteness make it an ideal candidate for Wilderness; however, mountain bike organizations have been holding large trail rides on the Shenandoah Mountain Trail for several years. It would make sense to recommend the Benson Run and the Bolshers Run drainages for Wilderness and leave the rest of the Jerkemtight area open for mountain biking.

The Benson Run watershed is pristine, remote, and unspoiled. It offers a true wilderness experience for those seeking solitude. It is unusual today to have the opportunity to preserve a whole watershed as wilderness. Benson Run is one of the gems of the GWNF.

Bolshers Run does not have any trails, and includes the eastern slope of Sisters Knob.

Jerkemtight Roadless Area is a favorite destination for outdoor recreational enthusiasts. The most important trail is the Shenandoah Mountain Trail. Twenty-two miles of the mountain’s crest are within the boundaries of Jerkemtight and Benson Run.

The shale barrens near South Sister Knob have been designated as a Special Biological Area. This area protects rare plants associated with the barrens.

The Roughhead Shiner and endangered Indiana Bat are also known to occur nearby.

Availability: There are five TESLR or Forest Service sensitive species within the area that benefit from human intervention. The 1,280 acre Special Biological Area on the south end requires prescribed burning, and 2,006 acres of pine species would also benefit from prescribed burning. There are 2,617 acres of private subsurface mineral rights in three blocks from roughly the center of the PWA up to the northwest portion. To exclude these would require reducing the size of the PWA by nearly half. There are two National IMBA mountain bike trails, one of which runs the length of the entire PWA. There have been significant investments in timber and wildlife projects dating 1993 to 2000. There are 2.1 miles of roads open year round or seasonally for motorized access into the area.

KELLEY MOUNTAIN (12,892 acres)

Capability: This moderately large area has a core of about 7,789 acres of semi-primitive land. In conjunction with the existing Saint Mary's Wilderness and Saint Mary's Wilderness Addition North, this could establish a large area of Wilderness. Within this area there are multiple ridges and valleys providing good opportunities for solitude, remoteness and physical challenge. This PWA, with its topography and natural features, can be dominated by ecological processes. There is a large, wide cherry-stem along Mill Creek Dam Road and a smaller one around Coles Run municipal water supply, which are not desirable in a Wilderness boundary. Some of the wilderness attributes of the area identified by public comments include:

> Kelley Mountain Big Levels is a good candidate for extra protection since it is adjacent to Saint Mary's Wilderness. It could create a protected land mass of over 22,000 acres that would remain available for both hiking and biking, and other forms of recreation.
>
> Recreational activities include hunting, fishing, camping, mountain biking, and hiking. There are about 25 miles of trail with loop hikes available.
>
> The whole area is well served by several stunning and popular trails.
>
> Boundary lines can be drawn to take into consideration the importance of the jeep road to bear hunters.
>
> Coles Run and Mill Creek are important watersheds for two reservoirs.
>
> Torry Ridge offers appealing and significant rock features.
>
> Many of the rugged, steep slopes are covered with significant scree slopes.
>
> There are many rock outcrops that provide tremendous views of the Shenandoah Valley.
>
> The lower areas, or the "levels", are biologically significant because of geology and the subsequent evolution of disjunct flora and fauna species. Kelley Mountain is an integral component of a large ecologically important area.
>
> Several rare species have been identified by the Heritage Program including Swamp Pink, Variable Sedge and Large Cranberry as well as possible rare invertebrate species. There is an 8,376 acre Special Biological Area.

Availability: There are three large blocks of private sub-surface mineral rights totaling 2,126 acres along the northern portion of the area. There are three TESLR or Forest Service sensitive species that exist in the area that benefit from habitat management activities. There are several trails running parallel to each other spread across the area, one of which is accessed by Mill Creek Dam Road that penetrates deeply into the interior of the PWA. There are authorized competitive recreation events that would be displaced by Wilderness designation. An OHV road separates Kelley Mountain from Saint Mary's Wilderness. There has been significant past investments in wildlife habitat improvements. Not including the cherry-stemmed roads or OHV road along the boundary, there are 1.9 miles of road open to the public for motorized access in the area.

LAUREL FORK (10,236 acres)

Capability: This moderately sized PWA has a core semi-primitive area of about 6,996 acres. The PWA is located in a fairly isolated area, but about 77% of the PWA boundary is adjacent to privately owned lands. The terrain within the PWA allows for opportunities for solitude and an unconfined type of recreation. The area is biologically unique on the GWNF and is the southernmost range for some northern species. There is a concern that climate change could result in these northern species migrating to the north and out of the area. There are large plantations of red pine and spruce. The area is marginally large enough for ecological processes to dominate. Some of the wilderness attributes of the area identified by public comments include:

Laurel Fork may be the premier candidate for Wilderness designation in the state of Virginia.
Laurel Fork is unique in the state of Virginia, the result, in part, of its location on a high, stream-dissected plateau of the Allegheny Mountains and the Ridge and Valley. The elevations, ranging from 2700 feet to over 4000 feet, have given rise to a forest of northern hardwoods, montane red spruce, and white pine, quite unlike the Appalachian oak forest that dominates the George Washington National Forest.
Laurel Fork and its tributaries support a native brook trout fishery highly prized by fly fisherman.
Beaver ponds and meadows in the headwaters of various runs west of Laurel Fork attract many visitors.
There are at least 25 species of flora and fauna that are ranked by the Virginia Division of Natural Heritage as rare in Virginia, including the northern flying squirrel, a federally listed endangered species.
Disjunct populations of snowshoe hare and fisher have been documented.
Two-thirds of Laurel Fork is Special Biological Area.
The existing trail system provides good access into the area and offers excellent opportunities for hiking and backpacking.
Due to its remote location this area offers a significant opportunity for solitude.
Contains one of the finest examples of Northern Boreal natural community complexes in Virginia.
Unique representative of the Allegheny Plateau Ecoregion within the Commonwealth.
Excellent opportunities for birding, hiking, backpacking, and fishing.

Availability: The area has multiple trails, some used by mountain bikers but that use is not estimated to be heavy. There are no authorized competitive recreation events that would be displaced by Wilderness designation. There are 22 miles of native brook trout streams, some are acidified and benefit from liming. This area is the southernmost range for some of the northern animal species found in this area, and some may benefit from management activities, particularly as more is learned about the effects on them of global warming. It is important to keep management options open to maintain these species in this area. There are no privately owned subsurface mineral rights that will be developed. There are 2.1 miles of road open for public access into this area.

LITTLE ALLEGHANY (15,395 acres)

Capability: This PWA has about 8,782 acres of semi-primitive which is oddly shaped and protruding down each "leg" of this PWA. The area is rugged and does provide opportunities for solitude and remote, primitive recreation. However, the odd configuration impedes the area's ability to have ecological processes dominate the landscape. About 75% of the boundary is adjacent to private land. And there is known illegal ATV use in the area, but there is no other evidence of human habitation or use. Some of the wilderness attributes of the area identified by public comments include:

Little Alleghany has an awkward shape, but that does not negate its capability for Wilderness.
The lack of trails, location on the Virginia /West Virginia boundary, size, and ruggedness are some of the characteristics that make this area a good candidate for Wilderness recommendation.
The long western boundary atop the high elevation of Allegheny Mountain is one of the attributes that makes this a good candidate for protection.
The slopes of Little Alleghany Mountain contain rock rubble and ledges with bands of solid rock walls running parallel to the slope. In general, the area is steep, rugged and relatively isolated.
Jim Dave Run is a small creek that lies in a long valley almost totally within the confines of the roadless area.
Due to the rugged terrain and topography, an abundance of primitive recreational opportunities occur.
There are no maintained trails within the roadless area.
Several informal campsites exist along the crest of Big Alleghany Mountain and are utilized during hunting season.

Availability: There are two TESLR or Forest Service sensitive species that are enhanced by active management. There are private sub-surface mineral rights on 374 acres. While this is not a large amount, due to its location, the entire southeast "leg" would need to be excluded to assure development of minerals does not occur within Wilderness. Approximately 5,621 acres are suitable for timber management; the last activity occurred in 1999. There are 202 acres of pine species that would benefit from prescribed burning. There are no system trails, no authorized competitive recreation events and no current motorized access into the area that would be displaced by Wilderness designation.

LITTLE MARE MOUNTAIN (11,918 acres)

Capability: Less than half of this area, a total of about 4,984 acres, is in the semi-primitive ROS class in the northern half of this PWA. The south portion has steep topography but could be described as a narrow panhandle. The larger block at the north end offers opportunities for solitude but the topography is not as rugged for offering physical challenges. The oddly shaped area is not conducive to allowing ecological processes to dominate the landscape. Close proximity to Douthat State Park with connector trails into the area may result in unacceptably high levels of user interaction diminishing the opportunities for solitude. Some of the wilderness attributes of the area identified by public comments include:

> Little Mare Mountain's location and use as a recreational area lend weight to the importance of its protection.
>
> Near the summit of Bald Knob on Warm Springs Mountain the elevation reaches almost 4,000 feet. The streams in the southwestern portion of this area feed into Smith Creek, a part of the drainage system for the Clifton Forge Reservoir and the Jackson River.
>
> There are many trails along Little Mare Mountain, including the Little Mare Mountain Trail and the Brushy Ridge Trail. In all there are over seventeen miles of trails. Some of these tie into the trail system that has been established at Douthat State Park.
>
> In addition, Little Mare Mountain provides the scenic backdrop for visitors to Hot Springs as well as motorists on US 39.
>
> The western edge of the ridge borders a very large Nature Conservancy reserve.

Availability: There is one TESLR or Forest Service sensitive species that is enhanced by management activity. The Nature Conservancy is working with the State in controlled burning projects outside of the western boundary. There are 141 acres of pine species within the PWA that benefit from natural or prescribed fires. There are existing and planned mountain bike and equestrian trails in the area, and competitive recreation events are held. At 6,557 acres, more than half of the area is suitable for timber production and there have been active management activities in 1993 and 1997. There are about 22 miles of native brook trout stream; at least some is acidified and could benefit from liming. About 33% of the boundary is adjacent to private, and there are known illegal ATV activities occurring in the PWA. There are no roads open to public motorized access into the area.

LITTLE RIVER (30,227 acres)

Capability: This is the largest area in the inventory and possibly the largest block of land to meet potential Wilderness criteria in the east. It has a huge core of about 20,500 acres of semi-primitive ROS class that offers significant opportunities for solitude, remoteness, primitive recreation and physical challenge. This is the largest PWA in the evaluation; and with its proximity to existing Ramseys Draft Wilderness and Ramseys Draft Addition, offers a significant opportunity on the GWNF to provide adjacent Wildernesses that cumulatively are of a substantial size. The area includes a 1,088 Natural Heritage Program Biological Area. About 21% of the boundary is adjacent to private. There is a private inholding with a cabin, but it is near the north boundary of the area and could be excluded. Some of the wilderness attributes of the area identified by public comments include:

> Little River is at the heart of the Shenandoah Mountain National Scenic Area Proposal.
>
> The boundary lines can be drawn to demonstrate the ability of different users to work out a compromise.
>
> The Little River Roadless Area is the largest roadless area in Virginia.

Little River served as a breathtaking backdrop in full autumn glory as President Clinton announced his Roadless Area Initiative from the top of Reddish Knob in October, 1999.

Elevations range from 4440 feet near the summit of Reddish Knob to roughly 1600 feet near Little River.

An eastern deciduous forest covers the entire area. Timber Ridge has deep soils that support stands of very large Red Oaks. There are pine stands on the southwest facing slopes.

Wildflowers are abundant. They include Wood Lilly, Painted Trillium, and Yellow Fringed Orchid.

The remoteness of Little River encourages and supports a healthy black bear population.

The area also provides refuge to a significant number of threatened species. There is an 11,259 Special Biological Area as well as 5857 acres of possible old growth.

An extensive trail network provides opportunities for many types of recreational activities.

Availability: Five TESLR species are found within the area that benefit from human intervention or disturbance. There are over 3,100 acres of private sub-surface mineral rights. A network of popular trails is found within the area that offers outstanding mountain biking opportunities, and competitive special recreation events are authorized within the area. The area is very popular with bear hunters. There are 3.1 miles of road open for motorized public access into the area.

MASSANUTTEN NORTH (16,530 acres)

Capability: This area contains about 11,148 acres of semi-primitive core. Sixty-eight percent of the boundary of this PWA is adjacent to private lands, much of which has been developed with farms, residential areas, cabins, etc. The area is too narrow to allow ecological processes to dominate the landscape. This narrow configuration, along with the level of use the area receives, diminishes the opportunity for solitude. Some of the wilderness attributes of the area identified by public comments include:

The Lee Ranger District lacks any lands with any federal legislative protections. The location of this strip of roadless areas and its popularity present a good opportunity for the Forest Service to acknowledge their importance to recreationalists.

Serves as a scenic backdrop to the slow moving South Fork of the Shenandoah River, Northern Massanutten Mountain stretches south from Front Royal almost fifteen miles to Camp Roosevelt.

Many rock outcrops are visible along crest of mountain.

The area is a recreational paradise. The Massanutten Mountain Trail travels the entire length of the ridge, and there is a shelter at Veach Gap. Numerous side trails climb from the bottom of both the eastern and western flanks to the ridge crest, connecting to the Massanutten Mountain Trail.

The South Fork is a popular canoeing river with several sites to put in and take out.

Availability: There is one TESLR or Forest Service sensitive species that may benefit from active management. There are reserved sub-surface mineral rights in five blocks totaling 1,465 acres. Two of these blocks stretch from boundary to boundary at the center of the area and at the north end of the area. Development of these minerals would result in roads and structures that are not consistent with Wilderness values and character. To exclude them would mean reducing the area by half about half its size. The area contains premiere technical mountain biking trails maintained by volunteers. Competitive recreation events are authorized in this area. There is only 0.1 mile of road open for motorized access into this PWA.

OAK KNOB-HONE QUARRY RIDGE (16,343 acres)

Capability: This large PWA offers a core semi-primitive area of about 8,804 acres. There are excellent opportunities for solitude, remoteness and primitive recreation that is physically challenging. The area is of a size and shape that ecological processes can dominate the landscape. There is an undesirable cherry-stem for the Hone Quarry recreation area. Some of the wilderness attributes of the area identified by public comments include:

Given the proximity of Oak Knob–Hone Quarry Ridge to the Hone Quarry Recreation Area, this large roadless area offers accessible yet remote and primitive recreational opportunities.
Oak Knob is a popular area for many types of outdoor recreation.
Mountain biking, rock climbing and hiking are very popular in the area, with approximately 26 miles of trails inside the boundaries. Family recreation is also abundant here, favorite destinations including Hidden Rocks, Cliff trail, Big Hollow/Hone Quarry Ridge loop, and the waterfall along Slate Springs.
Hunting, for deer, bear, and turkey, is another major recreational draw.
This area must be managed in a way that protects and promotes the valuable recreational resources it offers.
Several streams have sufficient water year round to support a native trout fishery.
The area is forested with mixed eastern hardwoods.
The area is inhabited by the Cow Knob Salamander.

Availability: There have been multiple prescribed fires between 1979 and 1999, encompassing about 35-40% of the area. About 882 acres are suitable for timber management. There are reserved sub-surface mineral rights on 617 acres near the east boundary that could be excluded with boundary adjustments. Some mineral exploration occurred in the 1980’s. There is one TESLR or Forest Service sensitive species that would benefit from active management. Mountain bike trails exist throughout the area, but there no competitive recreation events that occur here. There is a rock climbing area with permanent anchors. Bear hunting is a known dispersed recreation activity in this area. There are 5.7 miles of open or seasonally open roads in the area.

OLIVER MOUNTAIN (13,049 acres)

Capability: This area has a semi-primitive core of about 9,197 acres. The topography is not rugged; it rates fairly low for providing physical and mental challenge. Due to its configuration, the area is marginally capable of allowing natural processes to dominate. Approximately 77% of the boundary is adjacent to private land that, if developed, could diminish opportunities for solitude and a sense of remoteness. Some of the wilderness attributes of the area identified by public comments include:

Oliver Mountain is a wild and remote area. The terrain is steep and rugged.
Oliver Mountain is the dominant feature of this roadless area.
The area is predominately composed of eastern uplands hardwoods. The hardwoods are the dominant species with Pitch Pine, Table Mountain Pine and Virginia Pine located in drier regions.
Much of the roadless area is regaining its natural untrammeled appearance.
Hunting, hiking and backpacking are the primary recreational activities.
The Oliver Mountain Trail passes through the roadless area, and beautiful stands of old growth forest.
Lake Moomaw forms the northern boundary. There are several miles of trail located near Lake Moomaw.
The Virginia Division of Natural Heritage has identified two special biological areas with populations of rare plants. Boundaries can be adjusted so that the shale barren and the illegal Hughes Draft Road are removed, and to accommodate mountain bike use.

Availability: There are four TESLR or Forest Service sensitive species within the area that would benefit from management activity, particular shale barren species. There are 1,735 acres of pine species that would benefit from natural or prescribed fires. A road used by four-wheel-drive enthusiasts runs along Hughes Draft. There are multiple trails in the area used by mountain bikes, although some are not system trails and use of those is not authorized. There are no competitive recreation events that occur here. There are 2.4 miles of road that provide motorized public access into the area.

PADDY KNOB (5,987 acres)

Capability: This area has a small core of 3,284 acres of semi-primitive land; however the area is rugged, deeply incised and can offer physical challenge. The area is small for allowing ecological processes to dominate. About 50% of the boundary is adjacent to private and there is known illegal ATV use in the area that is not consistent with Wilderness values. Some of the wilderness attributes of the area identified by public comments include:

Paddy Knob is a good candidate for Wilderness recommendation given its position along the eastern flank of Allegheny Mountain.
It is a steep and rugged mountainside capable of offering a primitive experience.
The location of Paddy Knob is remote and the area is thinly populated.
The habitat is unusual for Virginia and deserves protection.

Availability: The area has been actively managed to provide outstanding habitat for the Mourning warbler that requires a fire cycle. The very hot prescribed fire of the late 1990's also released a large component of American chestnut. The area has been actively managed for timber, with 2,149 acres currently being suitable for timber production. There are no privately owned subsurface mineral rights. The area is not popular with mountain bicyclists and there are no authorized competitive recreation events that would be displaced. There are 1.7 miles of road open for motorized public access into the area.

POTTS MOUNTAIN (7,863 acres)

Capability: This area has a core of about 4,491 acres of semi-primitive land. The PWA is situated on the side of a mountain, but it is not particularly rugged to offer physical and mental challenge. The northern part of the PWA is very oddly shaped around private lands with residences that jut into the north boundary. About 32% of the total boundary is adjacent to private land. Some of the wilderness attributes of the area identified by public comments include:

Potts Mountain in combination with Barbour's Creek Wilderness, though separated by Potts Jeep Road-and Shawvers Run Wilderness-separated by FSR 176, would create a desirably large Wilderness complex.
Rocky outcropping reliably lend excitement and challenge to mountain tops.
A series of rock outcrops on the crest of Potts Mountain provide beautiful views of the Potts Creek Valley and Peters Mountain to the west.
The steep, rugged eastern flank of the ridge forms the headwaters for Barbours Creek.
There are several short trails in the Shanty Hollow area. These are the only trails in the entire area.
There is a small Special Biological Area located on the crest of the ridge.

Availability: Over half of the area, 4,143 acres, is suitable for timber production although there have not been any activities in the area since prior to 1993. There are about 190 acres of pine species that would benefit from prescribed burning. There are 91 acres of land with private subsurface mineral rights at the southern boundary. While that is not many acres, excluding them would nearly divide the PWA in half. A very popular jeep road exists along the south boundary between Potts Mountain and existing Barbours Creek Wilderness. Mountain bicycling use is low if it occurs at all, and there are no authorized competitive recreation events that would be displaced by Wilderness designation. There are no roads open to the public that offer motorized access into the PWA.

RAMSEYS DRAFT ADDITION (19,072 acres)

Capability: This PWA offers the largest potential addition to an existing Wilderness. It would greatly enhance opportunities for solitude, primitive recreation, and physical and mental challenge. It also would create a Wilderness large enough for natural processes to dominate. It contains the headwaters for the James and Potomac Rivers. Because it is adjacent to existing Wilderness, only about 19% of the boundary is adjacent to private land. Unfortunately there is some known ATV use that occurs. It meets the GWNF goal of establishing a large block of Wilderness in the east that can enhance the National Wilderness Preservation System. Some of the wilderness attributes of the area identified by public comments include:

Ramseys Draft Wilderness addition, when added to the existing Ramseys Draft Wilderness, would create a wilderness of nearly 20,000 acres. This would be by far the largest wilderness in Virginia.

The elevation range of this area stretches from approximately 2200 feet to 4200 feet on Hardscrabble Knob. The topography is steep with short, choppy drainages throughout the lower elevations. Slopes vary in steepness, some with grades exceeding eighty percent.

Dividing Ridge forms the boundary between two major watersheds. North of the ridge are the headwaters of the Potomac River Basin. South of the ridge are the headwaters of the James River Basin.

The most notable feature in both the existing Ramseys Draft Wilderness and the proposed addition are the large trees. The steep slopes, combined with the vegetation make the area very picturesque. This forest also provides excellent black bear habitat due to lack of human disturbance.

The Virginia Natural Heritage Division has recommended Big Bald Knob as a Special Interest Area and has identified four species of concern, including paper birch and the Cow Knob salamander.

Availability: The eastern portion of the PWA has 4,753 acres of land suitable for timber production. Timber and some wildlife habitat projects have occurred in the past. The North River Road is within the floodplain and should be relocated which would put it inside the northern boundary of this PWA. The west side of this PWA is almost entirely underlain by privately owned minerals (5,784 acres) that if developed would be a detriment to the Wilderness resource. There are no TESLR species that would benefit from management activities including prescribed burning. The southern portion of the area contains popular mountain biking trails and there are authorized competitive recreation events that occur. There is about 1.0 mile of open road that provides motorized public access into this area.

Augusta County Board of Supervisors passed a resolution opposing any additional designation of Wilderness in Augusta County.

RICH HOLE ADDITION (12,165 acres)

Capability: In line with the GWNF's goal of expanding the size of existing Wildernesses to improve their Wilderness qualities, this area offers the opportunity to expand the acreage of a small Wilderness. Furthermore, it will almost connect the Rich Hole and Rough Mountain Wildernesses, generally increasing the area of designated Wilderness in that vicinity. There were public comments that the existing Rich Hole is not a quality Wilderness due to its immediate proximity to Interstate 64, U.S. 11, S.R. 42 and an active railroad line, but this addition could improve the ability for visitors to find solitude. There are nine miles of native brook trout streams that are not acidified and do not require liming. About 36% of the PWA boundary is adjacent to private land (moderate compared to other PWAs in this evaluation), and there is known illegal ATV use. Some of the wilderness attributes of the area identified by public comments include:

Due to its location adjacent to the Rich Hole Wilderness, Wilderness designation of this roadless area would create a Wilderness of over 17,000 acres. This would be larger than any present Wilderness on the George Washington National Forest.

Due to the rugged nature of the area, there is only one, little utilized trail in the area. The White Rocks Tower Trail parallels the Rich Hole Wilderness boundary to the crest of Mill Mountain and then follows the ridge to FDR 333.

Hunting is the primary recreational activity of the area.

Mill Mountain's rugged terrain and remote location help to foster a healthy bear population.

Availability: About one-quarter of the area has been suitable for timber production (3,152 acres). The northern section along Forest Service Road 129 has been actively managed with timber production and prescribed burning. There are about 944 acres of pine species that benefit from natural or prescribed fire. There is little or no mountain bicycling use in this area and no authorized competitive recreation events that would be displaced. There are 4.5 miles of open road that provides motorized public access into the area. Forest Service Road 129 is a popular forest access route for hunters and anglers.

RICH PATCH (5,625 acres)

Capability: This PWA provides a semi-primitive core of 4,008 acres. This extremely narrow sliver of land, in and of itself, is not capable of providing for ecological or recreational Wilderness qualities. The majority of the PWA is on the Jefferson National Forest. Some of the wilderness attributes of the area identified by public comments include:

> Rich Patch is a very special spot and a good area for continued protection.

Availability: There have been no timber management activities since prior to 1993. One TESLR or Forest Service sensitive species exists in the area that might benefit from management activity. There are 316 acres of pine species that would benefit from natural or prescribed fire. There are many trails used by mountain bicyclists including a National Recreation Trail, but there are no authorized competitive recreation events that occur. There are no privately owned subsurface mineral rights. There is only 0.3 mile of open road that provides motorized public access into the area.

ROUGH MOUNTAIN ADDITION (2,063 acres)

Capability: Similar to Rich Hole above, this area would enhance the Wilderness character and values of the existing, relatively small Rough Mountain Wilderness. It adds about 752 acres of semi-primitive ROS class. It provides a portion of an eligible National Recreational River. Some of the wilderness attributes of the area identified by public comments include:

> Rough Mountain addition is a sensible way to increase the size of the Wilderness Preservation System on the GW.
> Capability and availability issues are negated by the congressional designation of Rough Mountain Wilderness.
> This Wilderness addition includes the remainder of Rough Mountain that was not included in the Virginia Wilderness bill of 1988.
> Designating the addition as Wilderness would protect the upper drainage of Big Hollow.

Availability: About 1,133 acres of this PWA have been suitable for timber production in the 1993 GWNF Plan, but no timber management activities have occurred during that time. There are shale barrens on the north end and 382 acres of pine species that would benefit from natural or prescribed fire. There is one TES or Forest Service sensitive species that could benefit from management activity. There is little or no mountain bicycling use, and there are no authorized competitive recreation events that would be displaced. There is no open road to provide motorized public access into the area.

SAINT MARY’S ADDITION NORTH (3,006 acres)

Capability: This addition would increase the size of the existing Saint Mary’s Wilderness. It has a semi-primitive core of almost 1,986 acres. The area is located on a north-facing mountainside with rugged terrain and two very deep and winding drainages providing opportunities for solitude, physical challenge and remoteness. Only about 6% of the boundary is adjacent to private land. Unfortunately, there is known illegal OHV use in the area. Some of the wilderness attributes of the area identified by public comments include:

> Includes the extremely inaccessible Russell Rocks, a unique geological feature of large jagged boulders.
> Russell Rocks are drained by Loves Creek and Stoney Run.
> There is also a 2,910 acre Forest Plan designated Special Biological Area.

Availability: There are three TES or Forest Service sensitive species that could benefit from active management. There are about 310 acres of pine species that would benefit from natural or prescribed fire. About 630 acres, or 21%, of the area has private subsurface mineral rights. There is no or little mountain bicycling use in the area and there are no authorized competitive recreation events that would be displaced by

Wilderness designation. The area is bordered on the east side by a popular Forest Service road and on the west and north by VA 42. A Forest Service road runs along most of the southern border of the area, but there are no roads that provide motorized access into the PWA.

SAINT MARY'S ADDITION, SOUTH (1,651 acres)

Capability: This small addition provides 889 acres of semi-primitive core. It contains rugged topography with multiple ridges and deeply incised drainages that can offer opportunities for solitude, especially when combined with the existing Saint Mary's Wilderness. However, about 56% of the boundary is adjacent to private that, if developed, would be a detriment to this area as a Wilderness resource. There is known illegal ATV use in this PWA. Remnants of a mine exist in the area and have not yet been restored. Some of the wilderness attributes of the area identified by public comments include:

> The area is known for its steep V drainages and numerous scree slopes especially in Dogwood Hollow.
>
> There is evidence of past human activities including an old homestead site and sites of past mining activities from the early 1900s. One old mine fissure has become a bat hibernaculum.

Availability: There are three TES and Forest Service sensitive species that could benefit from management activity. There are 227 acres of pine species that would benefit from natural or prescribed fire. There are 333 acres of private subsurface mineral rights in two large blocks occupying much of the northern portion of the PWA. There is no or little mountain bicycling use in the area and there are no authorized competitive recreation events that would be displaced by Wilderness designation. There is only 0.1 mile of open road providing public motorized access into the area.

SAINT MARY'S ADDITION, WEST (278 acres)

Capability: This addition provides no additional acres of semi-primitive; however it was acquired by the Forest Service for the express purpose of providing an addition to the existing Wilderness. Some of the wilderness attributes of the area identified by public comments include:

> The dominant geological feature of the area is Cellar Hollow and the small stream that drains the steep and rugged Cellar Mountain.
>
> While the area is small the forest is not. Cellar Hollow provides a wonderful refuge for cove hardwoods like tulip poplar and hemlock. Some of these trees are very large.

Availability: There are existing wildlife improvements and one TES or Forest Service species that may benefit from active management. There is no or little mountain bicycling use in the area and there are no authorized competitive recreation events that would be displaced by Wilderness designation. There are no privately owned subsurface mineral rights. There are no roads that provide motorized access into the PWA.

SHAWS RIDGE (7,268 acres)

Capability: This area has a core area of about 3,954 acres of semi-primitive land. The area is desirable for expanding the block of Wilderness with Ramseys Draft and its potential addition. The area is situated on a mountainside, but is not very rugged or deeply incised to offer outstanding opportunities for solitude and physical challenge. This PWA has a substantial amount of boundary adjacent to private land (87%) and a private inholding near the center of the area. If these private lands are developed, that could be detrimental to managing the area as an enduring resource of Wilderness. There is known illegal ATV use in the area. Some of the wilderness attributes of the area identified by public comments include:

> Shaws Ridge lies on the western flank of Shenandoah Mountain, immediately west of the Ramseys Draft Wilderness Addition.
>
> Headwaters Shale Barren, a Special Biological Area, is at the southeast end.
>
> The rare fishes Potomac Sculpin and Roughhead Shiner are known to occur downstream.

> Shaws Ridge Trail runs 6.3 miles along the ridgeline from FDR 501, dropping down to the Forest boundary along County Route 616 at the town of Headwaters.
> Shaws Ridge provides beautiful scenery for travelers on US 250.

Availability: There is one TESLR or Forest Service sensitive species and 396 acres of pine species that would be enhanced by natural or prescribed fire (shale barren species). There are 1.3 miles of road used for public access. There are 396 acres of pine species that would benefit from fire. There is no or little mountain bicycling use in the area and there are no authorized competitive recreation events that would be displaced by Wilderness designation. There are 4 acres of privately owned subsurface mineral rights. There are 1.3 miles of roads that provide motorized access into the PWA.

SHAWVERS RUN ADDITION (84 acres)

Capability: This area consists of 84 acres of Roaded Natural ROS and does not offer any semi-primitive core. If designated, it would add a length of road to the boundary. It would also add additional boundary that is adjacent to private land (about 32% of this addition is adjacent to private). However, there is no known illegal ATV use in this area.

Availability: The entire area has been suitable for timber production in the 1993 GWNF Plan. However, no timber management activities have occurred. There have been no wildlife management actions either. There is no or little mountain bicycling use in the area and there are no authorized competitive recreation events. There are no privately owned subsurface mineral rights. There are no roads that provide motorized access into the PWA.

THREE RIDGES ADDITIONS, ALL (369 acres)

Capability: Three Ridges South offers 56 acres and Three Ridges North offers 3 acres of semi-primitive area. The other two Additions offer no semi-primitive ROS setting. Three Ridges Southwest Addition contains a suspension bridge on the Appalachian Trail that is not compatible with the Wilderness resource. Three Ridges South and Three Ridges West additions do not appreciable bolster the size of the existing wilderness but would increase the border with private property. Three Ridges South has 51% boundary adjacent to private and Three Ridges West has 65% boundary adjacent to private. Three Ridges South has known illegal OHV use. Some of the wilderness attributes of the area identified by public comments include:

> It seems sensible to make additions to existing Wilderness areas whenever possible, especially when there is no reason not to do so.

Availability: The Three Ridges North Addition was acquired by the National Park Service for the Appalachian Trail corridor. Through a memorandum of understanding involving multiple tracts, the Forest Service agrees to manage these lands for the Appalachian Trail, assigning them to Management Prescription Area 4A-Appalachian Trail Corridor. There are no significant concerns for other resources or incompatible recreation opportunities.

THREE SISTERS (9,871 acres)

Capability: The area offers a semi-primitive core of about 6,224 acres. There is rugged terrain and multiple drainages to offer remote, primitive recreation opportunities. The presence of the popular Appalachian National Scenic Trail may result in unacceptably high encounters with other users, challenging one's ability to find solitude. An overnight trail shelter is also associated with the AT within this PWA; structures are inconsistent with managing an area as a Wilderness resource. The area is arguably large enough to allow natural processes to dominate. Some of the wilderness attributes of the area identified by public comments include:

Three Sisters forms the northern slope of the James River Gorge, where the James River cuts through the Blue Ridge and debouches into the Virginia Piedmont.
Bennetts Run supports a small population of native trout.
Rocky Row Ridge is the most prominent geological feature. The ridge is a rocky outcropping providing outstanding view of the James River and the James River Face Wilderness.
The position of the mountains in this area provides an ideal destination for those seeking solitude and a primitive experience.
There are several trails that climb the ridge to the crest.
The Appalachian Trail passes through.
Boundaries can be drawn to leave out the Appalachian Trail. Maintenance activities on the AT would not be impacted nor would any access roads be closed.

Availability: Wildlife management activities have occurred in the area in recent years, and 879 acres are suitable for timber production. There are 387 acres of pine species that could benefit from natural or prescribed fire. Streams within the area are acidified, and there are 10 miles of native brook trout stream present. These streams may benefit from future liming. There has been a significant investment in mine reclamation just outside of the eastern boundary. Additional work may be needed there. There are 491 acres of sub-surface mineral rights. This is in one block on the northwest boundary and could be excluded. There is little or no mountain biking use in this area. There are authorized competitive recreation events that would be displaced by Wilderness designation. There are 1.3 miles of road that currently provides motorized public access.

The Appalachian Trail is maintained by volunteers who use chainsaws. The local maintaining trail club does not support designation.

B. Evaluation of Need for Additional Wilderness on the GWNF

The concept of Wilderness is multifaceted as envisioned by the authors and framers of the 1964 Wilderness Act. As such there are a number of factors to consider in assessing the need for additional Wilderness including evaluating use trends and current visitation pressures on existing wilderness; the location, size and type of other Wildernesses in the general vicinity; the need to provide a refuge for species that have demonstrated an inability to survive in less than primitive surroundings (included in Capability evaluation); and ecosystems that are not represented or are under-represented in the National Wilderness Preservation System. Agency direction in assessing need is that it is most informative and meaningful when performed at a forest scale or regional scale.

The Eastern Wilderness Areas Act (1975) pointed out that "in the more populous eastern half of the United States there is an urgent need to identify, study, designate, and preserve areas for addition to the National Wilderness Preservation System". That Act established 15 additional areas as Wilderness and states further that "Congress finds and declares that . . . these ***and similar areas*** in the eastern half of the United States be promptly designated Wilderness..." (emphasis added). The need for such designation, as provided in this Act, is to preserve such areas as an enduring resource of Wilderness, which shall be managed to promote and perpetuate the Wilderness character of the land and its specific values of:

solitude,
physical and mental challenge,
scientific study,
inspiration, and
primitive recreation

for the benefit of all the American people of present and future generations. The GWNF did not have any Wildernesses designated in that 1975 Eastern Wilderness Areas Act. The JNF had one area designated at that time, the James River Face Wilderness. Since then, 22 more Wildernesses have been designated on the GWNF and JNF.

The following assumptions and observations are made in this assessment of need:

1. No target or formula has been provided for determining the appropriate distribution of Wilderness that is needed or should be provided in our region.
2. Some demand for primitive recreation opportunities can be met on non-Wilderness back-country lands. However, research data indicate that the public finds the permanence of Congressional Wilderness designation to be very important.
3. The ability to provide outstanding opportunities for solitude, inspiration and primitive recreation is to a great extent dependent on the size and shape of the Wilderness. A relatively large area of land with relatively little to no private interface is better suited to providing this type of experience than irregularly shaped, small areas that are adjacent to private land.
4. The demands for various uses of public lands are constantly increasing. National Forest System lands once referred to as "the lands nobody wanted" now seem to be the lands everybody wants. As this occurs, the lands meeting the criteria for PWAs may decrease.

For a look at the distribution of roadless areas and Wildernesses in the southeast United States, see the Southern Appalachian Assessment, Chapter 5 (SAMAB, 1996) at http://sunsite.utk.edu/samab/saa/reports/social/chapter5.pdf. This document discusses the location, size and type of other Wilderness and roadless areas, existing recreation use of Wilderness, and the occurrences of ecosystem subsections in Wilderness in the local and regional area. See also discussion of Wilderness at http://www.Wilderness.net/.

Table C-7 provides information about the existing Wildernesses and their distribution by County in Virginia. None of the GWNF Wildernesses are in West Virginia. The table does not include the small portions of Barbours Creek and Shawvers Run Wildernesses that occur in the GWNF but are primarily located in the Jefferson National Forest.

Table C-7. Existing Congressionally-Designated Wildernesses on the GWNF

Wilderness	Ranger District	Total Acres	County	Acres by County	Year Designated
Priest	Glenwood Pedlar	5,963	Nelson	5,963	2000
Ramseys Draft	North River	6,518	Augusta	6,518	1984
Rich Hole	James River	6,450	Rockbridge	3,200	1988
			Alleghany	3,250	
Rough Mountain	Warm Springs	9,300	Bath	9,096	1988
			Alleghany	204	
Saint Mary's	Glenwood Pedlar	9,835	Augusta	9,835	1984
Three Ridges	Glenwood Pedlar	4,608	Nelson	4,590	2000
			Augusta	18	
Totals	4 Ranger Districts	42,674	5 Counties	42,674	

The GWNF is not the only provider of Wilderness in the vicinity. The Shenandoah National Park is in closer proximity to the large urban population of Washington, D.C., and northern Virginia. It is also a short distance from populations west in the Shenandoah Valley. The Shenandoah National Park offers 79,579 acres of designated Wilderness, or approximately 40.4% of the 197,000 acres in its ownership.

Just to the west of the GWNF is the Monongahela National Forest (MNF) in West Virginia, the northern portion of which is within a few hours' drive or less of the Washington DC metropolitan area and the Shenandoah Valley. The southern end is within a few hours' drive or less of most of the George Washington National Forest and the population that resides within and adjacent to it. The MNF offers 115,779 acres of designated Wilderness. Just to the south of the GWNF is the Jefferson National Forest in Virginia, West Virginia and Kentucky. It offers 17 Wildernesses totaling 96,787 acres.

In an effort to determine if demand for Wilderness-based recreation is increasing, the results of the last two National Visitor Use Monitoring Results (NVUM) for George Washington and Jefferson National Forests are used (USDA Forest Service, Region 8, data collected fiscal years 2000 and 2006, published August 2001 and July 2007 respectively). In 2000, 34 days were sampled in Wilderness, and in 2006, 37 days were sampled.

Based on the statistical data, the Wilderness visits in 2000 were estimated to be 69,406, and the Wilderness visits in 2006 were estimated to be 61,200, a decrease of 10.38% over six years.

Both years' reports include a survey of perceived crowding in Wilderness. Table C-8 shows the results of that portion of the surveys. Seemingly in contrast to the decreased visitation reported, visitors in 2006 perceived Wilderness to be more crowded than did the visitors to Wilderness in 2000, although not overwhelmingly.

Table C-8. Perceived Crowding in Wilderness from NVUM Reports

Crowding Rating	2000 % of site visits	2006 % of site visits
10 Overcrowded	0	0.0
9	3	6.2
8	0	0.3
7	13	12.1
6	10	19.5
5	15	24.8
4	12	6.5
3	6	0.3
2	26	30.0
1 Hardly anyone there	15	0.3

The NVUM provides a list of visitors' home zip codes. In the 2000 survey, there were a total of seven home zip codes provided by visitors; in 2006, there were a total of 89 and one foreign country, indicating that visitors are coming from a broader and more diverse area than previously.

Another source of information about demand for Wilderness recreation opportunities is the July 2002 report by Ken Cordell titled "A Survey of Residents of the Greater Southern Appalachian Region to Describe: Public Use and Preferred Objectives for Southern Appalachian National Forests, Public Survey Report, George Washington and Jefferson National Forests", commonly referred to as the Public Survey Report (Web Series: SRS-4901-2002-5). This report provides the findings of a telephone survey of residents of counties located within 75 miles of each of the 13 southern Appalachian national forests. A minimum of 400 telephone interviews were conducted for each of these national forests. The report indicates that 41% of local residents 16 and older who responded that they had visited the GWNF in the prior 12 months had visited a Wilderness area. Over 64% of local respondents 16 years of age or older indicated that designating additional acres of Wilderness was important to them, and over 42% indicated that it was extremely important to them. Since the completion of the 2006 NVUM and the 2002 Public Survey Reports cited above, six new Wildernesses and six additions to existing Wildernesses were congressionally-designated designated on the Jefferson National Forest totaling 40,340 acres. Three new Wildernesses were added and three were expanded on the Monongahela National Forest as well.

With 24 Wildernesses, Virginia ranks 1st of the states east of the Mississippi with the most Wilderness units, and 10th nationally. While Virginia is ranked 35th nationally for total area (U.S. Census), it ranks 17th nationally for total acres of designated Wilderness. Virginia also ranks 17th for percent of the state's total land area that is designated Wilderness (www.Wilderness.net).

Wilderness is valued for, among other reasons, preserving representative natural ecosystems. In terms of ecological classification, all of the PWAs are within the Central Appalachian Broadleaf-Coniferous Forest Meadow Province. Within this province, the GWNF contains portions of the Northern Blue Ridge, Ridge and Valley and the Appalachian Plateau physiographic regions. All of these physiographic regions are well represented with existing Wilderness. Wilderness in the Northern Blue Ridge include Saint Mary's, Priest, Three Ridges and Shenandoah Wilderness. Wilderness in the Ridge and Valley include Ramseys Draft, Rough Mountain and Rich Hole. And the Monongahela NF's Wildernesses are found in both the Appalachian Plateau as well as the Alleghany Highlands.

At the regional and the local scales, there are no known visitor use pressures on existing Wilderness on the GWNF that would potentially be alleviated by additional Wilderness designation near population centers. In fact, per the NVUM surveys data cited above, use of Wilderness appears to have decreased between 2001 and 2006. Saint Mary's Wilderness receives the highest use on the George Washington NF, while Ramseys Draft receives moderate use. The other four Wildernesses receive low use (SAA Chapter 5 at page 193, 1996). Saint Mary's has always been popular and receives repeat visitation by people familiar with this Wilderness. Sixteen years after Saint Mary's designation, two Wildernesses, Priest and Three Ridges, were designated near to and in the same physiographic region as Saint Mary's, yet there was no apparent decline of visitation in Saint Mary's. Other management actions will be required if the pressures of use in Saint Mary's result in unacceptable numbers of encounters with other visitors or unacceptable impacts to resources. Designating new Wilderness will not solve those issues.

The primary benefit that could be achieved through additional designation of Wilderness on the GWNF would be to expand the size of one or more existing Wilderness to provide better opportunities for solitude, remoteness, challenge, and the ability of natural processes to dominate. This expansion could include designating adjacent areas as well. Though not as effective as contiguous blocks, adjacent Wilderness separated by a narrow road corridor could be effective in meeting this goal.

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TABLE C-9. Potential Wilderness Evaluations - Capability

APPENDIX C1: TABLE C-9 CAPABILITY		ADAMS PEAK	ARCHER KNOB	BEARDS MOUNTAIN	BEECH LICK KNOB	BIG SCHLOSS	CRAWFORD KNOB
RANGER DISTRICT		Pedlar	North River	James River, Warm Spgs	North River	Lee	North River
SIZE OF PWA OR ADDITION (ACRES)		8,226	7,110	10,152	14,087	28,347	14,851
CATEGORIES FOR ASSESSING CAPABILITY	BASIC NATURAL CAPABILITY ELEMENTS, VALUES OR FEATURES	Comments	Comments	Comments	Comments	Comments	Comments
NATURE DOMINATES; SUBSTANTIALLY FREE OF IMPROVEMENTS AND HUMAN HABITATION	Acidified streams (non-limestone streams)	No	No	No	No	History of liming 1 mile of Stony Creek on south end of PWA.	No
	Presence of structural improvements	Nature Camp	No	No	2 communication sites near NNW bdy	Mill Mountain Trail shelter, bridges, walkway	No
	Private inholdings	No	No	No	No	Tract near eastern boundary contains a subdivision; could be excluded with a boundary adjustment.	1 on ridgetop; SE quadrant-not very near bdy; possible to excl but big chunk.
	Subdivisions adjacent to PWA boundary	Yes	No	Yes	No	Subdivisions exist to the east and west of the southern half of the PWA.	No
	Est. percent of boundary beside pvt lands	68%	22%	70%	51%	35%	58%
	Other evidence of human habitation or use	No	No	Adjacent to SP with high density trail system	No	PATC cabin at Sugar Knob under permit; in the interior of the southern "mass" of the PWA.	No

APPENDIX C1: TABLE C-9 CAPABILITY		ADAMS PEAK	ARCHER KNOB	BEARDS MOUNTAIN	BEECH LICK KNOB	BIG SCHLOSS	CRAWFORD KNOB
RANGER DISTRICT		Pedlar	North River	James River, Warm Spgs	North River	Lee	North River
SIZE OF PWA OR ADDITION (ACRES)		8,226	7,110	10,152	14,087	28,347	14,851
OPPORTUNITIES FOR SOLITUDE AND PRIMITIVE, UNCONFINED RECREATION	Opportunities for primitive recreation, solitude, physical and mental challenge, inspiration	4,400 ac SP in central W; none on N & S; int opps but relatively small	Relatively small core of 4,440 ac SP, but is in mass with int views in steep drains.	Not very good. About 7,000 ac of SP, but narrow and along mountainside with mult ext views to pvt - cabins, farms, camps; poor configuration.	9,500 ac SP in mass; good opps for isolation and primitive rec; many knobs around perimeter help block views to private lands and potential future development	Almost 20,000 ac of SP; large areas of interior with no views to private can offer good primitive rec opps; however dense system of heavily used trails that offer circuits/loops makes it unlikely to achieve solitude/isolation.	11,830 ac SP in mass; opps for isolation from external sights/sounds, but mult trails may prevent solitude
	Other pros or cons to opps for primitive rec and solitude	No	No	No	No	Close to DC and Northern Va	No
ABILITY TO PROVIDE SPECIAL FEATURES OR VALUES	National or regional heritage/historic values	No	No	No	No	No	No
	Presence of TESLR species, FS sensitive species or species found only here that DO NOT need active management	No	No	Roughhead shiner	No	NE bulrush; 767 acre SBA on the eastern bdy of PWA; 979 ac. Nat. Heritage Program Biological Area	Cow Knob Salamander
	Presence of old growth stands (FS data; see also Va Mtn Treasures comments below)	No	No	No	Yes, per SELC report	No	No
	Presence of special area (NRT, RNA, etc)	No	No	Rec River	No	Scenic River	No
	Presence of special geologic area	No	No	No	No	Big Schloss geologic area	No
	Native brook trout	5 mi.	1 mi.	2 mi.	13 mi.	12 mi.	3 mi.

APPENDIX C1: TABLE C-9 CAPABILITY		ADAMS PEAK	ARCHER KNOB	BEARDS MOUNTAIN	BEECH LICK KNOB	BIG SCHLOSS	CRAWFORD KNOB
RANGER DISTRICT		Pedlar	North River	James River, Warm Spgs	North River	Lee	North River
SIZE OF PWA OR ADDITION (ACRES)		8,226	7,110	10,152	14,087	28,347	14,851
	stream(s), miles						
	Area contains veg unique to VA, ie, "northern" species such as balsam fir	Paper birch	No	No	No	Norway Spruce - planted	No
	Elev over 4,000 feet, acres	No	No	No	No	No	No
	Other special feature or value	No	No	No	No	No	Headwater for James & Potomac
MANAGEABILITY	Adjacent to long-term disturbance	No	No	No	No	No	No
	Known illegal OHV or ATV use	ATV	No	ATV	ATV	ATV	Yes
	Other challenges related to manageability	No	No	NO	No	No	No

APPENDIX C1: TABLE C-9 CAPABILITY		DOLLY ANN	DUNCAN KNOB	ELLIOTT KNOB	GALFORD GAP	GUM RUN	HIGH KNOB
RANGER DISTRICT		James River	Lee	North River	Warm Springs	North River	North River
SIZE OF PWA OR ADDITION (ACRES)		9,524	5,973	11,070	6,689	14,547	18,447
CATEGORIES FOR ASSESSING CAPABILITY	BASIC NATURAL CAPABILITY ELEMENTS, VALUES OR FEATURES	Comments	Comments	Comments	Comments	Comments	Comments
NATURE DOMINATES; SUBSTANTIALLY FREE OF IMPROVEMENTS AND HUMAN HABITATION	Acidified streams (non-limestone streams)	Yes	Yes	Yes	No	Yes	No
	Presence of structural improvements	No	Trail bridge	Comm Towers	Oil & gas well casing	Old VDGIF building exists on eastern bdy - can be excluded (or removed?)	Foundation, steps
	Private inholdings	No	No	Possible on SE bdy-need to verify.	No	1 small inholding near south boundary contains a cabin; can be excluded.	No
	Subdivisions adjacent to PWA boundary	Yes	Yes	No	No	Several along the east boundary	Yes
	Est. percent of boundary beside pvt lands	54%	44%	9%	66%	50% (includes City of Harrisonburg reservoir)	28%
	Other evidence of human habitation or use	Mine shafts being closed	No	Outside SE boundary - communication site with 2 towers.	No	No	No

APPENDIX C1: TABLE C-9 CAPABILITY		DOLLY ANN	DUNCAN KNOB	ELLIOTT KNOB	GALFORD GAP	GUM RUN	HIGH KNOB
RANGER DISTRICT		James River	Lee	North River	Warm Springs	North River	North River
SIZE OF PWA OR ADDITION (ACRES)		9,524	5,973	11,070	6,689	14,547	18,447
OPPORTUNITIES FOR SOLITUDE AND PRIMITIVE, UNCONFINED RECREATION	Opportunities for primitive recreation, solitude, physical and mental challenge, inspiration	5,850 ac SP, most in south mass, but mostly mountaintop with exterior views	Small core of 3,232 ac SP on mountain top; mostly ext views.	7,100 ac SP in mass; opps for isolation and challenge; very rugged; North Mtn Trail is popular.	About 4,919 ac of SP north and central w/ RN around S perimeter; PWA narrow and along mountainside with high elev views to ext pvt land; core area offers isolation - no system trails so few encounters.	10,797 ac SP in mass with SP buffer on one side and City of H'burg reservoir on other; good opps for isolation;	11,760 ac SP; S fair mass; NW oddly shaped; rugged; 2 int trails; 1 bdy trail - may hinder solitude.
	Other pros or cons to opps for primitive rec and solitude	No	No	No	No	No	No
ABILITY TO PROVIDE SPECIAL FEATURES OR VALUES	National or regional heritage/historic values	Old iron mining area	No	Parkersburg Pike	No	Remnants of stone cabin/camp, possibly from Civil War; on boundary along FDR 225B	High Knob Tower
	Presence of TESLR species, FS sensitive species or species found only here that DO NOT need active management	No	No	Cow knob salamander; 1,470 acre Natural Heritage Program Biological Area	No	Cow Knob Salamander; 4,331 acre SBA	Cow Knob Salamander; 7,597 acre SBA
	Presence of old growth stands (FS data; see also Va Mtn Treasures comments below)	No	No	No	No	No	Yes, In center of PWA along a trail
	Presence of special area (NRT, RNA, etc)	No	Yes-NRT	No	No	No	No

APPENDIX C1: TABLE C-9 CAPABILITY		DOLLY ANN	DUNCAN KNOB	ELLIOTT KNOB	GALFORD GAP	GUM RUN	HIGH KNOB
RANGER DISTRICT		James River	Lee	North River	Warm Springs	North River	North River
SIZE OF PWA OR ADDITION (ACRES)		9,524	5,973	11,070	6,689	14,547	18,447
	Presence of special geologic area	No	No	No	No	No	No
	Native brook trout stream(s), miles	11 mi	No	1 mi.	No	24 mi.	7 mi.
	Area contains veg unique to VA, ie, "northern" species such as balsam fir	Planted Norway spruce	No	Planted Norway spruces, larch	Maybe along MNF border	Red pine	Planted Balsam fir
	Elev over 4,000 feet, acres	53 ac	No	359 ac.	573 ac.	24 acres	404 acres
	Other special feature or value	No	No	Headwater for James & Potomac	No	No	No
MANAGEABILITY	Adjacent to long-term disturbance	Papermill odors	No	No	No	No	No
	Known illegal OHV or ATV use	ATV	Yes	No	ATV	ATV and OHV, coming in at NE on FDR 304; also at SE bdy with Oak Knob-Hone Quarry	ATV
	Other challenges related to manageability	No	No	Squatters live along SR 39	No	No	No

APPENDIX C1: TABLE C-9 CAPABILITY		JERKEMTIGHT	KELLEY MOUNTAIN	LAUREL FORK	LITTLE ALLEGHANY	LITTLE MARE MOUNTAIN	LITTLE RIVER
RANGER DISTRICT		North River	Pedlar	Warm Springs	Warm Springs	Warm Springs	North River
SIZE OF PWA OR ADDITION (ACRES)		27,314	12,892	10,236	15,395	11,918	30,227
CATEGORIES FOR ASSESSING CAPABILITY	BASIC NATURAL CAPABILITY ELEMENTS, VALUES OR FEATURES	Comments	Comments	Comments	Comments	Comments	Comments
NATURE DOMINATES; SUBSTANTIALLY FREE OF IMPROVEMENTS AND HUMAN HABITATION	Acidified streams (non-limestone streams)	No	Yes	Yes	No	Yes	Yes
	Presence of structural improvements	No	Mt. Torry Furnace, CCC Camp 8, bldgs	Dev rec site	Weir on NE boundary; can be excluded.	FAA site, RD weather station, stone bldg, dam	North River
	Private inholdings	No	No	No	No	No	Long narrow tract at N end has a cabin; can be excluded.
	Subdivisions adjacent to PWA boundary	No	Yes	No	No	Yes	No
	Est. percent of boundary beside pvt lands	21%	21%	77%	75%	33%	21%
	Other evidence of human habitation or use	No	Coles Run municipal water source - dam, reservoir and pipeline near north boundary	No	No	No	No

APPENDIX C1: TABLE C-9 CAPABILITY		JERKEMTIGHT	KELLEY MOUNTAIN	LAUREL FORK	LITTLE ALLEGHANY	LITTLE MARE MOUNTAIN	LITTLE RIVER
RANGER DISTRICT		North River	Pedlar	Warm Springs	Warm Springs	Warm Springs	North River
SIZE OF PWA OR ADDITION (ACRES)		27,314	12,892	10,236	15,395	11,918	30,227
OPPORTUNITIES FOR SOLITUDE AND PRIMITIVE, UNCONFINED RECREATION	Opportunities for primitive recreation, solitude, physical and mental challenge, inspiration	15,840 ac SP up thru center; mult ridges & twisting drainages provide good interior core.	7,789 ac SP in mass; good int opps away from sights/sounds but location & Sherando prevent solitude. Wide cherrystem on Turkey Pen Ridge.	6,996 ac SP with opps for isolation and prim rec; but MULT TRAILS & adj MNF rec sites may prevent solitude and result in mult encounters.	8,782 ac SP in middle of each leg-half way down SW and most all of SE; and middle of top - surrounded by RN on most of perimeter. Lots of core area for isolation; rugged and steep. Rural farms b/w "legs".	4,984 ac SP toward upper half; mountainside; poor opps due to ext views, narrow shape; mult trails w/ high use out of Douthat; pvt dev along SW border.	20,500 ac SP in mass; excellent opps for isolation/solitude; mult trails inc NRT may result in encounters with others.
	Other pros or cons to opps for primitive rec and solitude	No	No	No	No	No	No
ABILITY TO PROVIDE SPECIAL FEATURES OR VALUES	National or regional heritage/historic values	No	Camp 8 and Mt. Torry Furnace just outside of eastern boundary	No	No	No	Reddish Knob, Spring
	Presence of TESLR species, FS sensitive species or species found only here that DO NOT need active management	448 acre Natural Heritage Program Biological Area.	Virginia sneezeweed, Swamp pin; 8,619 acre SBA 3 blocks along N, NE and E boundary. 1,624 acre Natural Heritage Program Biological Area.	Waterflan lichen, Va northern flying squirrel, Southern water shrew; 6,171 acre SBA. 687 acre Natural Heritage Program Biological Area.	No	No	Cow Knob Salamander; 11,969 SBA

APPENDIX C1: TABLE C-9 CAPABILITY		JERKEMTIGHT	KELLEY MOUNTAIN	LAUREL FORK	LITTLE ALLEGHANY	LITTLE MARE MOUNTAIN	LITTLE RIVER
RANGER DISTRICT		North River	Pedlar	Warm Springs	Warm Springs	Warm Springs	North River
SIZE OF PWA OR ADDITION (ACRES)		27,314	12,892	10,236	15,395	11,918	30,227
	Presence of old growth stands (FS data; see also Va Mtn Treasures comments below)	No	No	No	no	no	No
	Presence of special area (NRT, RNA, etc)	Rec River	No	No	Rec River	No	Scenic river, NRT
	Presence of special geologic area	No	No	No	No	No	No
	Native brook trout stream(s), miles	9 mi.	20 mi.	22 mi.	9 mi.	22 mi.	24 mi.
	Area contains veg unique to VA, ie, "northern" species such as balsam fir	No	No	Heritage reports - large plantations of red pine and spruce in rows.	No	No	Mountain ash
	Elev over 4,000 feet, acres	No	No	58 ac.	36 ac.	No	584 ac.
	Other special feature or value	No	No	No	No	No	Largest IRA in VA; possibility for a wilderness of substantial size, especially in conjunction with Ramsey's Draft
MANAGEABILITY	Adjacent to long-term disturbance	No	No	No	No	No	No
	Known illegal OHV or ATV use	ATV and OHV	ATV and OHV	ATV	ATV	ATV	ATVs on Trail 443 coming in from east side

APPENDIX C1: TABLE C-9 CAPABILITY		JERKEMTIGHT	KELLEY MOUNTAIN	LAUREL FORK	LITTLE ALLEGHANY	LITTLE MARE MOUNTAIN	LITTLE RIVER
RANGER DISTRICT		North River	Pedlar	Warm Springs	Warm Springs	Warm Springs	North River
SIZE OF PWA OR ADDITION (ACRES)		27,314	12,892	10,236	15,395	11,918	30,227
	Other challenges related to manageability	No	Numerous disp campsites all along northern bdy (FDR 42)	No	No	No	No

APPENDIX C1: TABLE C-9 CAPABILITY		MASSANUTTEN NORTH	OAK KNOB-HONE QUARRY	OLIVER MOUNTAIN	PADDY KNOB	POTTS MOUNTAIN	RAMSEYS DRAFT ADDITION
RANGER DISTRICT		Lee	North River	James River	Warm Springs	James River	North River
SIZE OF PWA OR ADDITION (ACRES)		16,530	16,343	13,049	5,987	7,863	19,072
CATEGORIES FOR ASSESSING CAPABILITY	BASIC NATURAL CAPABILITY ELEMENTS, VALUES OR FEATURES	Comments	Comments	Comments	Comments	Comments	Comments
NATURE DOMINATES; SUBSTANTIALLY FREE OF IMPROVEMENTS AND HUMAN HABITATION	Acidified streams (non-limestone streams)	No	Yes	No	No	Yes	Yes
	Presence of structural improvements	Stone base, wood deck	No	No	Fire tower remains	Time capsule	VDGIF building
	Private inholdings	No	No	No	No	Not an inholding, but 2 large blocks of pvt jut into interior of PWA.	No
	Subdivisions adjacent to PWA boundary	Subdivisions exist all along east side and the central west and northwest side	Yes	Yes	No	Several families live in pvt that juts into interior on N end.	Yes
	Est. percent of boundary beside pvt lands	69%	15%	77%	50%	32%	19%, mostly narrow strip on SW end
	Other evidence of human habitation or use	No	No	No	No	No	No
OPPORTUNITIES FOR SOLITUDE AND PRIMITIVE, UNCONFINED RECREATION	Opportunities for primitive recreation, solitude, physical and mental challenge, inspiration	11,150 ac SP but all linear; long mountainside w/ external views	8,800 ac SP in mass; good int area but roadbed through and mult trails evidence humans. Cherry stem for Hone Quarry not desirable.	9,200 ac SP - away from Lake, but juxtaposed with non-FS; views external to PWA. Would want to exclude area near Lake due to sound.	About 3,284 ac SP in core w/ RN on W,N,E perimeter; overall small core, but area is deeply incised and offers isolation.	4,491 ac SPM; area has fairly large mass of SP, but on a mountainside with external views.	11,000 ac SP in mass; mtnside w/ deep twisting drainages; for int opps away from sights/sounds. Good opp for solitude.

APPENDIX C1: TABLE C-9 CAPABILITY		MASSANUTTEN NORTH	OAK KNOB-HONE QUARRY	OLIVER MOUNTAIN	PADDY KNOB	POTTS MOUNTAIN	RAMSEYS DRAFT ADDITION
RANGER DISTRICT		Lee	North River	James River	Warm Springs	James River	North River
SIZE OF PWA OR ADDITION (ACRES)		16,530	16,343	13,049	5,987	7,863	19,072
	Other pros or cons to opps for primitive rec and solitude	No	No	No	No	Jeep trail on boundary b/w Potts Mtn PWA and Barbours Creek W.	No
ABILITY TO PROVIDE SPECIAL FEATURES OR VALUES	National or regional heritage/historic values	Morgans Road; Washington planned to use it to retreat into Fort Valley, if needed	No	No	No	Children's Forest	Confederate Breastworks
	Presence of TESLR species, FS sensitive species or species found only here that DO NOT need active management	No	Cow Knob Salamander; 4,411 acre SBA	No	Bald eagle, Southern water shrew, Southern rock vole; 874 acre SBA; 73 ac Natural Heritage Program Biological Area.	McGraw Gap xystodesmid, Rock skullcap, NE bulrush; 70 acre SBA	Cow Knob Salamander; 2,460 acre SBA on north end.
	Presence of old growth stands (FS data; see also Va Mtn Treasures comments below)	No	No	No	No	No	No
	Presence of special area (NRT, RNA, etc)	Massanutten Mountain NRT; Recreational River	No	No	No	No	NRT
	Presence of special geologic area	No	No	No	No	No	No
	Native brook trout stream(s), miles	No	12 mi.	No	No	16 miles	7 mi.
	Area contains veg unique to VA, ie, "northern" species such as balsam fir	No	Planted	No	Norway spruce - planted.	No	Red pine, planted, on north end.

APPENDIX C1: TABLE C-9 CAPABILITY		MASSANUTTEN NORTH	OAK KNOB-HONE QUARRY	OLIVER MOUNTAIN	PADDY KNOB	POTTS MOUNTAIN	RAMSEYS DRAFT ADDITION
RANGER DISTRICT		Lee	North River	James River	Warm Springs	James River	North River
SIZE OF PWA OR ADDITION (ACRES)		16,530	16,343	13,049	5,987	7,863	19,072
	Elev over 4,000 feet, acres	No	117 ac.	No	374 ac.	No	204 ac.
	Other special feature or value	No	No	No	No	No	Headwater for James & Potomac
MANAGEABILITY	Adjacent to long-term disturbance	No	No	No	Noise, changing water levels at Pump Back Storage Unit	No	
	Known illegal OHV or ATV use	ATVs enter from Funktown on east	ATVs enter at several points on N and E bdy	ATV	ATV	ATV and OHV	ATV
	Other challenges related to manageability	Long, narrow area with a lot of boundary against private	No	No	No	No	No

APPENDIX C1: TABLE C-9 CAPABILITY		RICH HOLE ADDITION	RICH PATCH (GW PORTION)	ROUGH MTN ADDITION	ST. MARY'S NORTH	ST MARY'S SOUTH	ST. MARY'S WEST
RANGER DISTRICT		James River & Warm Spgs	James River	Warm Springs	Pedlar	Pedlar	Pedlar
SIZE OF PWA OR ADDITION (ACRES)		12,165	5,625	2,063	3,006	1,651	278
CATEGORIES FOR ASSESSING CAPABILITY	BASIC NATURAL CAPABILITY ELEMENTS, VALUES OR FEATURES	Comments	Comments	Comments	Comments	Comments	Comments
NATURE DOMINATES; SUBSTANTIALLY FREE OF IMPROVEMENTS AND HUMAN HABITATION	Acidified streams (non-limestone streams)	No	No	No	Yes	No	No
	Presence of structural improvements	Fire tower foundation	No	No	No	No	No
	Private inholdings	No	No	No	No	No	No
	Subdivisions adjacent to PWA boundary	No	No	No	Yes	Yes	Houses exist all along western boundary
	Est. percent of boundary beside pvt lands	36%	37%	54%	6%	56%	19%
	Other evidence of human habitation or use	No	No	RR ROW road	No	No	

APPENDIX C1: TABLE C-9 CAPABILITY		RICH HOLE ADDITION	RICH PATCH (GW PORTION)	ROUGH MTN ADDITION	ST. MARY'S NORTH	ST MARY'S SOUTH	ST. MARY'S WEST
RANGER DISTRICT		James River & Warm Spgs	James River	Warm Springs	Pedlar	Pedlar	Pedlar
SIZE OF PWA OR ADDITION (ACRES)		12,165	5,625	2,063	3,006	1,651	278
OPPORTUNITIES FOR SOLITUDE AND PRIMITIVE, UNCONFINED RECREATION	Opportunities for primitive recreation, solitude, physical and mental challenge, inspiration	About 7,100 ac SP on mountainside with views toward Rough Mtn to west and northwest and SR 42 to southwest. I64 and US60 are south. No great core area by itself, but makes good block when combined with existing wilderness. Not much pvt interface.	4000 ac SP, all of which is narrow and against pvt boundary on GW side.	Yes	1,985 ac SP with rugged terrain; good int opps away from sights/ sounds; no trails	No	Opps for primitive recreation when combined with St. Mary's Wilderness
	Other pros or cons to opps for primitive rec and solitude	Noise from I-64, on DOD flight path, hunt camps on adjacent private land.	No	No	No	No	No
ABILITY TO PROVIDE SPECIAL FEATURES OR VALUES	National or regional heritage/historic values	No	No	No	No	No	No
	Presence of TESLR species, FS sensitive species or species found only here that DO NOT need active management	No	No	No	Swamp pink; 2,977 SBA - Habitat for TES Species.	No	Swamp pink

APPENDIX C1: TABLE C-9 CAPABILITY		RICH HOLE ADDITION	RICH PATCH (GW PORTION)	ROUGH MTN ADDITION	ST. MARY'S NORTH	ST MARY'S SOUTH	ST. MARY'S WEST
RANGER DISTRICT		James River & Warm Spgs	James River	Warm Springs	Pedlar	Pedlar	Pedlar
SIZE OF PWA OR ADDITION (ACRES)		12,165	5,625	2,063	3,006	1,651	278
	Presence of old growth stands (FS data; see also Va Mtn Treasures comments below)	No	No	No	No	No	No
	Presence of special area (NRT, RNA, etc)	Rec River	No	Rec River	No	No	Wild River
	Presence of special geologic area	No	No	No	No	No	No
	Native brook trout stream(s), miles	9 mi.	7 mi.	No	4 mi.	No	No
	Area contains veg unique to VA, ie, "northern" species such as balsam fir	No	No	No	No	No	No
	Elev over 4,000 feet, acres	No	No	No	No	No	No
	Other special feature or value	No	No	No	No	No	Headwaters for both James & Potomac Rivers
MANAGEABILITY	Adjacent to long-term disturbance	No	No	High use RR, fire breaks along tracks	No	No	No
	Known illegal OHV or ATV use	ATV	No	ATV	OHV	ATV	Yes

APPENDIX C1: TABLE C-9 CAPABILITY		RICH HOLE ADDITION	RICH PATCH (GW PORTION)	ROUGH MTN ADDITION	ST. MARY'S NORTH	ST MARY'S SOUTH	ST. MARY'S WEST
RANGER DISTRICT		James River & Warm Spgs	James River	Warm Springs	Pedlar	Pedlar	Pedlar
SIZE OF PWA OR ADDITION (ACRES)		12,165	5,625	2,063	3,006	1,651	278
	Other challenges related to manageability	No	No	Area provides only legal access to existing Rough Mtn Wilderness	No	Mine restoration and monitoring (req'd by Va)	No

APPENDIX C1: TABLE C-9 CAPABILITY		SHAWS RIDGE	SHAWVER'S RUN ADDITION	THREE RIDGES ADDITION SOUTH	THREE RIDGES ADDITION SOUTHWEST	THREE RIDGES ADDITION WEST	THREE RIDGES ADDITION NORTH	THREE SISTERS
RANGER DISTRICT		North River	James River	Pedlar	Pedlar	Pedlar	Pedlar	Pedlar
SIZE OF PWA OR ADDITION (ACRES)		7,268	84	187	9	90	83	9,871
CATEGORIES FOR ASSESSING CAPABILITY	BASIC NATURAL CAPABILITY ELEMENTS, VALUES OR FEATURES	Comments	Comments	Comments	Comments	Comments	Comments	Comments
NATURE DOMINATES; SUBSTANTIALLY FREE OF IMPROVEMENTS AND HUMAN HABITATION	Acidified streams (non-limestone streams)	No	No	No	No	No	No	Yes
	Presence of structural improvements	No	No	No	Suspension bridge over Tye River	No	No	Johns Hollow AT shelter
	Private inholdings	Fairly large and in middle of PWA; may be hard to exclude.	No	No	No	No	No	No
	Subdivisions adjacent to PWA boundary	Yes, all along SW boundary	No	Yes	No	No	No	Subdivision to the west
	Est. percent of boundary beside pvt lands	87%	32%	51%	40%	65%	33%	30%
	Other evidence of human habitation or use	No	No	No	No	No	No	No
OPPORTUNITIES FOR SOLITUDE AND PRIMITIVE, UNCONFINED RECREATION	Opportunities for primitive recreation, solitude, physical and mental challenge, inspiration	Relatively small 3,950 ac SP thru center; mostly ridgetop but some int opps; trails & pvt inholding concern	No added SP benefit to Shawver's Run	No	No	No	No	Good core of 6,224 ac SP in mass in center; AT runs through the middle - high use may prevent solitude.

APPENDIX C1: TABLE C-9 CAPABILITY		SHAWS RIDGE	SHAWVER'S RUN ADDITION	THREE RIDGES ADDITION SOUTH	THREE RIDGES ADDITION SOUTHWEST	THREE RIDGES ADDITION WEST	THREE RIDGES ADDITION NORTH	THREE SISTERS
RANGER DISTRICT		North River	James River	Pedlar	Pedlar	Pedlar	Pedlar	Pedlar
SIZE OF PWA OR ADDITION (ACRES)		7,268	84	187	9	90	83	9,871
	Other pros or cons to opps for primitive rec and solitude	Garbage dump	Adds length along a road and along a bdy with pvt.	No	No	No	No	No
ABILITY TO PROVIDE SPECIAL FEATURES OR VALUES	National or regional heritage/historic values	No	No	No	No	No	No	No
	Presence of TESLR species, FS sensitive species or species found only here that DO NOT need active management	No	No	No	Waterfan lichen	No	No	149 acre Natural Heritage Program Biological Area
	Presence of old growth stands (FS data; see also Va Mtn Treasures comments below)	No	No	No	No	No	No	No
	Presence of special area (NRT, RNA, etc)	No	No	No	No	No	No	No
	Presence of special geologic area	No	No	No	No	No	No	No
	Native brook trout stream(s), miles	No	1 mi.	1 mi.	No	No	No	10 mi.
	Area contains veg unique to VA, ie, "northern" species such as balsam fir	No	No	No	No	No	No	No
	Elev over 4,000 feet, acres	No	No	No	No	No	No	No
	Other special feature or value	Headwater for James & Potomac	No	No	No	No	No	No

APPENDIX C1: TABLE C-9 CAPABILITY		SHAWS RIDGE	SHAWVER'S RUN ADDITION	THREE RIDGES ADDITION SOUTH	THREE RIDGES ADDITION SOUTHWEST	THREE RIDGES ADDITION WEST	THREE RIDGES ADDITION NORTH	THREE SISTERS
RANGER DISTRICT		North River	James River	Pedlar	Pedlar	Pedlar	Pedlar	Pedlar
SIZE OF PWA OR ADDITION (ACRES)		7,268	84	187	9	90	83	9,871
MANAGEABILITY	Adjacent to long-term disturbance	No	No	No	No	No	No	Active amalite mine
	Known illegal OHV or ATV use	ATV	No	OHV	No	No	No	ATVs enter on the east and north
	Other challenges related to manageability	No	No	No	No	No	No	No

TABLE C-10. Potential Wilderness Evaluations - Availability

APPENDIX C2: TABLE C-10 AVAILABILITY		ADAMS PEAK	ARCHER KNOB	BEARDS MOUNTAIN	BEECH LICK KNOB	BIG SCHLOSS	CRAWFORD KNOB
RANGER DISTRICT		Pedlar	North River	James River, Warm Spgs	North River	Lee	North River
SIZE OF PWA OR ADDITION (ACRES)		8,226	7,110	10,152	14,087	28,347	14,851
CATEGORIES OF OTHER RESOURCES	OTHER RESOURCES DEMANDS THAT THE AREA COULD SATISFY	Comments	Comments	Comments	Comments	Comments	Comments
TIMBER, VEGETATION AND FIRE - PAST AND CURRENT MANAGEMENT INVESTMENTS	Existing suitable timber from 1993 Plan	763 acres on NNE boundary	1,322 acres; multiple spines along NW bdy, along SE bdy and "boot" where FDR 382B enters from E.	1,327 acres central west border and north end	5,588 acres, mostly in the eastern portion of the PWA and an area within the SW portion.	5,548 acres; various patches scattered around the periphery; primarily east and north.	3,796 acres: SW, NE and small amount on NNW.
	Timber sales harvested since 1993	3 units in NE portion dating 1993-1995	1 unit north end 1993	Yes	1 unit at north-center bdy dated 2005 and 7 units in northeast part of area, dating 1993-2000.	All or portions of 16 units mostly around boundary of northern finger	8 units along S and NW perimeter, 1994-1998
	Timber sales currently under contract	No	No	No	No	No	No
	Presence of Rx burns or approved burns not completed yet.	No	Gum Lick burn	Lg area at ctr on W bdy; not in GIS	1993 on NNE boundary; no existing trails near the area.	Large area on south end around Little Schloss burned in 2003; 2 in Vance Cove that are not in GIS	Large burn in 2000 on S end
	Existing surface contracts, permits, agreements that conflict with Wilderness	Yes	No	No	Marshall Run	PATC has permit for cabin at Sugar Knob.	No
	Area contains Table mtn, Va, Pitch pine (Rx burn)	1076 acres	1,734	1,428	1,292 acres	123 acres	393 acres

APPENDIX C2: TABLE C-10 AVAILABILITY		ADAMS PEAK	ARCHER KNOB	BEARDS MOUNTAIN	BEECH LICK KNOB	BIG SCHLOSS	CRAWFORD KNOB
RANGER DISTRICT		Pedlar	North River	James River, Warm Spgs	North River	Lee	North River
SIZE OF PWA OR ADDITION (ACRES)		8,226	7,110	10,152	14,087	28,347	14,851
MINERALS AND LANDS	Reserved/outstanding subsurface rights, acres	No	No	No	1,158 acres; all one block along western boundary; can be excluded.	7,118 acres; large areas at southeast and northwest portion of southern "mass"; excluding these areas would leave only "lobster claw" at NE	No
	Area contains land suitable for disposal on land adjustment map, acres	376	23	256	65 acres	10 acres	64
TES SPECIES AND WILDLIFE	Area contains TES and/or FS sensitive species or habitat enhanced by human intervention or disturbance	Sand grape, Mtn paper birch	Phlox buckleyi, Plains forstweed; 24 acre SBA near center of PWA on Archer Knob on Gr No Mtn Trail.	Shale barren rockcress; 853 acres Natural Heritage Program Special Biological Area	No	Wood turtle	No
	Existing wildlife habitat improvements using mechanical methods that conflict with W.	6 shown in GIS in northern portion	1 opening and linear WL clearing in south end.	No	Along NE boundary; none are in the interior.	12 wildlife openings in GIS and district notes that more exist; Wilson Cove Deer Study Area in WV	WL opening with a pond
RECREATION	Competitive events	Yes	No	No	No	Yes	Yes

APPENDIX C2: TABLE C-10 AVAILABILITY		ADAMS PEAK	ARCHER KNOB	BEARDS MOUNTAIN	BEECH LICK KNOB	BIG SCHLOSS	CRAWFORD KNOB
RANGER DISTRICT		Pedlar	North River	James River, Warm Spgs	North River	Lee	North River
SIZE OF PWA OR ADDITION (ACRES)		8,226	7,110	10,152	14,087	28,347	14,851
	Mountain biking - heavily used trails	Whetstone Ridge trail, extends from SW bdy to mid-eastern bdy, all within SP core	North Mtn Trail	Yes	No trails no; however NEPA is done on planned segment of Great Eastern Trail (multi use)	System of multiple mountain bike trails	Per pub comments; multiple. Per district, not heavily used
	Horseback riding - heavily used trails	No	Yes	No		Yes	No
	Trail partners perform mtce with chainsaws	Yes	No	Yes		Yes	Yes
	Other rec demands that may conflict with Wilderness values		Currently, motorized access for hunters w/ disabilities; heavy disp camping on N end; geocaching on N end.	Heavy illegal ATV use along E boundary; SUP along FDR 637			
OTHER AGENCY INTERESTS	Dept of Energy identified area as having wind power class 3 or greater	558	114	No	843 acres	7,550	968 acres
PUBLIC ACCESS	Presence of roads open year round or seasonally, miles	1.2	No	No	0.2 mile on north bdy; dead ends at 2005 timber unit.	11.2	0.4 mile

APPENDIX C2: TABLE C-10 AVAILABILITY		ADAMS PEAK	ARCHER KNOB	BEARDS MOUNTAIN	BEECH LICK KNOB	BIG SCHLOSS	CRAWFORD KNOB
RANGER DISTRICT		Pedlar	North River	James River, Warm Spgs	North River	Lee	North River
SIZE OF PWA OR ADDITION (ACRES)		8,226	7,110	10,152	14,087	28,347	14,851
PUBLIC COMMENTS	Comments that provide additional information for assessing availability.	Make NSA; heavy bike use on Whetstone Ridge trail; maintained by mtn bikers; keep Nature Camp and roads in the north out of wilderness; manage for WL	No. Mtn Trail used by mtn bikes; move boundary to west side of trail; old growth; agree to W west of North Mountain Trail; scenic area; WL mgmt	Mtn bike use; good WL habitat; extensive use out of Douthat; No to wilderness - remote highlands; no logging; no road building	Good quality timber and historic/current WL mgmt; yes to Wilderness but exclude Great Eastern Trail along western portion of area (Carr Mountain).	WV needs to maintain Deer Study Area; mult mtn bike trails; volunteers; horse enduros, WL mgmt; adjust bdy to only have northern finger as Wilderness, and the rest as Scenic Area; yes to Wilderness for entire Big Schloss area; public drinking water, watershed	Mult mtn bike trails on S half; agree w/ W north of trails 487, 489; WL mgmt; move W bdy to exclude suitable timber area.

APPENDIX C2: TABLE C-10 AVAILABILITY		ADAMS PEAK	ARCHER KNOB	BEARDS MOUNTAIN	BEECH LICK KNOB	BIG SCHLOSS	CRAWFORD KNOB
RANGER DISTRICT		Pedlar	North River	James River, Warm Spgs	North River	Lee	North River
SIZE OF PWA OR ADDITION (ACRES)		8,226	7,110	10,152	14,087	28,347	14,851
VIRGINIA MOUNTAIN TREASURES	Comments that provide additional information for assessing availability.	Dominated by steep,rugged mountains; elev 1200-3000'; Whetstone is long ridge dissected by numerous, deep, narrow drainages; rock slides are common; upland hardwoods with Pitch pine; cove hardwoods in sheltered hollows; scenic rock outcrops and pinnacles; black bear and timber rattlers; prehistoric sites; lot of disp rec activities; 1066 acres of possible old growth.	Numerous drainages; Scott Hollow Barrens conservation site; old growth in northern part of PWA; 7 miles Gr No Mtn Trail connects to Elliott Knob Crawford Mtn treasures; large area of SP, but much classified suitable for timber & road building by FS; threatened by potential ATV development; 1835 ac of potential old growth.	Scenic backdrop for Douthat; many peaks; many streams dissect flanks of ridge; tribs of Cowpasture River; 1 of few areas on GW accessed by canoeists; several trails; 2,921 acres of possible old growth.	One of the largest IRAs on GW; elev 1650-3150 with diverse topo; multiple drainages; large SP area for experiencing solitude; old FDR is closed and grassed goes to interior; Blue Hole CG at north bdy; much area is suitable for timber; 4241 acres of possible old growth.	One of the biggest IRAs in the eastern national forests; elev 1600-3300'; sandstone capped mtns create notable stone outcrops where Peregrine falcons have been released to the wild; multiple streams are tribs to N. Fork of Shenandoah River; 7500 acre SMA; unsuitable, managed to maintain natural appearance; multiple existing disp rec activities; native trout stream; 866 acre SBA; 4825 acres of possible old growth	Occupies both sides of mountain; elev 1650'-3728'; hollows and streams, rugged side slopes with deep narrow drainages; Red Oak Spring near summit-stream created rock ledges, waterfalls; disp rec on system of 3 trails; Civil War history; up to 4276 ac of possible old growth. NOTE: VMT wisely excl narrow strip S of FDR 1269.

APPENDIX C2: TABLE C-10 AVAILABILITY		DOLLY ANN	DUNCAN KNOB	ELLIOTT KNOB	GALFORD GAP	GUM RUN	HIGH KNOB
RANGER DISTRICT		James River	Lee	North River	Warm Springs	North River	North River
SIZE OF PWA OR ADDITION (ACRES)		9,524	5,973	11,070	6,689	14,547	18,447
CATEGORIES OF OTHER RESOURCES	OTHER RESOURCES DEMANDS THAT THE AREA COULD SATISFY	Comments	Comments	Comments	Comments	Comments	Comments
TIMBER, VEGETATION AND FIRE - PAST AND CURRENT MANAGEMENT INVESTMENTS	Existing suitable timber from 1993 Plan	3,424 acres on west, much of southern PWA, narrow band on east bdy, all of "panhandle".	1,228 acres around north, west and south boundaries	3,468 acres around the W, N and NE perimeter.	4,467 acres scattered throughout entire area (substantially overlaps SP)	307 acres - SE boundary	4,296 acres - most of west portion (substantially overlaps SP)
	Timber sales harvested since 1993	4 in 1993; 1 in 1997; along east side of "panhandle"		9 units and part of 2 others around perimeter dating 1994-1997	10 units and part of 11th 1993-1999; incl Mulligan helicopter sales	3 units in SE corner (TSI contract) dated 1998-1999	7 units dating 1993 to 2005 primarily along west bdy but also 2 units in south-center along 1022
	Timber sales currently under contract	No		Yes	No	No	Yes, per district note.
	Presence of Rx burns or approved burns not completed yet.	In 1993, just north of center in the "pan" or mass of PWA.		No	Near S bdy about 2000	No	Large area at the south burned in 2000
	Existing surface contracts, permits, agreements that conflict with Wilderness	No	Yes	No	No	Yes	No
	Area contains Table mtn, Va, Pitch pine (Rx burn)	16	686	208	5	321	338 acres

APPENDIX C2: TABLE C-10 AVAILABILITY		DOLLY ANN	DUNCAN KNOB	ELLIOTT KNOB	GALFORD GAP	GUM RUN	HIGH KNOB
RANGER DISTRICT		James River	Lee	North River	Warm Springs	North River	North River
SIZE OF PWA OR ADDITION (ACRES)		9,524	5,973	11,070	6,689	14,547	18,447
MINERALS AND LANDS	Reserved/outstanding subsurface rights, acres	No	No	No	No	2,529 acres - one block on northeast side of PWA; can be excluded.	No
	Area contains land suitable for disposal on land adjustment map, acres	58	No	No	No	36 acres	136
TES SPECIES AND WILDLIFE	Area contains TES and/or FS sensitive species or habitat enhanced by human intervention or disturbance	Var sedge, Sword leaved phlox; 2,076 acre SBA in the center of "mass and 49 ac. Natural Heritage Program Biological Area	N. bristly sarsaparilla; 35 acre SBA; 93 ac. Nat. Heritage Program Biological Area	Least trillium, Slender wheatgrass, Mountain paper birch; big 715 ac SBA extends from S/center bdy up through middle of PWA.	No	No	Pearly everlasting, Ground juniper
	Existing wildlife habitat improvements using mechanical methods that conflict with W.	Yes	Yes	Yes	Yes	10 shown in GIS, primarily around boundary	About 15 wildlife openings shown in GIS
RECREATION	Competitive events	No	Yes	Yes	No		No
	Mountain biking - heavily used trails	No	Yes	Trails exist, but not heavily used per district.	No	Trails exist, but not heavily used per district.	Yes
	Horseback riding - heavily used trails	No	Yes	No	No	No	No
	Trail partners perform mtce with chainsaws	No	Yes	Yes	No	No	Yes

APPENDIX C2: TABLE C-10 AVAILABILITY		DOLLY ANN	DUNCAN KNOB	ELLIOTT KNOB	GALFORD GAP	GUM RUN	HIGH KNOB
RANGER DISTRICT		James River	Lee	North River	Warm Springs	North River	North River
SIZE OF PWA OR ADDITION (ACRES)		9,524	5,973	11,070	6,689	14,547	18,447
	Other rec demands that may conflict with Wilderness values						
OTHER AGENCY INTERESTS	Dept of Energy identified area as having wind power class 3 or greater	1,415	No	1,197	704	1101 acres	3,116 acres
PUBLIC ACCESS	Presence of roads open year round or seasonally, miles	2.5	0.1	No	1.8	2.2 miles	4.4 miles
PUBLIC COMMENTS	Comments that provide additional information for assessing availability.	Mtn bike use and now horse use; WL mgmt for birds, bear, grouse; NSA; No to Wilderness; No to road building; no logging; protect SIA and surroundings.	Mtn bike tech trails; mtce done by vols; NSA	Add southern block of No. Mtn to be consistent with VA Treasures; watershed protection; WL mgmt-want more for birds, bear, grouse; mtn bike trails & mtce; agree w/ wilderness if exclude suitable area on W and NW third of PWA.	Special area, high elev habitat, high elev Allegheny; exclude from management; eval area to the south; extend PWA to include Chestnut Ridge on the SW. Don't lose timber, WL and hunting values.	Mtn bike use on trail from Chestnut Knob to Rawley Springs (SE portion of area); more OHV opps; yes to W-drinking water supply/watershed; watershed for public drinking water	Shen Mtn Trail through center of PWA with 4 mtn bike side trails entering along west bdy; agree to W on eastern portion of area; 4WD access; maintain early successional; yes to Wilderness-protect municipal watershed

APPENDIX C2: TABLE C-10 AVAILABILITY		DOLLY ANN	DUNCAN KNOB	ELLIOTT KNOB	GALFORD GAP	GUM RUN	HIGH KNOB
RANGER DISTRICT		James River	Lee	North River	Warm Springs	North River	North River
SIZE OF PWA OR ADDITION (ACRES)		9,524	5,973	11,070	6,689	14,547	18,447
VIRGINIA MOUNTAIN TREASURES	Comments that provide additional information for assessing availability.	Highest point in Alleghany Co - 4072 ft. Cliff on west side with great views ; open parklike flat on Big Knob; large old White oaks; globally rare species; D.A. Hollow large boulders, rugged, rock ledges, waterfalls; SBA; one trail; 2,735 ac possible old growth.	"Catback Mountain" area has two main parallel ridges and contains the headwaters of Passage Creek, a 34 acre SBA for Scothorn Gap Shale Barren, Waterfall Mountain Cliffs conservation site recommended by DNH as SBA, Duncan Hollow Trail that connects Camp Roosevelt to US 211 and side trails for loops; accessible boardwalk to cliffs; may contain 246 acres of possible old growth.	High elev of 4463'; steep slopes near ridge, some over 80%; clear, cool springs high on ridge; cold spring bubbles from ground on W mtn; sprngs feed mult streams; VA DNH id'd T&E plants; black bear habitat; 962 SBA; up to 4,407 ac possible old growth.	"Scaffold Run" is located on spine of Allegheny Mtn, one of VA and WV's highest-knobs exceeding 4000 feet. Eastern slope rugged with many drainages; tribs to Greenbrier River-ultimately Gulf of Mexico; high elev old growth stands, up to 1,752 acres; 1 of few sites on GW with Red spruce; remote rec opps plentiful; no existing trail system.	Elev 1800->4000'; 3 major ridges drained by numerous runs; western Dundore Mtn provides groundwater protection for Switzer Lake-reservoir for Harrisonburg; remote and rugged-habitat for black bear; Cow Knob Salamander prefers late successional, old growth; mixed hardwoods; 5429 acres of possible old growth.	"Skidmore Fork" is home to 10 T&E species with 5 being extremely rare; 1200 acre tract of old growth that DNH describes as "an exemplary natural community"; SBA is a gem; elev exceed 4000 feet on 3 knobs; challenging primitive recr opps; Skidmore Fork serves as principle water source for Harrisonburg and needs protection.

APPENDIX C2: TABLE C-10 AVAILABILITY		JERKEMTIGHT	KELLEY MOUNTAIN	LAUREL FORK	LITTLE ALLEGHANY	LITTLE MARE MOUNTAIN	LITTLE RIVER
RANGER DISTRICT		North River	Pedlar	Warm Springs	Warm Springs	Warm Springs	North River
SIZE OF PWA OR ADDITION (ACRES)		27,314	12,892	10,236	15,395	11,918	30,227
CATEGORIES OF OTHER RESOURCES	OTHER RESOURCES DEMANDS THAT THE AREA COULD SATISFY	Comments	Comments	Comments	Comments	Comments	Comments
TIMBER, VEGETATION AND FIRE - PAST AND CURRENT MANAGEMENT INVESTMENTS	Existing suitable timber from 1993 Plan	6,936 acres along E and N boundary	71 acres - a couple of blocks along north boundary	30 acres along west boundary	5,621 acres - entire north end and scattered throughout west "leg"	6,557 acres in southern tip and entire east half	2,073 acres
	Timber sales harvested since 1993	12 units and parts of 4 more around perimeter except 1 no. of The Bump, dating 1996-2000	No	No	17 units from 1993 to 1999	7 units 1993-1997 in center along E bdy	5 units around E and S perimeter, dating 1994-2005
	Timber sales currently under contract	No	No	No	No	No	No
	Presence of Rx burns or approved burns not completed yet.	Large burns in 1993, 2000 E of NE boundary but within VMT bdy	Yes, near NNE boundary	No	No	Maintained; on S end of PWA; not in GIS	West bdy (w of Trail 539) and SE bdy on Middle Mountain
	Existing surface contracts, permits, agreements that conflict with Wilderness	No	No	Yes	Yes	Yes	Sale planned in NE quadrant of area.
	Area contains Table mtn, Va, Pitch pine (Rx burn)	2,006 acres	1475 acres	No	202	141	1,907 acres

APPENDIX C2: TABLE C-10 AVAILABILITY		JERKEMTIGHT	KELLEY MOUNTAIN	LAUREL FORK	LITTLE ALLEGHANY	LITTLE MARE MOUNTAIN	LITTLE RIVER
RANGER DISTRICT		North River	Pedlar	Warm Springs	Warm Springs	Warm Springs	North River
SIZE OF PWA OR ADDITION (ACRES)		27,314	12,892	10,236	15,395	11,918	30,227
MINERALS AND LANDS	Reserved/outstanding subsurface rights, acres	2,617 acres in large block at NW bdy extending into center of N portion; 2 smaller blocks near center; would take 50% of area to excl.	2,126 acres; 3 large blocks on N bdy - exclude top half of PWA; small block on S bdy.	No	374 acres; 1 block from bdy to bdy; to exclude-cut off SE "leg"	No	3,127 acres in 2 blocks on E bdy either side of Hearth.Lake & Buck Mtn Tr.; can be excl.
	Area contains land suitable for disposal on land adjustment map, acres	2 acres	No	No	No	No	No
TES SPECIES AND WILDLIFE	Area contains TES and/or FS sensitive species or habitat enhanced by human intervention or disturbance	Sword leaved phlox, Slender wheatgrass, Wild chess, Coal skink, Shale barren rockcress; 1,280 acre SBA on SW end of PWA.	Var sedge, Mtn paper birch, Big Levels salamander	No	Phlox buckleyi, roughhead shiner; 56 acre SBA at top N bdy, extends into Paddy Knob PWA.	Variable sedge; 94 acre SBA; 441 acre Natural Heritage Program Biological Area.	Barrens tiger beetle, Sword leaved phlox, Turkey beard, Mtn paper birch, coal skink; 1,088 acre Natural Heritage Program Biological Area.
	Existing wildlife habitat improvements using mechanical methods that conflict with W.	Along W boundary	About 17 shown in GIS, with many along boundary	No	No	Yes	Multiple WL openings throughout the area
RECREATION	Competitive events	No	Yes	No	No	Yes	Yes
	Mountain biking - heavily used trails	Trail goes up through center of area.	Yes	Yes	No	Planned	Yes

APPENDIX C2: TABLE C-10 AVAILABILITY		JERKEMTIGHT	KELLEY MOUNTAIN	LAUREL FORK	LITTLE ALLEGHANY	LITTLE MARE MOUNTAIN	LITTLE RIVER
RANGER DISTRICT		North River	Pedlar	Warm Springs	Warm Springs	Warm Springs	North River
SIZE OF PWA OR ADDITION (ACRES)		27,314	12,892	10,236	15,395	11,918	30,227
	Horseback riding - heavily used trails	Yes	Yes	No	No	Planned	Yes
	Trail partners perform mtce with chainsaws	Yes	Yes	No	No	Yes	Yes
	Other rec demands that may conflict with Wilderness values	No	OHV road separates Kelley Mtn PWA from St. Mary's W.				Hang gliding at Reddish Knob
OTHER AGENCY INTERESTS	Dept of Energy identified area as having wind power class 3 or greater	553 acres	1,077	1,185	1,416	438	5,804 acres
PUBLIC ACCESS	Presence of roads open year round or seasonally, miles	2.1 miles	1.9	2.1	No	No	3.8 miles
PUBLIC COMMENTS	Comments that provide additional information for assessing availability.	Nat'l IMBA Trail - Shen Mtn & Jerk Trails; keep trails open; okay with W on north block above The Bump; don't allow timber or road building on E side of Shenandoah Mtn.	Heavily used by mtn bikes on 3 trails throughout area; ; Keep open Cole Road. OHV trails wanted - NW portion; Along N bdy, D.N.H.B + B3 (?) and parallel loop trail would be nice (please no bikes); NSA	Manage for unique biological significance; Wilderness study area; serves many rec uses; energy use; hunting access; WL clearings; timber mgmt; leave it managed as is and lose opp to protect a valuable place; good wilderness; why wait?	Little access for W users; loss of WL mgmt; transmission lines, mineral rights; pvt interface concern for fire; inholding breaks up area; no conflicts in SE leg and intact watershed- agree with W; do not agree with W for SW leg; okay for W at N end.	High use from Douthat State Park; comp events; historic WL and timber should continue; mtn bikes and horses use Little Mare Mtn Trail; No to Wilderness; remote highlands or similar; NRA	Mult mtn bike trails; mgmt for grouse needed; agree to a core of wilderness with a perimeter of NSA that includes allowing mtn bikes on mult trails; yes to Wilderness- drinking water supply/watershe d

APPENDIX C2: TABLE C-10 AVAILABILITY		JERKEMTIGHT	KELLEY MOUNTAIN	LAUREL FORK	LITTLE ALLEGHANY	LITTLE MARE MOUNTAIN	LITTLE RIVER
RANGER DISTRICT		North River	Pedlar	Warm Springs	Warm Springs	Warm Springs	North River
SIZE OF PWA OR ADDITION (ACRES)		27,314	12,892	10,236	15,395	11,918	30,227
VIRGINIA MOUNTAIN TREASURES	Comments that provide additional information for assessing availability.	Relatively low elev lands with mod slopes; steep drainages; 22 miles of Shen Mtn Trail on crest; shale barrens are SMA; rare plants; 1,280 SBA; up to 6500 ac possible old growth.	Major creek drainages, native trout streams; several small waterfalls on Johns Run; eastern upland hardwoods; pockets of old growth Hemlock; dense laurel and rhodos in understory; diversity of rock types; steep rugged slopes, scree slopes; Big Levels with rare species; SBA; 958 acres of possible old growth; mult rec activities; 25 miles of trail incl loops.	Unique in VA-high, stream dissected plateau in Allegheny Mtns and the Ridge & Valley. Elev 1700 to over 4000 feet; northern hardwoods, white pine, unlike Appal oak forest; native brook trout; beaver ponds and meadows; 25 species ranked by DNR as rare in VA; 2/3 of area is SBA; up to 701 acres of possible old growth; existing trails offer access; opp for solitude due to remoteness of PWA.	Rock rubble ledges, bands of solid rock parallel to slope; steep, rugged, isolated; elev 1,850-4,200; Jim Dave Run almost totally within bdy of area; primitive rec opps; no maintained trails; hunter disp campsites; 4,161 acres of possible old growth.	Elev 3500-4000 on 3 mountains; deeply incised ridge; drainage for Clifton Forge reservoir, Jackson River; many trails offer 17 total miles-some tie to Douthat; scenic backdrop for Hot Spgs; borders large TNC reserve.	Largest IRA in VA; site chosen by Pres Clinton to announce his Roadless Area Initiative; elev 1600-4440'; headwaters for Little River and significant trib for North River; deep soils on Timber Ridge support large red oaks; pine on SW facing slopes; abundance of wildflowers; remote area-black bear; many threatened species; SBA and 5,87 acres of possible old growth; extensive trail network including NRT.

APPENDIX C2: TABLE C-10 AVAILABILITY		MASSANUTTEN NORTH	OAK KNOB-HONE QUARRY	OLIVER MOUNTAIN	PADDY KNOB	POTTS MOUNTAIN	RAMSEYS DRAFT ADDITION
RANGER DISTRICT		Lee	North River	James River	Warm Springs	James River	North River
SIZE OF PWA OR ADDITION (ACRES)		16,530	16,343	13,049	5,987	7,863	19,072
CATEGORIES OF OTHER RESOURCES	OTHER RESOURCES DEMANDS THAT THE AREA COULD SATISFY	Comments	Comments	Comments	Comments	Comments	Comments
TIMBER, VEGETATION AND FIRE - PAST AND CURRENT MANAGEMENT INVESTMENTS	Existing suitable timber from 1993 Plan	3,615 acres - entire east side of ridge and some on SW boundary	882 acres - NE boundary of PWA	No	2,149 acres on multiple spines from east boundary 2/3 across PWA; none in north	4,143 ac scattered across most of PWA except NNE corner	4,753 acres
	Timber sales harvested since 1993	2 units near NE boundary in 1994 and 2000; district notes some cutting units missing from GIS	4 units on NE boundary dating 1997	No	5 units; parts of 2 others 1993-1997; small along FDR 141	No	8 units dating from 1994-1995 along east bdy
	Timber sales currently under contract	No	No	No	No	No	No
	Presence of Rx burns or approved burns not completed yet.	No	Five burns encompass about 35-40% of PWA, dating 1979, 1991, 1998, 1999, 2002	No	Burned east flank of Paddy Knob (west bdy of PWA) in early 1990s	No	Very small area on NE boundary
	Existing surface contracts, permits, agreements that conflict with Wilderness	No	No	Yes	Yes	No	No
	Area contains Table mtn, Va, Pitch pine (Rx burn)	607	673 acres	1,735	52	190 acres	1,020 acres

APPENDIX C2: TABLE C-10 AVAILABILITY		MASSANUTTEN NORTH	OAK KNOB-HONE QUARRY	OLIVER MOUNTAIN	PADDY KNOB	POTTS MOUNTAIN	RAMSEYS DRAFT ADDITION
RANGER DISTRICT		Lee	North River	James River	Warm Springs	James River	North River
SIZE OF PWA OR ADDITION (ACRES)		16,530	16,343	13,049	5,987	7,863	19,072
MINERALS AND LANDS	Reserved/outstanding subsurface rights, acres	1,465 acres in 5 blocks: 2 large which stretch from FS bdy to bdy; no excluding them.	617 acres - rectangular mass on E end on top of Back Mtn; if any exploration or production activities occur in future, they might be visually evident; this area can be excluded with bdy adjustment.	No	No	91 acres just in from S. bdy where FDR 146 ends; south end of Little Mountain; would divide PWA in half to exclude. Cate-corner to NW is pvt jutting in.	5,784 acres; entire west side of Ramsey's Draft.
	Area contains land suitable for disposal on land adjustment map, acres		No	181	No	No	No
TES SPECIES AND WILDLIFE	Area contains TES and/or FS sensitive species or habitat enhanced by human intervention or disturbance	N. bristly sarsaparilla; 56 acre Nat. Heritage Program Biological Area	Bristly black currant, Mtn paper birch	Sword leaved phlox, App grizzled skipper, Smooth coneflower, Shale barren rockcress; 359 acre SBA and 372 acre Natural Heritage Program Biological Area	Morning Warbler		No
	Existing wildlife habitat improvements using mechanical methods that conflict with W.	Only 1 exists in GIS	Yes		Yes	Yes	3 WL openings on north end.
RECREATION	Competitive events	Yes	No	No	No	No	Yes

APPENDIX C2: TABLE C-10 AVAILABILITY		MASSANUTTEN NORTH	OAK KNOB-HONE QUARRY	OLIVER MOUNTAIN	PADDY KNOB	POTTS MOUNTAIN	RAMSEYS DRAFT ADDITION
RANGER DISTRICT		Lee	North River	James River	Warm Springs	James River	North River
SIZE OF PWA OR ADDITION (ACRES)		16,530	16,343	13,049	5,987	7,863	19,072
	Mountain biking - heavily used trails	Premiere technical trails maintained by vols	Mountain bike trails exist throughout the area - cannot be excluded.	More trails than shown on map.	No	No	Shen Mtn Trail and access on Sinclair Mtn Trail. Improvements planned for Sinclair Hollow trailhead.
	Horseback riding - heavily used trails	Yes	Yes	Yes	No	Yes	Yes
	Trail partners perform mtce with chainsaws	Yes	Yes	No	No	No	Yes
	Other rec demands that may conflict with Wilderness values		Rock climbing area with permanent anchors			Jeep trail on boundary b/w Potts Mtn PWA and Barbours Creek W.	Conf Breastworks; need to exclude Mtn House from area; competitive events on mtn trails on south end.
OTHER AGENCY INTERESTS	Dept of Energy identified area as having wind power class 3 or greater	1,378	1,111 acres	1,467	916	1,018 acres	1,666 acres
PUBLIC ACCESS	Presence of roads open year round or seasonally, miles	0.1	5.7 miles	2.4	1.7	No	1.0 mile

APPENDIX C2: TABLE C-10 AVAILABILITY		MASSANUTTEN NORTH	OAK KNOB-HONE QUARRY	OLIVER MOUNTAIN	PADDY KNOB	POTTS MOUNTAIN	RAMSEYS DRAFT ADDITION
RANGER DISTRICT		Lee	North River	James River	Warm Springs	James River	North River
SIZE OF PWA OR ADDITION (ACRES)		16,530	16,343	13,049	5,987	7,863	19,072
PUBLIC COMMENTS	Comments that provide additional information for assessing availability.	Prime mtn bike tech trails; mtce by vols; NSA or other special designation; include a block north of PWA on Green Mountain; status of inventory and status TBD (not clear of intent); all NSA Ridge & Valley or 12C JNF Plan	Mult mtn bike trails exist; develop OHV opps; yes to W-drinking water supply/watershed	More trails than shown on map-used by mtn bikes; 4WD road goes all the way through Hughes Draft; mtn bike use; more trails wanted in Lake front-country - potential shared use "stacked" loop trail system on N end; agree to Wilderness on SW end.	Lots of WL mgmt; change bdy to drop areas of active mgmt; Yes to W; Agree with W.	Maintain Children's Forest Trail; leave Potts Mtn Jeep Trail out of PWA; mineral rights may keep road open.	Inc. part of Nat'l IMBA Trail; mtn bike use important here; adjust bdy toward E and N of Trails 447, 448, 472, 496 to allow mtn bikes; expand W to the N of Ramsey's Draft; Expand this W! (on E side of existing). Want to continue mgmt activities on suitable eastern 1/4-1/3 of PWA.

APPENDIX C2: TABLE C-10 AVAILABILITY		MASSANUTTEN NORTH	OAK KNOB-HONE QUARRY	OLIVER MOUNTAIN	PADDY KNOB	POTTS MOUNTAIN	RAMSEYS DRAFT ADDITION
RANGER DISTRICT		Lee	North River	James River	Warm Springs	James River	North River
SIZE OF PWA OR ADDITION (ACRES)		16,530	16,343	13,049	5,987	7,863	19,072
VIRGINIA MOUNTAIN TREASURES	Comments that provide additional information for assessing availability.	Scenic backdrop to S. fork Shenandoah River; 15 miles of IRA; many outcrops along the crest; mult streams serve as tribs to S. Fork on the east and Passage Creek to N. fork on the west; recreational paradise; Massanutten Trail the entire length with side trails; Veach Gap shelter; S. Fork popular with canoeists; 3727 acres of possible old growth.	Good access from Hone Quarry rec area; >12.5 miles of trails; many existing disp rec activities; native trout fishery; many high knobs; stands of cove hardwoods in drainages; Cow Knob Salamander; up to 1952 acres of possible old growth.	Several creeks; eastern uplands hardwoods w/ Pitch, Table mountain and Virginia pines; elev up to 3,565 feet; steep and rugged; regaining natural appearance; trail goes through old growth; 2 VA SBAs; 1 GW SBA.	"Paddy Lick" has some of the highest elev in the GW -4477 feet. Steep ridge is dissected by streams incl Back Creek which provides fine whitewater paddling after significant rainfall. SBA and species like Bald eagle, Mourning warbler, undeveloped area; one trail; stands of old growth up to 2,649 acres.	"Toms Knob" views, elev up to 3800 feet; Many streams, several short trails; small SBA and small pockets of potential old grown.	"Bald Ridge/Lynn Hollow" should be given combo of designation; elev 2200-4200'; steep with short, choppy drainages on lower elev; some steep slopes >80%; ridge w/in PWA forms bdy b/w 2 major watersheds; large trees are notable; very picturesque; black bear habitat; VA NHD recommends Big Bald Knob as SIA with 4 species of concern; existing SBA; 6211 acres of possible old growth.

APPENDIX C2: TABLE C-10 AVAILABILITY		RICH HOLE ADDITION	RICH PATCH (GW PORTION)	ROUGH MTN ADDITION	ST. MARY'S NORTH	ST. MARY'S SOUTH	ST. MARY'S WEST
RANGER DISTRICT		James River & Warm Spgs	James River	Warm Springs	Pedlar	Pedlar	Pedlar
SIZE OF PWA OR ADDITION (ACRES)		12,165	5,625	2,063	3,006	1,651	278
CATEGORIES OF OTHER RESOURCES	OTHER RESOURCES DEMANDS THAT THE AREA COULD SATISFY	Comments	Comments	Comments	Comments	Comments	Comments
TIMBER, VEGETATION AND FIRE - PAST AND CURRENT MANAGEMENT INVESTMENTS	Existing suitable timber from 1993 Plan	3,152 acres	No	1,133 acres scattered throughout, except NNW tip	12 acres - very narrow along north boundary	137 acres in NNW boundary	No
	Timber sales harvested since 1993	Older cutting units at far south end.	No	No			
	Timber sales currently under contract	No	No	No			
	Presence of Rx burns or approved burns not completed yet.	Large area in N point in 2005.	No	No			
	Existing surface contracts, permits, agreements that conflict with Wilderness	Yes	No	No	No	No	No
	Area contains Table mtn, Va, Pitch pine (Rx burn)	944 acres	316	382	310	227	No
MINERALS AND LANDS	Reserved/outstanding subsurface rights, acres	No	No	No	630 acres; more than 20% of area in large block on N extending into center.	333	No
	Area contains land suitable for disposal on land adjustment map, acres	350 acres	No	553	No	No	No

APPENDIX C2: TABLE C-10 AVAILABILITY		RICH HOLE ADDITION	RICH PATCH (GW PORTION)	ROUGH MTN ADDITION	ST. MARY'S NORTH	ST. MARY'S SOUTH	ST. MARY'S WEST
RANGER DISTRICT		James River & Warm Spgs	James River	Warm Springs	Pedlar	Pedlar	Pedlar
SIZE OF PWA OR ADDITION (ACRES)		12,165	5,625	2,063	3,006	1,651	278
TES SPECIES AND WILDLIFE	Area contains TES and/or FS sensitive species or habitat enhanced by human intervention or disturbance	443 acre SBA in middle of PWA - Habitat for TES Species. 41 acre Natural Heritage Program Biological Area.	Pirate bush	Millboro leatherflower; 72 acre SBA	Var sedge, Mtn paper birch, Big Levels salamander	No	Big Levels salamander; 99 acre Natural Heritage Program Biological Area.
	Existing wildlife habitat improvements using mechanical methods that conflict with W.	Yes	No	No	Yes	Yes	Yes
RECREATION	Competitive events	No	No	No	No	No	No
	Mountain biking - heavily used trails	No	No	No	No	No	No
	Horseback riding - heavily used trails	No	No	No	No	No	No
	Trail partners perform mtce with chainsaws	No	No	No	No	No	No
	Other rec demands that may conflict with Wilderness values		Too many trails incl NRT; same Rx as JNF Plan	No			No
OTHER AGENCY INTERESTS	Dept of Energy identified area as having wind power class 3 or greater	1,043	1,111	No	857	111	No
PUBLIC ACCESS	Presence of roads open year round or seasonally, miles	4.5 miles	0.3	No	No	0.1	No

APPENDIX C2: TABLE C-10 AVAILABILITY		RICH HOLE ADDITION	RICH PATCH (GW PORTION)	ROUGH MTN ADDITION	ST. MARY'S NORTH	ST. MARY'S SOUTH	ST. MARY'S WEST
RANGER DISTRICT		James River & Warm Spgs	James River	Warm Springs	Pedlar	Pedlar	Pedlar
SIZE OF PWA OR ADDITION (ACRES)		12,165	5,625	2,063	3,006	1,651	278
PUBLIC COMMENTS	Comments that provide additional information for assessing availability.	Change bdy to exclude FS362 for hunters; mtn biking, hunting, fishing in area; protect area between Rough Mtn & Rich Hole Wildernesses to create larger block of W; need to hunt, harvest timber, game mgmt; remove from suitable; adjust to excl Tr 466. Close FDR 362.	Too many conflicts with mtn bike use for Wilderness; too many trails including NRT	Yes for Wilderness. Don't discount due to size - include with Rich Hole Addition acres.			Agree to Wilderness
VIRGINIA MOUNTAIN TREASURES	Comments that provide additional information for assessing availability.	Nothing specific; make bigger Wilderness with Rich Hole & Rough Mountain.	Not included.	Noting specific; make bigger Wilderness with Rich Hole & Rough Mountain.	Contains extremely inaccessible Russell Rock, unique geologic feature; 2910 acre SBA.	Known for steep V drainages and numerous scree slopes, esp Dogwood Hollow. Evidence of past include homestead site, mining activities from early 1900's, old mine fissure has become bat hibernaculum.	Addition B (St. Mary's W) is a recent FS acquisition. Cellar Hollow is a dominant geologic feature and contains cove hardwoods. Small stream is steep and rugged.

APPENDIX C2: TABLE C-10 AVAILABILITY		SHAWS RIDGE	SHAWVER'S RUN ADDITION	THREE RIDGES ADDITION SOUTH	THREE RIDGES ADDITION SOUTHWEST	THREE RIDGES ADDITION WEST	THREE RIDGES ADDITION NORTH	THREE SISTERS
RANGER DISTRICT		North River	James River	Pedlar	Pedlar	Pedlar	Pedlar	Pedlar
SIZE OF PWA OR ADDITION (ACRES)		7,268	84	187	9	90	83	9,871
CATEGORIES OF OTHER RESOURCES	OTHER RESOURCES DEMANDS THAT THE AREA COULD SATISFY	Comments	Comments	Comments	Comments	Comments	Comments	Comments
TIMBER, VEGETATION AND FIRE - PAST AND CURRENT MANAGEMENT INVESTMENTS	Existing suitable timber from 1993 Plan	148 acres along N bdy	84 acres - entire addition	187 acres - entire area	No	No	No	879 acres on SSE boundary and NW boundary
	Timber sales harvested since 1993	No	No					5 units dated 2004 on SE boundary
	Timber sales currently under contract	No	No					No
	Presence of Rx burns or approved burns not completed yet.	No	No					No
	Existing surface contracts, permits, agreements that conflict with Wilderness	Yes	No	No	No	No	No	No
	Area contains Table mtn, Va, Pitch pine (Rx burn)	396	No	No	No	No	No	387 acres
MINERALS AND LANDS	Reserved/outstanding subsurface rights, acres	4 acres	No	No	No	No	No	491 acres in small block on NW bdy can be excluded.
	Area contains land suitable for disposal on land adjustment map, acres	No	No	No	No	No	No	No

APPENDIX C2: TABLE C-10 AVAILABILITY		SHAWS RIDGE	SHAWVER'S RUN ADDITION	THREE RIDGES ADDITION SOUTH	THREE RIDGES ADDITION SOUTHWEST	THREE RIDGES ADDITION WEST	THREE RIDGES ADDITION NORTH	THREE SISTERS
RANGER DISTRICT		North River	James River	Pedlar	Pedlar	Pedlar	Pedlar	Pedlar
SIZE OF PWA OR ADDITION (ACRES)		7,268	84	187	9	90	83	9,871
TES SPECIES AND WILDLIFE	Area contains TES and/or FS sensitive species or habitat enhanced by human intervention or disturbance	Shale barren rockcress; SBA on SE boundary	No	No	No	No	No	No
	Existing wildlife habitat improvements using mechanical methods that conflict with W.	Yes	Yes	Yes	Yes	Yes	Yes	3 wildlife openings, Sheps Pond?
RECREATION	Competitive events	No	No	No	No	No	No	Yes
	Mountain biking - heavily used trails	No	No	No	No	No	No	No
	Horseback riding - heavily used trails	No	No	No	No	No	No	No
	Trail partners perform mtce with chainsaws	No	No	No	Yes	No	Yes	Yes
	Other rec demands that may conflict with Wilderness values		No					
Other Agency Interests	Dept of Energy identified area as having wind power class 3 or greater	No	No	11	No	No	18	614 acres
Public Access	Presence of roads open year round or seasonally, miles	1.3	No	No	No	No	No	1.3

APPENDIX C2: TABLE C-10 AVAILABILITY		SHAWS RIDGE	SHAWVER'S RUN ADDITION	THREE RIDGES ADDITION SOUTH	THREE RIDGES ADDITION SOUTHWEST	THREE RIDGES ADDITION WEST	THREE RIDGES ADDITION NORTH	THREE SISTERS
RANGER DISTRICT		North River	James River	Pedlar	Pedlar	Pedlar	Pedlar	Pedlar
SIZE OF PWA OR ADDITION (ACRES)		7,268	84	187	9	90	83	9,871
PUBLIC COMMENTS	Comments that provide additional information for assessing availability.	Manage for WL and timber; maintain roadless	None					Agree to wilderness for western portion-keep AT and FDR 36D out of wilderness; area used for adventure competitions; NSA; WL mgmt.

APPENDIX C2: TABLE C-10 AVAILABILITY		SHAWS RIDGE	SHAWVER'S RUN ADDITION	THREE RIDGES ADDITION SOUTH	THREE RIDGES ADDITION SOUTHWEST	THREE RIDGES ADDITION WEST	THREE RIDGES ADDITION NORTH	THREE SISTERS
RANGER DISTRICT		North River	James River	Pedlar	Pedlar	Pedlar	Pedlar	Pedlar
SIZE OF PWA OR ADDITION (ACRES)		7,268	84	187	9	90	83	9,871
VIRGINIA MOUNTAIN TREASURES	Comments that provide additional information for assessing availability.	Headwaters for both James & Potomac Rivers; Shale barren SBA at SE end; rare fishes downstream; 1 trail; access by 2 FS roads; beautiful scenery for US 250 travelers; up to 2619 ac possible old growth.	This small triangular addition was not specifically included in report.	Not included.	Not included.	Not included.	Not included.	North slope of James River Gorge, on bdy of 2 LTAs; elev ranging from 900-3400'; several small streams drain to Maury River; native trout stream; headwaters of Otter Creek; prominent geological feature in Rocky Row Ridge; outstanding views of James River and JR Face W; several trails including AT; 2777 acres of possible old growth.

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APPENDIX D – WILD AND SCENIC RIVERS ELIGIBILITY DETERMINATION

The 1993 Forest Plan Revision included an extensive review and evaluation of the rivers of the George Washington National Forest. Appendix D of the 1993 Forest Plan was reviewed. The information and determinations documented in Appendix D remain valid with minor changes in conditions.

Public comments did identify some additional rivers for consideration. These included Trout Run, Waites Run, Stony Creek (North of Bayse), German River, Benson Run, Stuart Run (with Buck Lick and Bolshers Run), Mill Creek (Maury River), Wilson Creek, Mill Creek (Cowpasture River), Jim Dave Run, Potts Creek, Little Back Creek, Crow Run (with Little Crow Run), and Big Mary's. A review of these streams identified no nationally or regionally outstandingly remarkable values in recreation, scenery, wildlife, geology, botany or heritage resources. Under the fisheries resource we did identify that Potts Creek and Mill Creek provide habitat for the James spinymussel. However, in both of these cases, the location of the mussel is downstream of National Forest System lands.

I. INTRODUCTION

This appendix contains evaluations of 14 rivers located in or close to the George Washington National Forest. These evaluations determine which of the 14 rivers have qualities that make them eligible for inclusion in the National Wild and Scenic River System. The evaluations also determine whether the eligible rivers should receive wild, scenic, or recreational river classification.

A determination locally that a river is eligible does not necessarily mean that it will meet suitability criteria when, in the final stages, it is evaluated from a national perspective. Eligibility evaluations are an initial step in a process that ultimately requires action by Congress to include a river in the National Wild and Scenic River System.

The Forest Service completed the eligibility and classification evaluations contained in this Appendix. Suitability evaluations for each of the eligible rivers are being performed by a combination of state and federal agencies and will be published at a later date. The suitability studies are the final step in determining whether or not a river is recommended to Congress for further consideration.

The evaluations presented here are in accord with the National Wild and Scenic Rivers Act of 1968 (the Act) and in response to the Nationwide Rivers Inventory (National Park Service, January 1982) and the concerns of the American Rivers Conservation Council.

II. THE EVALUATIONS: WILD AND SCENIC DESIGNATIONS FOR LOCAL RIVERS

Stream miles listed are approximate and were taken from maps on a scale of 1/2 inch = 1 mile.

Back Creek

For evaluation purposes, Back Creek is divided into three segments. Back Creek is described in this report from its confluence with the Jackson River, north to its headwaters. A total of 32.79 miles is considered in this evaluation. The majority of the stream corridor is in private ownership. George Washington National Forest land is on both sides of the creek for a total of 2.35 miles and on one side of the creek for an additional 1.52 miles. Both the streambanks and the stream are subject to riparian rights, since the stream is not considered navigable. This limits river access and use to property owners and guests. Back Creek is located entirely within Bath County, where officials have expressed concern about additional federal control of land in the county.

Segment A - From Lake Moomaw to State Route 39 (5.59 miles)

This 5.59-mile segment flows through Back Creek Gorge. Blowing Springs Campground at State Route 39 provides the only public access until Lake Moomaw. The Virginia Commission of Outdoor Recreation found this segment eligible for inclusion in the Virginia Scenic Rivers System. This free-flowing stream traverses 2.35 miles (both banks) and 0.01 miles (one bank) of the Forest. There is little development along this segment and little disturbance. Water quality is considered average to good. There is some canoe use along Segment A when the water is high. There are several jeep trails, but no developed roads along this segment of Back Creek.

Eligibility of Back Creek - Segment A by:

Scenic Value: There is little development along this section of Back Creek. The corridor is considered attractive where the stream passes through the gorge. Overall the stream is small-to-medium in size, with a few medium-size pools. The rate of flow is medium except during storm periods. Topography along this segment is relatively steep. The forest cover consists of hardwoods mixed with hemlock and pine. Understory species are those common to the area. Large boulders add visual variety to the streambed in several locations. A Class A-Distinctive rating is assigned to the scenic values.

Recreational Value: Recreation use along Segment A consists of fishing, canoeing, and kayaking. Most of this use comes from adjacent landowners who post their property and prevent public access. During periods of high water, the segment through Back Creek Gorge from Blowing Springs to Lake Moomaw is used by both canoeists and kayakers. With Class 2 and 3 rapids present, this is an excellent white-water creek. This section is not classed as navigable. A Class A-Distinctive rating is assigned to the recreation values.

Geologic Value: This segment contains interesting geological formations, including outcroppings and high cliffs through the gorge area. A Class A-Distinctive rating is assigned to the geologic values.

Fish and Wildlife Values: This segment is not considered to be an outstanding fishery. Some fish do enter Back Creek from Lake Moomaw, including spawning rainbow trout. Because the adjacent private property is posted, access is limited. This corridor provides habitat for wildlife species typical of the Forest. A Class B- Common rating is assigned to the fish and wildlife values.

Historic and Cultural Values: There are known prehistoric and historic sites along this segment that are eligible for the National Register of Historic Places. It is probable that additional prehistoric sites exist. A Class A-Distinctive rating is assigned to the historic and cultural values.

Eligibility Determination: Segment A of Back Creek is eligible for designation under the Wild and Scenic Rivers Act because it is free-flowing and has outstandingly remarkable scenic, recreational, geologic, historic, and cultural values.

Classification Determination: Because Segment A of Back Creek is eligible for designation, it is necessary to determine the appropriate classification. According to the criteria in FSH 1909, Chapter 8, the entire 5.59 miles can qualify for inclusion in the system under the scenic classification. This classification is based primarily on the fact that development along the river is sparse and existing roads are inconspicuous.

Segment B - From Blowing Springs Campground to Pump Storage Lake (9.96 miles)

This 9.96-mile segment is located within Bath County. The majority of land along this segment is privately owned. Back Creek touches National Forest System land at four locations on one side for a total distance of 1.51 miles. This segment is not considered to be navigable. There are no impoundments along this segment. State Highway 39 and County Road 600 parallel the shoreline and are evident from the stream. Open farm land, houses and bridges are common features. The size of the stream is medium to small. The flow is regulated by the Back Creek Pump Storage project and is extremely low during the summer months. Most of the private property is posted. Forest and agricultural practices are evident within the stream corridor. Water quality is average to good. The segment is suitable for fish and wildlife propagation and some recreational activities.

Eligibility of Back Creek - Segment B by:

Scenic Value: Segment B of Back Creek is typical of many streams in the area. It is an attractive creek, but has no distinctive or outstanding features. The stream is shallow with small pools with a gradual gradient. The current is fairly slow with uniform flow characteristics. During storm periods and when water is released from the pump storage lake, the rate of flow increases. The gently rolling valley is bordered by steep mountain terrain and varies in width. The forest cover consists of mixed hardwoods and pine with common understory species. Open farm land borders the creek in many locations. A Class B-Common rating is assigned for scenic values.

Recreational Value: Current recreation use includes swimming, canoeing and fishing by adjacent landowners. Virginia Power has developed a trout fishery and recreation facilities along this segment and provides public access to the river along the upper mile of the segment. This segment is not considered navigable. A Class B-Common rating is assigned for recreational values.

Geologic Value: This segment has no unusual rock outcroppings or other geologic features. The corridor consists primarily of farm land and forest land typical of the area. A Class C-Minimal rating is assigned to the geologic values.

Fish and Wildlife Values: This segment of Back Creek supports a trout fishery from the dam, downstream for one mile. The area provides habitat for wildlife species typical of the Forest. A Class B-Common rating is assigned to the fish and wildlife values.

Historic and Cultural Values: There are known prehistoric and historic sites located along this segment. Information on these sites is documented in studies conducted by the Archaeology Laboratory at James Madison University. Additional sites probably exist. A Class A-Distinctive rating is assigned to the historic and cultural values.

Eligibility Determination: Segment B of Back Creek is eligible for designation under the Wild and Scenic Rivers Act because it is free-flowing and has outstandingly remarkable historic and cultural values.

Classification Determination: Because Segment B of Back Creek is eligible for designation, it is necessary to determine the classification that would result from designation. According to the criteria in FSH 1909, Chapter 8, the entire 9.96 miles can qualify for inclusion in the system under the recreational classification. This determination is based primarily on the fact that much of the private land adjacent to the river contains residential structures and agricultural facilities.

Segment C - Back Creek Pump Storage Project to Headwaters (17.24 miles)

The majority of this 17.24-mile segment is in Highland County; approximately 1.5 miles are located in Bath County. The portion in Highland County serves as the Forest boundary. This entire segment has been extensively channelized as a result of the floods of 1969, 1972, and 1985. This segment is not considered navigable. The stream is small with low rates of flow except during major storm events. There is no National Forest System land along this segment. State roads parallel and cross this segment in several locations. The stream is free-flowing.

Eligibility of Back Creek - Segment C by Value:

Scenic Value: Segment C of Back Creek is attractive, but has no features that rate as distinctive or outstanding. The stream is shallow with a few small pools and a gradual gradient. The current is fairly slow with uniform flow characteristics. During storm periods, the rate of flow increases considerably. The gently rolling valley is bordered by steep mountains that vary the width of the valley. The forest cover is typical mixed hardwoods and pine with common understory species. There is a lot of open farm land adjacent to the Creek. A Class C-Minimal rating is assigned for scenic values.

Recreational Value: Current recreation use is limited to swimming and fishing by adjacent landowners. This segment is not considered navigable. Public access is not available on this segment. A Class C-Minimal rating is assigned for recreational values.

Geologic Value: This segment has no unusual rock outcroppings or other geologic features. The corridor consists of farm land and forest land typical of the area. A Class C-Minimal rating is assigned to the geologic values.

Fish and Wildlife Values: This segment does not support a sport fishery. The area provides habitat for wildlife species typical of the Forest. A Class C-Minimal rating is assigned to the fish and wildlife values.

Historic and Cultural Values: There are no known prehistoric or historic sites along this segment, but there is a probability that prehistoric sites do exist within the corridor. Since no systematic survey has been conducted along this section, a Class B-Common rating is assigned to the historic and cultural values.

Eligibility Determination: Segment C of Back Creek is not eligible for designation under the National Wild and Scenic Rivers Act due to the amount of disturbance to the stream channel and the lack of outstandingly remarkable values. For these reasons, this segment will not be studied further for designation under the Wild and Scenic River Act.

Bullpasture River

The Bullpasture River is divided into two sections for purposes of this evaluation. The Bullpasture is described from its confluence with the Cowpasture River north to its headwaters. There is no federal land ownership along the Bullpasture River. The lower two miles of the Bullpasture are located in Bath County with the remainder in Highland county. A total of 18 miles is studied for eligibility for the National Wild and Scenic River System.

Segment A - The Bullpasture Gorge

There is no federal ownership along this 3-mile segment of the Bullpasture River. The segment stretches from the confluence with the Cowpasture River to a ford where Route 609 departs from Route 678. The majority of this segment is in Bath County and is inside the Forest boundary. The gorge is scenic with large boulders and cliffs and presents a challenge to the white-water enthusiast. This area is stocked with trout under the state put-and-take system.

Eligibility of Bullpasture River - Segment A by:

Scenic Value: The section of the Bullpasture River in the gorge contains rock bluffs and large boulders. The stream is typically shallow and small. The rate of flow can vary greatly with periods of rain and drought. For the most part, however, it is relatively slow. There is a fairly steep gradient through this section. Forest types include mixed hardwoods and some pine and hemlock. The paved state road is adjacent to the stream and is very evident from the stream. A Class A-Distinctive rating is assigned to the scenic values.

Recreational Value: This section is stocked by the VDGIF with trout under the put-and-take program. According to the book Virginia White Water by H. Roger Corbett, this section offers big white-water consisting of Class 3, 4 and 5 rapids. The gorge is not navigable year-round and is considered dangerous during periods of high water. The stream is shallow with large boulders in this section. A Class A-Distinctive rating is assigned to the recreational values.

Geologic Value: This section has rock bluffs and cliffs. There are large boulders in the stream. A Class A-Distinctive rating is assigned to the geologic values.

Fish and Wildlife Values: This section is stocked with trout by the VDGIF under the put-and take program. The wildlife species of the area is typical of the Forest. A Class B-Common rating is assigned to the fish and wildlife values.

Historic and Cultural Values: There are no known prehistoric or historical sites along this section. No survey has been conducted along the Bullpasture River. A Class B-Common rating is assigned to the historic and cultural values.

Eligibility Determination: Section A of the Bullpasture River, including the Bullpasture Gorge, is eligible for designation under the National Wild and Scenic Rivers Act because it is free-flowing and has outstandingly remarkable scenic, recreational, and geologic values.

Classification Determination: Because Segment A is eligible for designation, it is necessary to determine the classification that would result from designation. According to the criteria established in FSH 1909, Chapter 8, the entire three-mile segment qualifies under the scenic classification. The determination is based on the fact that the segment has outstanding scenic values, but is bordered by paved Route 678.

Segment B - North of the Bullpasture Gorge to the headwaters

This 15-mile segment of the Bullpasture River has been heavily channelized from the Highland Wildlife Management Area to the headwaters. There are paved state roads adjacent to the stream and sections of the road have heavy limestone rip-rap for flood protection. Due to disturbances including channelization, Segment B does not qualify under the National Wild and Scenic Rivers Act.

Cacapon – Lost River

The 89-mile segment described in the Nationwide Rivers Inventory begins at the dam below Great Cacapon and ends at Baker, West Virginia. A segment of this river is a congressionally mandated study river. The study was completed by the U.S. Department of Interior, Park Service, in the summer of 1982. The Department of Interior study team found the river unsuitable because of lack of public support for designation and did not recommend inclusion in the national system.

Based on findings in the National Park System report, the Cacapon-Lost River will not be considered further.

Cedar Creek

This 25-mile evaluation segment of Cedar Creek is located in Shenandoah and Frederick counties. The section begins at the State Route 622 bridge and ends at its headwaters in the Lee District of the Forest. The majority of land along the creek is privately owned.The Forest Service owns land adjacent to the headwaters for a total of 2.65 miles. The majority of the stream is located outside the Forest boundary.

Cedar Creek is a small stream with sections in its headwaters that go dry every year. Private property within the corridor is largely undeveloped and is a mixture of agriculture and forest land. Forest and agricultural practices are evident along most of the stream. Development on the private property is starting to occur. There are houses, cabins, and two private fish hatcheries. Most private property is posted. Water quality is average. A small native brook trout population is in the extreme headwaters. The stream has been stocked with trout under the state's put-and-take program in the past, but due to littering, parking problems, and acid deposition, the program was halted. Both regular and low-water bridges cross the stream.

Eligibility of the Cedar Creek 25-mile Segment by:

Scenic Value: Cedar Creek flows over gently rolling terrain where mountains are visible in the background. There are no distinctive or outstanding features within the corridor. The stream is relatively small and shallow at the headwaters, but becomes larger with pools toward the end of the evaluation segment. The majority of the reach on the Forest goes dry during the summer. Because of the gently rolling terrain, the creek has uniform flow characteristics. During storm periods, the flow is faster and higher. The adjacent forest cover is typical mixed hardwood and pine with common understory species. A Class B-Common rating is assigned to scenic values.

Recreational Value: Current recreation use consists of fishing, canoeing, and kayaking. Fishing activity is curtailed since the stream is no longer stocked under the state's put-and-take program.There is some bass fishing along the lower reach outside of the Forest boundary. Most of the private property along the creek is posted so there is little public access outside the Forest. The stream is not classified as navigable. A Class B-Common rating is assigned to the recreational values.

Geologic Value: There are no unusual or outstanding rock outcroppings, cliffs or other geological formations along the stream. The "Three High Heads" of Paddy Mountain are visible from Cedar Creek Valley. A Class B-Common rating is assigned to the geologic values.

Fish and Wildlife Values: The stream is no longer stocked with trout under the state's put-and-take program. Smallmouth bass, rock bass, sunfish, and some other species occur in the lower reach of the stream. There is a small population of brook trout in the headwaters. The headwaters are badly impacted by acid deposition. The area provides habitat for wildlife species typical of the Forest. A Class C-Minimal rating is assigned to the fish and wildlife values.

Historic and Cultural Values: Stevens Fort, an old iron furnace, and two tannery sites are located within the corridor and have the potential for historical significance. A Class A-Distinctive rating is assigned to the historic and cultural values.

Eligibility Determination: With the exception of the intermittent headwaters, Cedar Creek is eligible for designation under the National Wild and Scenic Rivers Act. The intermittent headwaters are defined as that section of the creek from its headwaters down to where the creek crosses the boundary between the Forest and private land at approximately the 1,330-foot contour. The creek is free-flowing and has outstandingly remarkable historic and cultural values.

Classification Determination: Because Cedar Creek is eligible for designation, it is necessary to determine the classification that could result from designation. According to the criteria in FSH 1909, Chapter 8, a total of 20 miles qualifies for inclusion in the system under the scenic classification.

Cowpasture River

For evaluation purposes, the Cowpasture River is divided into four segments. The Cowpasture is described in this report from its confluence with the James River to its headwaters to the north. The Forest Service currently owns a total of 3.5 miles of land on one side of the river only. This 3.5 miles of riverbank land is divided among 10 tracts and is not contiguous. Forest Service ownership of the land on both sides of the river totals 4.5 miles on three tracts which are not contiguous. A total of 78.11 miles is studied for eligibility for the National Wild and Scenic River System.

The State of Virginia selected the portion of the Cowpasture River from Panta to Route 42 for further evaluation as a component of the Virginia Scenic Rivers System. Banks and stream are subject to riparian rights since the majority of the stream is not declared navigable. The Virginia Department of Game and Inland Fisheries (VDGIF) states that the section from the U.S. Route 60 bridge to the confluence with the Jackson River is declared navigable.

Citizen interest in designation of the Cowpasture River is strong. The Cowpasture Property Owners Association is a group of landowners who organized for the purpose of participating in the designation process.

Segment A - Confluence with the Jackson River to Route 42 Bridge

The majority of this 16-mile segment is within Alleghany County. National Forest System land borders the river on one side only for three miles and at three different locations. The VDGIF states that the portion between U. S. Route 60 bridge and the confluence with the Jackson River is navigable. There are no impoundments along this segment. Portions of Segment A are paralleled by roads, including State Highway (SH) 42. It is crossed by roads and/or highways four times, including Interstate 64, and by a railroad line three times. There is no developed trail access to the river. Most of the shoreline along this segment currently consists of forest and agricultural land where management of these lands is evident. There is some development along the river including cabins, houses, and a private campground. Most of the adjacent private land is posted against trespassing. This segment is suitable for fish and wildlife propagation, wading, and canoeing.

Eligibility of Cowpasture River - Segment A by:

Scenic Value: Segment A of the Cowpasture River is an attractive river that is typical of rivers within the George Washington National Forest and the surrounding area. It has no features that rate as distinctive or outstanding. The stream is shallow, medium in width with some large pools, and has a gradual gradient. The current is fairly slow with no waterfalls, cascades of significant whitewater. The valley bottom is gently rolling with steep mountain terrain bordering it on one side. Several shale bluffs are evident from the river. Forest cover along the river is mixed hardwood and pine with common understory species. A Class B-Common rating is assigned to the scenic values.

Recreational Value: Current recreation use of Segment A is limited to fishing, canoeing, tubing, and swimming by adjacent landowners. The section between the U.S. Route 60 bridge and the confluence with the Jackson River is considered navigable by the VDGIF. This segment receives high use by tubers and canoeists. Public access is limited to two locations: from the Route 42 bridge and from national forest land on the Evans Tract off State Road 633. This limited access keeps river use down. A Class A-Distinctive rating is assigned to the recreational values.

Geologic Value: This segment has no unusual rock outcroppings. Two shale bluffs are visible from a short segment of the stream. The corridor consists of farm land and forest types typical of the George Washington National Forest. A Class C-Minimal rating is assigned to the geologic values.

Fish and Wildlife Values: This segment supports a sport fishery of smallmouth bass and muskellunge with other species such as sunfish. Spawning muskellunge -- a rarity in the state -- are present in this segment. The area provides habitat for wildlife species typical of the Forest. A Class A-Distinctive rating is assigned to the fish and wildlife values.

Historic and Cultural Values: There are known prehistoric sites on the main terraces of the river on National Forest System land. It is likely that additional prehistoric sites exist on private property along the river. Evidence of an antebellum mansion can be found on the government owned Evans (#1657) Tract. Again, there is a high probability that undiscovered and potentially significant prehistoric sites exist within this river corridor. A Class A-Distinctive rating is assigned to the historic and cultural values.

Eligibility Determination: Segment A of the Cowpasture River is eligible for designation under the Wild and Scenic Rivers Act. It is free-flowing and determined to have outstandingly remarkable recreational and fish and wildlife values.

Classification Determination: Because Segment A of the Cowpasture River is eligible for wild and scenic river system, it is necessary to determine its potential classification as either wild, scenic, or recreational. According to criteria in FSH 1909, Chapter 8, the entire 16 miles qualifies for inclusion in the system under the recreational classification. This determination is based primarily on the fact that several major highways and railroad bridges cross and parallel this section of the river.

Segment B - From Route 42 Bridge to the confluence with the Bullpasture River

This 48.11-mile segment is located entirely within Bath County. National Forest System land borders on one side only for 4.33 miles and is spread out over seven locations. Forest Service lands border both sides for 4.28 miles at two locations. There is one small dam near Millboro Springs, a few low-water bridges and a few swinging foot-bridges, including one on national forest land. Portions of Segment B are paralleled by roads. Other roads provide access to the river. There is one foot-trail on National Forest System land that provides access to the river.

The shoreline is largely undeveloped and is a mixture of forested and agricultural land. The development that exists includes cabins, houses, and tilled farm land. The majority of the adjacent private land is posted. Forest and agricultural practices are evident within the stream corridor. The segment is suitable for fish and wildlife propagation, wading, canoeing, and other uses. Water quality is average. Three locations provide public access along this segment. This segment has not been declared navigable.

Eligibility of Cowpasture River - Segment B by:

Scenic Value: Segment B of the Cowpasture River is typical of many rivers in the Forest and the area. The stream is small-to-medium in width and shallow, with some large pools of water. It has a gradual gradient and no stretches of whitewater. The current is fairly slow with uniform flow characteristics. The valley bottom is gently rolling with steep mountain terrain bordering one side. No cliffs or other rock formations are evident along this segment. The forest cover is typical mixed hardwood and pine with common understory species. A Class B-Common rating is assigned to the scenic values.

Recreational Value: Current recreation use of Segment B consists of fishing, canoeing, tubing, and swimming by adjacent landowners and the general public along tracts owned by the Forest Service. Public access is limited. This river segment has not been declared navigable. Due to these factors, recreational use is limited. A Class B-Common rating is assigned to the recreational values.

Geologic Value: This segment has no unusual rock outcroppings. The corridor consists of farm land and forest typical of the George Washington National Forest. A Class C-Minimal rating is assigned to the geologic values.

Fish and Wildlife Values: This segment supports a sport fishery of smallmouth bass, muskellunge, and other species such as sunfish. Spawning muskellunge--a rarity in the state--are present in this segment. The area provides habitat for wildlife species typical of the Forest. The majority of the private property along this segment is posted and severely limits fishing-and-wildlife-related access. A Class A-Distinctive rating is assigned to the fish and wildlife values.

Historic and Cultural Values: There are known prehistoric archeological sites on the Forest. There is a high probability that additional prehistoric sites exist in the corridor on both private and federal lands. A known historic site exists on the Forest-Service-owned Wallace Tract.The tract includes an old brick house which may have historical value and may qualify for the National Register of Historical Places. Another historical site with potential exists on the Walton Tract.The tract contains the remains of several old homesites. Dickinson Fort is another potentially significant site located within the corridor. A Class A-Distinctive rating is assigned to the historic and cultural values.

Eligibility Determination: Segment B of the Cowpasture River is eligible for designation under the National Wild and Scenic Rivers Act. It is free-flowing and has outstandingly remarkable fish and wildlife and historic and cultural values.

Classification Determination: Because Segment B of the Cowpasture River is eligible for designation, it is necessary to determine its potential classification as either wild, scenic, or recreational. According to the criteria in FSH 1909, Chapter 8, the entire 48.11-mile segment qualifies for inclusion in the system under the recreational classification.This classification is based on the fact that several roads cross the river and that concentrated development exists along the river in the area of Millboro Springs. In addition, there is a small dam on the river in the Millboro Springs area.

Segment C - Confluence with Bullpasture River to Patna

The majority of this six-mile segment is within Highland County. It is not considered navigable.The river is free-flowing, but small. Segment C is inside Forest boundaries. There is no public access and the majority of the adjacent private property is posted. Roads parallel and cross the river at several locations. Upper reaches of the river go dry during extended dry periods. Adjacent land is farm land with sections of hardwood and pine and is used for pasture, primarily. Little opportunity exists for fish propagation, wading, canoeing, and other forms of recreation. The river passes through a section of a state wildlife management area for about 1.5 miles. Of note, the section downstream from Panta to the end of segment C and part of Segment B has been selected by the state for further evaluation as part of the Virginia Scenic Rivers System.

Eligibility of Cowpasture River - Segment C by:

Scenic Value: Segment C is typical of the upper reaches of rivers in the area. It is attractive, but has no distinctive or outstanding features. It is small-to-medium in size with low-flow except during major storm periods. The current is fairly slow with uniform flow characteristics. The topography of the valley is gently rolling with steep bordering mountains. No rock outcroppings are evident. The forest cover is typical hardwood and pine with common understory species. A state highway parallels the stream and several houses are scattered along its banks. A Class C-Minimal rating is assigned to the scenic values.

Recreational Value: Current recreation use is limited to adjacent landowners and consists of fishing and swimming. There is no public access to Segment C. The stream does not have sufficient flow for boating except during major storm periods. A Class C-Minimal rating is assigned to the recreational values.

Geologic Value: This section has no unusual rock outcroppings except near the confluence with the Bullpasture River. The corridor consists of farm land and forest types typical of the area. A Class C- Minimal rating is assigned to the geologic values.

Fish and Wildlife Value: This section does not support a sport fishery.The area provides habitat for wildlife species typical of the area. A Class C-Minimal rating is assigned to the fish and wildlife values.

Historic and Cultural Value: There are no known archeological or historical sites along this section, but there is a probability for archeological sites. Since no survey has been conducted, a Class B-Common rating is assigned.

Eligibility Determination: With no outstandingly remarkable values present, Segment C of the Cowpasture River is not eligible for designation under the National Wild and Scenic Rivers Act. Segment C will not be studied further for designation.

Segment D - Patna to the headwaters

The majority of this 8-mile segment is within Highland County. From Patna to the headwaters, the stream has been channelized in many locations. Channelization was done in response to the floods of 1969, 1972, and 1985. Segment D is not considered navigable. The river is free-flowing, but small in size. This segment is within the Forest boundary. There is no public access and the majority of adjacent private property is posted. Roads parallel and cross the river at several locations. Upper reaches of the river go dry during extended dry periods. Adjacent land is farm land that is used primarily for pasture, with sections of hardwood and pine woodlands. Little opportunity exists for fish propagation, wading, canoeing, or other forms of recreation.

Due to channelization of the river, the section from Panta to the headwaters will not qualify for wild and scenic river designation and will not be considered further.

Dry River

This stream is not on the National Rivers Inventory. In response to an appeal by the American Rivers Conservation Council, this river was reviewed on-the-ground by the Forest and American Rivers. A 22-mile segment of the Dry River was studied, including the portion from the headwaters to where the river exits the Forest boundary. This river received major damage during the floods of 1969, 1972, 1985, and several earlier floods. The river is heavily channelized.There are some impoundments on the river, including the city of Harrisonburg water supply diversion dam at Riven Rock Park and dams on the upper mainstem, Skidmore Fork, and Dry Run.

Because of the extensive channelization, Dry River is not free-flowing and is not eligible for inclusion in the wild and scenic river system.

Irish Creek

This stream is not on the National Rivers Inventory. In response to an appeal by the American Rivers Conservation Council, Irish Creek was reviewed on-the-ground by representatives of the George Washington National Forest and American Rivers. An 8.5-mile segment was studied, from the headwaters to where Irish Creek exits the Forest boundary. An on-the-ground evaluation of this stream showed that it was heavily damaged during the floods of 1969, 1972, and 1985. Extensive channelization and gabion structures dominate the entire evaluation segment. Because of the extensive channelization, Irish Creek is not free-flowing and is not eligible for inclusion in the wild and scenic river system.

Jackson River

The 42.69 miles of the Jackson River being considered here was divided into four segments for evaluation purposes. The Jackson is described in this report from its headwaters south to an area called Clearwater Park, located just north of Covington, Virginia. Forest Service ownership along the Jackson River is non-contiguous. Segments of the Jackson have been evaluated by the Virginia Commission of Outdoor Recreation and found worthy of inclusion in the Virginia Scenic River System. Citizen interest in any proposed wild and scenic river designations would be extremely high.

Segment A - U.S. Forest Service lands at the northern boundary of the Hidden Valley Tract to the headwaters

This segment is within Bath and Highland counties and contains approximately 14.3 miles. The majority of property along this segment is privately-owned and 75 percent of this segment is outside the Forest boundary. The private property is posted. This segment is not considered navigable. The portion in Highland County is outside the Forest boundary. This segment touches Forest land at two locations for an approximate distance of 0.66 miles in Bath County near Star Chapel. This segment is paralleled by State Highway 220 and is bridged by Highway 220 and county roads 607 (twice), 606, and 608. The segment was heavily channelized in several locations after the floods of 1969, 1972, and 1985. The disturbed sections are short, but scattered over the entire length.

Eligibility of Jackson River - Segment A by:

Scenic Value: Segment A of the Jackson River is typical of the rivers in this part of the state. Although attractive, it has no distinctive or outstanding features. The stream is medium-to-small and for the most part, shallow. A few pools are scattered along this reach. The current is slow, with uniform flow characteristics. The valley is gently rolling with steep mountain terrain on one side near the river. There are no rock cliffs, ledges or shale bluffs evident from the stream. The forest cover is typical mixed hardwood and pine with common understory plants. The majority of the bordering land is private farming with pasture land along the river. Many of these bordering properties are developed with houses, barns, bridges, and other structures. This segment is paralleled by State Highway 220. A Class C-Minimal rating is assigned to the scenic values.

Recreational Value: Current recreation use of Segment A is limited to fishing and swimming by adjacent landowners. This segment is not considered navigable. A Class C-Minimal rating is assigned to the recreational values.

Geologic Value: This segment has no unusual or outstanding geological features. The corridor consists of farm land and forests typical of the GWNF area. A Class C-Minimal rating is assigned to the geologic values.

Fish and Wildlife Values: Parts of this segment support smallmouth bass, sunfish and other species. Fishing access is limited due to adjacent private property. The area provides habitat for wildlife species typical of the Forest. A Class C-Minimal rating is assigned to the fish and wildlife values.

Historic and Cultural Values: Although a systematic survey has not been conducted along this segment, there are known prehistoric sites located on private land adjacent to the river. Because these sites have not been evaluated for significance, a Class B-Common rating is assigned to the historic and cultural values.

Eligibility Determination: Due to channelization and development along the river, Segment A of the Jackson River is not eligible for designation. This same conclusion was reached by the Virginia Commission of Outdoor Recreation in their study. For these reasons this segment will not be evaluated further for designation under the National Wild and Scenic Rivers Act.

Segment B - From Hidden Valley southern boundary to U.S. Forest Service lands at the northern boundary of the Hidden Valley Tract (7.06 miles)

This 7.06-mile segment is located in Bath County. A total of 6.56 miles of this segment is located on the Forest. Property along the remaining .5 miles is posted. This section is not legally declared navigable, however, the section inside the Forest is in public ownership and, therefore, is de facto navigable. Public vehicle access is available at either end. A jeep trail parallels a portion of the stream and is used by hikers and for administrative purposes by the Forest Service. Most of the shoreline is forested. One low-water bridge crosses the stream at the Warwick Mansion. A swinging foot-bridge on the Forest crosses the stream above Muddy Run. There are a few open fields and structures adjacent to or bordering this segment of the river.

Eligibility of Jackson River - Segment B by:

Scenic Value: Segment B of the Jackson River is an attractive river. Forest cover along the river is nearly continuous. Open fields border the river in several locations, adding variety to the environment. There is a variety of plant species, including large trees. The streambed is medium in width. The rate of flow is medium and there is little-to-no white-water, except during storm periods. Several structures are visible within the river corridor. The old jeep road is not highly visible from the stream. There is one low water bridge. There are flats adjacent to the stream, with some steep side slopes to add to the variety. A Class A-Distinctive rating is assigned to the scenic values.

Recreational Value: Current recreation use consists of trout fishing, wading, canoeing, hunting, and hiking. Most land along this segment is public, under Forest Service management, accessible, and available for recreational use. Much of the length of this segment is a walk-in fishery, providing a somewhat unique recreation opportunity for the area. Outstanding white-water canoeing and kayaking opportunities exist along this segment in Hidden Valley. A Class A-Distinctive rating is assigned to the recreational values.

Geologic Value: A few rock outcroppings are present, but most are not visible from the river. The corridor consists primarily of forest interspersed with open fields. Forest types along the river are typical of the George Washington National Forest. A Class B-Common rating is assigned to the geologic values.

Fish and Wildlife Values: This segment is stocked with trout by the Virginia Division of Game and Inland Fisheries (VDGIF) under the state's put-and-take system. This section of the river is an otter re-introduction site, one of several in Virginia. A Class A-Distinctive rating is assigned to the fish and wildlife values.

Historic and Cultural Values: This segment contains the Warwick Mansion that is on the National Register of Historic Places. A low-water bridge across the river provides access to the mansion. A rock shelter with a significant prehistoric component is located in the corridor along this segment and is on the National Register of Historic Places. There is a high probability that additional archeological sites exist within this corridor. A Class A- Distinctive rating is assigned to the historic and cultural values.

Eligibility Determination: Segment B of the Jackson River is eligible for designation under the National Wild and Scenic Rivers Act because it is free-flowing and has outstandingly remarkable scenic, recreational, fish and wildlife, and historic and cultural values.

Classification Determination: Because Segment B of the Jackson River is eligible for designation, it is necessary to determine the classification that could result from designation. According to the criteria in FSH 1909, Chapter

8, the entire 7.06 miles qualifies for designation under the scenic classification. The segment has outstanding scenic qualities and is bordered and accessed by paved state highways.

Segment C - Hidden Valley to McClintic Bridge (8.33 miles)

This 8.33-mile segment is bordered almost entirely by private property. The exception is 0.27 miles of Forest ownership. While there are numerous access points to the river, most are located on posted private property and are not available to the general public. Many private roads parallel the stream. A few structural improvements such as farm buildings, houses, and hunt cabins exist along the stream. Existing use along the river consists primarily of hunting camps and agriculture. The shoreline is a mixture of forest land and open fields. This segment is suitable for fish and wildlife propagation, wading, canoeing, and other uses. The water clarity ranges from average to good. This segment is not considered navigable, therefore, public access to the river is controlled by the landowners.

Eligibility of Jackson River - Segment C by:

Scenic Value: Segment C of the Jackson River is an attractive area. The size ranges from small-to-medium in width and is mostly shallow with some large pools. The rate of flow ranges from slow to fast. There are large boulders in some sections of the stream channel and cliffs are evident in some locations. Topography ranges from gently-rolling valley to steep-sided gorge. Richardson Gorge has outstanding scenery. Roads are evident along sections of this segment. The forest cover consists of hardwoods, hemlock, some pine. Understory species are those common to the GW. A Class A-Distinctive rating is assigned to the scenic values.

Recreational Value: Current recreation along Segment C consists of fishing, canoeing, kayaking, and swimming by adjacent landowners and guests. There is little public land along this segment. The segment is not considered navigable and access is controlled by adjacent landowners who have posted their property. Through Richardson Gorge, the river drops 40 feet per mile for two miles, making it an excellent river for white-water enthusiasts. There is some trout fishing in this segment. A Class A-Distinctive rating is assigned to the recreational values. If access problems can be resolved, this segment has excellent potential for public recreation use.

Geologic Value: There are several rock outcroppings along this segment. Richardson Gorge has many interesting and beautiful geological formations. A Class A-Distinctive rating is assigned to the geologic values.

Fish and Wildlife Values: Segment C contains smallmouth bass and bluegills as well as stocked and wild trout. The area is posted and access for fishing is not available to the general public. There is evidence that the special strain of rainbow trout stocked in Lake Moomaw are beginning to make spawning runs into this section of the river. If this spawning run continues to build, this would dramatically increase the fishery value of this section. This area provides habitat for wildlife species that are typical of the Forest. A Class B-Common rating is assigned to the fish and wildlife values.

Historic and Cultural Values: There are known historic and prehistoric sites along this segment. These include Fort Dinwiddie and the Hirsch Mound, both located on private land. There is a high probability that additional prehistoric sites exist. A Class A-Distinctive rating is assigned to the historic and cultural values.

Eligibility Determination: Segment C of the Jackson River is eligible for designation under the National Wild and Scenic Rivers Act because it is free-flowing and has outstandingly remarkable scenic, recreational, geologic, and historic and cultural values.

Classification Determination: Because Segment C of the Jackson River is eligible for designation, it is necessary to determine the classification that could result from designation. According to the criteria in FSH 1909, Chapter 8, the entire 8.33 miles qualifies for inclusion in the system under the scenic classification. This determination is based primarily on the fact that development along the river is sparse and roads are inconspicuous.

Segment D - Gathright Dam to Clearwater Park (13.0 miles)

This segment is 13.0 miles long. It begins at Gathright Dam and ends at the bridge where State Route 687 crosses the river at Clearwater Park. The majority of the river frontage is privately owned and posted. The first 1/2-mile is bordered by public land administered by the Corps of Engineers. There is one canoe access point on Corps lands. The Forest Service administers five access points along this segment of the river. These are located on small tracts purchased by the Corps of Engineers and later transferred to the Forest Service to provide public access to the river. This segment was declared navigable by the federal courts in 1982. In contrast to the federal court's determination that this segment is navigable, adjacent landowners maintain that they own the bottom of the river. They do not permit fishing or recreation access to the river by the general public. Only two of the publicly owned access points have been developed to date.

County and private roads parallel the river and county roads 687 and 638 cross it. An abandoned railroad grade parallels the segment for its entire length. Several farms and private homes are located along this segment, including a few private subdivisions. This segment of the river is used by canoeists, kayakers, tubers, and swimmers.

Eligibility of Jackson River - Segment D by:

Scenic Value: Segment D of the Jackson River is an attractive stream. It is medium in size and the depth ranges from shallow to deep where the river pools. The rate of flow ranges from average to fast and is regulated by the discharge at Gathright Dam. In some sections, there are large boulders and rapids. Shale cliffs are evident at three or four locations. The river valley is gently rolling and bordered by steep mountains. Roads parallel the river and are visible from the river along most of this segment. Several houses are located along the river. Forest cover is typical of the area and consists of mixed hardwoods and pine, including several hemlock groves. The understory species are common to the forest type. A Class B-Common rating is assigned to the scenic values.

Recreational Value: Canoeing, kayaking, and tubing are becoming popular along this segment of the Jackson River. Fishing and swimming are popular in a few locations, but adjacent landowners discourage these uses. This segment is navigable and has six public access points. Most of the private property is posted. Bass fishing is good and the VDGIF plans to turn this segment into trout fishing waters. VDGIF maintains that this could be one of the best trout streams in the East due to Gathright Dam and Lake Moomaw and the ability to control temperature and oxygen levels of the water. This segment has good potential for river recreation use. A Class A-Distinctive rating is assigned to the recreational values.

Geologic Value: At least four outstanding shale and limestone bluffs within the corridor are visible from this segment. Many users consider them outstanding geological features. A Class A-Distinctive rating is assigned to the geologic values.

Fish and Wildlife Values: At present, there is an outstanding fishery in this segment. The river contains smallmouth bass and panfish. A trout fishery is being developed. The river has been legally declared navigable, but adjacent landowners maintain they own the bottom of the river. Due to Lake Moomaw and Gathright Dam, water flow is regulated and the released water is typically colder than it would be without the release from the lake. The ability to release cold water into this segment provides for outstanding trout waters. The corridor provides habitat for wildlife species typical of the Forest. With the trout fishery being developed, this segment qualifies for a Class A-Distinctive rating.

Historic and Cultural Values: There are known historic and prehistoric archeological sites along this segment. There is high probability that additional prehistoric sites exist. A Class A-Distinctive rating is assigned to the historic and cultural values.

Eligibility Determination: Segment D of the Jackson River is eligible for designation under the National Wild and Scenic Rivers Act because it is free-flowing and has outstandingly remarkable historical, cultural, recreational, geologic, and fish and wildlife values.

Classification Determination: Because Segment D of the Jackson River is eligible for designation, it is necessary to determine the segment's classification. According to the criteria in FSH 1909, Chapter 8, the entire 13.0 miles qualifies for inclusion in the system under the recreational classification. This determination is based primarily on the fact that this segment of the river is paralleled by roads and is developed by private landowners.

North River

This evaluation will examine a 16-mile segment of the North River from its headwaters to the point it exits the Forest approximately one mile east of the town of Stokesville, Virginia. The segment is located in Augusta County and Forest ownership of land along the river is almost complete. Private property does border the river for approximately 1.5 miles in the vicinity of Stokesville. The river is small and shallow except during major storm periods. Normally, the current is fairly slow with uniform flow characteristics. Steep mountain terrain is on both sides of the river. State and Forest roads exist in the stream corridor. Portions of the stream are stocked with trout under the state's put-and-take program. Much of the river has been heavily damaged by the floods of 1969, 1972, and 1985. Floods prior to these resulted in many gabions being installed along sections of the stream. The river is not considered navigable.

Segment A - From the headwaters to North River Campground.

The streambed and channel along the nine-mile section from the headwaters to the North River Campground show heavy flood damage and are channelized with gabions in some locations. Two dams are located within this section. Therefore, this section of the North River cannot be considered free-flowing and does not qualify for eligibility under the Act. As defined in the Act, free-flowing "means existing or flowing in natural condition without impoundment, diversion, straightening, rip-rapping, or other impoundment of the waterway."

Segment B - From North River Campground to Camp May Flather

This section is approximately 5.0 miles long. It is free-flowing and small in size. The average flow is relatively low. Flood damage along this segment is relatively absent. The adjoining property is owned entirely by the Forest Service. The shoreline is undeveloped. Some past forest management practices are evident along a short section of this stream. A Forest Service trail follows this section, part of which is an old jeep road that is used to stock trout. The surrounding forest is typical hardwood and pine with common understory species.

Eligibility of North River - Segment B by:

Scenic Value: Segment B of North River is an attractive segment with many outstanding rock formations and cliffs. The stream is typically shallow as it flows between a series of small pools. During periods of high water, usually in the spring and following moderate rains, North River provides a challenging white-water experience, including several Class 4 rapids. The stream flows over varying terrain, which adds to its attractiveness. Located in the North River gorge, this section is bordered by steep, mountainous terrain on both sides. A Forest Service trail, once a jeep trail, follows this section and crosses it at nine locations. The trail is still used by VDGIF vehicles to stock trout in the spring. There are signs of timber cutting in the corridor. The cutting was to salvage ice-damaged timber and most was on an individual tree selection basis. One small clearcut is evident. The surrounding forest cover is typical mixed hardwood and pine with common understory species. A Class A-Distinctive rating is assigned to the scenic values.

Recreational Value: Current recreation use consists of hunting, fishing, hiking, and seasonal canoeing and kayaking. During high water, this section is capable of providing good white-water canoeing and kayaking. This section traverses public land and has adequate access at both ends. The North River Gorge hiking trail receives heavy use. Camping is available at the North River Campground. A Class A-Distinctive rating is assigned to the recreational values.

Geologic Value: This segment through the North River Gorge contains several cliffs and outstanding rock formations. A Class A-Distinctive rating is assigned to the geologic values.

Fish and Wildlife Values: This segment is stocked in the spring with trout under the state's put-and-take program. It is also stocked in the fall if there is enough water to support fish. Several wildlife clearings are in the North River Gorge. For the most part, they are located away from the streambed and are not readily visible from the river. The area provides habitat for wildlife species typical of the Forest. A Class B-Common rating is assigned to the fish and wildlife values.

Historic and Cultural Values: There are no known prehistoric archeological sites along this segment. Camp May Flather dates back to the 1930s and North River Campground is an old CCC camp site. There is an old logging railroad grade in the gorge area. A Class A-Distinctive rating is assigned to the historic and cultural values.

Eligibility Determination: The North River Gorge area of North River is eligible for designation under the National Wild and Scenic Rivers Act. It is free-flowing and has outstandingly remarkable scenic, recreation, geologic, historic, and cultural values.

Classification Determination: Because the North River Gorge segment of North River is eligible for designation, it is necessary to determine the classification that could result from designation. According to criteria in FSH 1909, Chapter 8, a total of 5.0 miles qualifies for inclusion in the system under the scenic classification.

Segment C - From Camp May Flather to the Forest's proclamation boundary.

This 2-mile section is located below the Forest boundary and crosses private property. The streambed and channel contain extensive flood-related damage and channelization. As with Segment A, this section of the North River cannot be considered free-flowing and therefore, is not eligible under the Act.

Passage Creek

Passage Creek is divided into three segments for evaluation purposes. Passage Creek is described in this report from its headwaters north to its confluence with North Fork Shenandoah River. This evaluation covers 34.5 miles from the confluence of the North Fork of the Shenandoah River to the beginning point of perennial stream flow. Within this 34.5-mile segment, the Forest Service owns 0.9 miles of land on one side and 9.7 miles on both sides of the creek. The majority of Passage Creek is located within the ridge commonly referred to as Massanutten Mountain. It flows north through Fort Valley and into the North Fork of the Shenandoah River. It is not considered navigable. State of Virginia studies do not consider Passage Creek eligible the Virginia Scenic Rivers System.

Segment A - Headwaters to State Route 730 (6.3 miles)

This 6.3-mile segment is bordered on both sides by National Forest System land except for 0.9 miles of private property on one bank. This segment is located in Page and Shenandoah counties. Segment A is a very small stream with low flows and a slow moving current. During periods of drought, some sections of Segment A become dry. The stream is free-flowing and the shoreline is entirely wooded. Crisman Hollow Road parallels the entire segment. Hiking trails parallel and cross the creek at several locations. Forest management practices are evident along several sections of this segment. Part of this segment is stocked by the VDGIF under the Virginia's put-and-take program. Sections are suitable for wading and trout fishing. Water quality is average.

Eligibility of Passage Creek - Segment A by:

Scenic Value: Segment A of Passage Creek is a typical small mountain stream. It has no distinctive or outstanding features. The stream is small and shallow, following a gradual gradient. Sections go dry during periods of drought. The current is slow with uniform flow characteristics. Steep mountain slopes border the creek on both sides. From a visual standpoint, there are no outstanding rock formations, cliffs, or bluffs. Forest cover along the creek consists of mixed hardwood and pine. The understory consists of common species. A Class C-Minimal rating is assigned to the scenic values.

Recreational Value: Current recreation use consists of wading and trout fishing under the put-and-take program. Land based recreation activities that occur in the corridor include hiking and big and small game hunting. A Class C-Minimal rating is assigned to the recreational values.

Geologic Value: There are no outstanding geological formations within the corridor. A Class C-Minimal rating is assigned to the geologic values.

Fish and Wildlife Values: This segment is stocked with trout by the VDGIF put-and-take program. The area provides habitat for wildlife species typical of the Forest. A Class C-Minimal rating is assigned to the fish and wildlife values.

Historic and Cultural Values: There are no known archeological sites in the corridor of this segment. Crisman Hollow Road is one of the many Forest roads constructed by the Civilian Conservation Corps (CCC). Camp Roosevelt is located just south of the end of this segment. A Class C-Minimal Rating is assigned to the historic and cultural values.

Eligibility Determination: Segment A of Passage Creek is not eligible for designation under the National Wild and Scenic Rivers Act. The segment does not have outstandingly remarkable values. For this reason, Segment A will not be studied further for designation under the National Wild and Scenic Rivers Act.

Segment B - From State Route 730 to Forest Boundary

This 21.3-mile segment is located in Shenandoah County. It runs the length of Fort Valley and is bordered entirely by private property. Route 678 parallels this segment of the stream for the entire length. A few roads cross the stream by means of low-water bridges. The corridor consists of agricultural and forest land with several houses and a few subdivisions. It is not considered navigable. Because most of the private property is posted, the stream is not accessible to the general public. The segment is suitable for fish and wildlife propagation, wading, and canoeing during periods of high water. Water quality is average. There are no impoundments.

Eligibility of Passage Creek - Segment B by:

Scenic Value: Segment B of Passage Creek is typical of many streams on the George Washington National Forest. It is an attractive creek, but has no features that rate as distinctive or outstanding. This is a small stream that meanders through Fort Valley. The stream is shallow with occasional small pools. There are mountains on both sides of the broad, four-mile wide valley. The valley is gently rolling and supports a number of farms and houses. The forest cover is typical mixed hardwoods and some pine, with common understory species. A Class B-Common rating is assigned to the scenic values.

Recreational Value: Current recreation use of Segment B is limited to fishing and swimming by the adjacent landowners. There is some canoeing during periods of high water. The stream is not classified as navigable and use is controlled by the landowners. This reduces the recreational use of the stream. A Class B-Common rating is assigned to the recreational values.

Fish and Wildlife Values: This segment supports smallmouth bass and sunfish populations but is not considered a significant sport fishery due to its small size. The area provides habitat for wildlife species typical of the Forest. A Class C-Minimal rating is assigned to the fish and wildlife values.

Geologic Value: This segment has no outstanding visible geological formations. This segment of Passage Creek flows through Fort Valley which is about 22 miles long by four miles wide. There are not many natural entrances into the valley. Mountains are visible on both sides. A Class B-Common rating is assigned to the geologic values.

Historic and Cultural Values: Camp Roosevelt, the site of the first Civilian Conservation Corps camp in the nation, is located at the beginning of this segment. Caroline Furnace, an old iron furnace site, is also located near the beginning of this segment. Fort Valley derives its name from and has historical significance relating back to the Revolutionary War period. There are additional known historical sites in this corridor. A Class A-Distinctive rating is assigned to the historic and cultural values.

Eligibility Determination: Segment B of Passage Creek is eligible for designation under the National Wild and Scenic Rivers Act. It is free-flowing and has outstandingly remarkable historic and cultural values.

Classification Determination: Because Segment B of Passage Creek is eligible for designation, it is necessary to determine the classification that could result from designation. According to the criteria in FSH 1909, Chapter 8, the entire 21.3 miles qualifies for inclusion in the system under the recreational classification. This determination results from the relatively large number of houses and farms located along the river.

Segment C - From Forest Boundary downstream to North Fork Shenandoah

This 6.9-mile segment flows through a narrow gorge located in Shenandoah County. It is bordered by Forest lands for 4.3 miles and by private land for 2.6 miles. Adjacent National Forest System land is used primarily for recreation and timber production. State Route 678, a two-lane paved road, parallels the stream through the gorge. One small dam exists between Forest land and the state fish hatchery. Private land bordering the creek is typically used for agriculture. There are some houses and other developments in the corridor. Elizabeth Furnace Recreation Area is a relatively large developed recreation site located on the creek on Forest land. The state has a fish hatchery in the corridor outside the Forest boundary. Most of the private property is posted. The segment on the Forest is stocked with trout under the state's put-and-take program. The segment is suitable for fish and wildlife propagation, wading, and canoeing during periods of high water. Water quality is average.

Eligibility of Passage Creek - Segment C by:

Scenic Value: Segment C of Passage Creek is an attractive creek located within a narrow gorge. The gorge area is scenic and bordered by cliffs and rock formations that enhance the visual resource. The creek is shallow with occasional pools. Part of the stream has a fairly steep gradient and during storm periods, usually in the spring, the current is fast. The stream is bordered by steep mountain slopes as it passes through the gorge, then through rolling terrain before flowing into the Shenandoah River. Forest cover along the creek includes mixed hardwood and pine with common understory species. A Class-A-Distinctive rating is assigned to the scenic values.

Recreational Value: Current recreation use of Segment C consists of trout fishing under the state's put-and-take program, wading, and swimming. During periods of high water, the section in the gorge is also used for canoeing and kayaking. The stream is not considered navigable. A small dam is located just outside the Forest boundary. Adjacent private lands are posted so public access is limited to the part of the creek that crosses the Forest. Elizabeth Furnace Recreation Area is located in the corridor of this segment and offers both camping and picnicking. A Class A-Distinctive rating is assigned to the recreational values.

Geologic Value: This segment contains some outstanding cliffs and rock formations in the gorge area. A Class A-Distinctive rating is assigned to the geologic values.

Fish and Wildlife Values: The section on National Forest System land is stocked with trout under the state's put-and-take program. The creek also supports smallmouth bass and sunfish populations. A state fish hatchery is located within the corridor just outside the Forest. The area provides habitat for wildlife species common to the Forest. A Class B-Common rating is assigned to the fish and wildlife values.

Historic and Cultural Values: This segment of Passage Creek and its corridor contain several potentially significant historical sites. Elizabeth Furnace, an old iron furnace, is located within the corridor.The Elizabeth Furnace recreation area was constructed by the CCC. An old log cabin from the charcoal iron furnace era, a slave cemetery, and prehistoric sites are also located within the corridor. A Class A-Distinctive rating is assigned to the historic and cultural values.

Eligibility Determination: Segment C of Passage Creek is eligible for designation under the National Wild and Scenic Rivers Act. With the exception of a small dam located between the state fish hatchery and national forest land, it is free-flowing. As is stated in FSH 1909, Chapter 8.21b, "...the existence of low dams...at the time any river is proposed for inclusion...does not automatically disqualify it for designation...." Also, this segment of the creek has outstandingly remarkable scenic, recreational, geologic, historic, and cultural values.

Classification Determination: Because Segment C of Passage Creek is eligible for designation, it is necessary to determine the classification that could result. According to the criteria in FSH 1909, Chapter 8, the entire 6.9 miles qualifies for inclusion in the system under the recreational classification. This classification is for several reasons, including the presence of the Elizabeth Furnace Recreation Area and a number of houses and farms along the creek.

St. Mary's River

A total of 8.6 miles of St. Mary's River is considered in this evaluation. St. Mary's is divided into two segments for evaluation purposes. St. Mary's is described in this report from its headwaters west to its confluence with the South River. The first segment includes the headwaters down to where the river exits the St. Mary's Wilderness boundary. The second segment includes that portion from the St. Mary's Wilderness boundary to its confluence with the South River. National Forest System land along the upper reaches borders the St. Mary's on both sides for 4.60 miles and on one side for 0.50 miles. St. Mary's is a small stream with low rates of flow except during major storm events. The upper segment, all on the Forest, is currently designated as a State Scenic River. This section is also within the St. Mary's Wilderness.

The stream is not classified as navigable. The water quality is average for the Blue Ridge Mountains. There is some disturbance as a result of floods outside the Forest boundary. A road parallels most of the portion on private property and there are some private developments. There are no impoundments. This stream is suitable for normal fish and wildlife propagation. There is trout fishing and wading in the St. Mary's.

Segment A - From the headwaters to the St. Mary's Wilderness boundary (4.6 miles).

Eligibility of St. Mary's River - Segment A by:

Scenic Value: There are rock formations and small waterfalls within this segment of the St. Mary's River. The stream is designated as a State Scenic River. A Class B-Common rating is assigned to scenic values.

Recreational Value: Current recreation use consists of fishing for brook trout, wading, bathing, hiking, and camping. Recreation use along the river is high. In addition, this segment is located within St. Mary's Wilderness and, as such, offers a unique recreation opportunity not available on most of the Forest. The stream is not large enough to permit canoeing and there is no record of such use. There is an old mining railroad grade that has been developed into a trail along a portion of the stream. A Class A-Distinctive rating is assigned to recreational values.

Geologic Values: Within the wilderness area, there are rock outcrops and small waterfalls. The river also flows through a small gorge. While these features add to the geological value of the river, they are not uncommon in the Blue Ridge Mountain area. A Class B-Common rating is assigned to the geologic values.

Fish and Wildlife Values: This stream contains native brook trout and a few wild rainbow trout. Segment A of St. Mary's River is a Featured Brook Trout Stream. Acid deposition has almost completely eliminated rainbow trout and brown trout.Several minnow species have been eliminated. If acid deposition continues to destroy the fishery, the value of the river from a fisheries standpoint will be reduced. The area provides habitat for wildlife species typical of the Forest. A Class A-Distinctive rating is assigned to the fish and wildlife values.

Historic and Cultural Values: An old mining railroad grade parallels the stream. There are known archeological sites in the corridor. There is evidence of iron ore washers in the stream channel. Since no systematic survey has been conducted in this corridor, a Class B - Common rating is assigned to the historic and cultural values.

Eligibility Determination: Segment A of St. Mary's River is eligible because it is free-flowing and has outstandingly remarkable recreational and fish and wildlife values.

Classification Determination: Because St. Mary's River is eligible for designation, it is necessary to determine the classification that would result from designation. According to the criteria in FSH 1909, Chapter 8, the entire 4.6 miles qualifies for inclusion in the system under the wild classification. This determination is based primarily on the fact that little or no man-made disturbances exist within the river corridor inside St. Mary's Wilderness.

Segment B - From the St. Mary's Wilderness Area boundary to the confluence with the South River (4 miles).

Eligibility of St. Mary's River - Segment B by:

Scenic Value: No outstanding features are present. The scenery is common for the area. There are some man-made intrusions along the stream. A Class B-Common rating is assigned to scenic values.

Recreational Value: Current recreation use consists of fishing for brook trout and some wading and bathing. The stream is not large enough to permit canoeing and there is no record of such use. A Class B-Common rating is assigned to recreational values.

Geologic Value: A Class B-Common rating is assigned to the geologic values.

Fish and Wildlife Values: This stream contains a few trout. The area provides habitat for wildlife species typical of the Forest. A Class C-Minimal rating is assigned to the fish and wildlife values.

Historic and Cultural Values: There are no known archeological sites in the corridor. However, since it is in the Blue Ridge Mountains, the potential for archeological sites is strong. A Class C-Minimal rating is assigned to the historic and cultural values.

Eligibility Determination: Segment B of St. Mary's River is not eligible for designation under the National Wild and Scenic Rivers Act because of the lack of outstandingly remarkable values. For this reason, Segment B of St. Mary's River will not be studied further for designation.

North Fork Shenandoah River

The section of the North Fork of the Shenandoah River evaluated here consists of a 39-mile segment between State Highway 55 at Strasburg and State Route 675 at the town of Edinburg. The segment is located in Shenandoah and Frederick counties. Of note, the segment of the North Fork Shenandoah River from Burnshire Bridge to the Route 55 crossing in Strasburg, Virginia, qualifies for inclusion in the state's scenic river system. Forest property borders the east side of the river at three locations for a total of 0.6 miles. Each of these sites consists of steep bluffs and, as such, is not suitable for canoe access. Most of the river lies outside the Forest.

From a structural standpoint, there are two old power dams on the river and several low water bridges. Roads cross the river in four locations and additional roads end adjacent to the river. There is no developed trail access. The town of Woodstock obtains its water from the river. Water from the river is also used for irrigation of corn west of Edinburg. The stream is shallow between pools. Overall, the river follows a gradual gradient and the flow is fairly slow with uniform flow characteristics.Development along the shoreline includes farm land, subdivisions, and vacation cabins. Forest management practices are also evident at certain points along the river. The river is suitable for fish and wildlife propagation, wading, canoeing, and other uses. Water quality is average. The segment is considered navigable. The state has marked the segment from New Market to Riverton for further study.

Eligibility of the North Fork Shenandoah River - 39-mile Segment by:

Scenic Value: The evaluation segment includes the "Seven Bends" of the Shenandoah River, an interesting and scenic area where the river makes a series of sharp bends, at times almost turning back on itself. The surrounding valley is gently rolling with the Massanutten Ridge rising steeply on the east side. There are several shale bluffs evident from the river. The adjacent forest cover is typical mixed hardwood and pine with common understory species. A Class A-Distinctive rating is assigned to the scenic values.

Recreational Value: Current recreation use is limited due to the lack of public access. There is fishing, canoeing and swimming, mostly by adjacent landowners and guests. The river is considered to be navigable. A Class B-Common rating is assigned to the recreational values.

Geologic Value: This segment contains the "Seven Bends," a significant physiographic/geographic feature. A few shale bluffs are located along the river. A Class A-Distinctive rating is assigned to the geologic values.

Fish and Wildlife Values: This segment supports a sport fishery of smallmouth bass, sunfish, and catfish. The smallmouth bass fishing is not as well known or as good as in other rivers in the state. The area provides habitat for wildlife species typical of the Forest. A Class B-Common rating is assigned to the fish and wildlife values.

Historic and Cultural Values: There are known prehistoric sites along the river. Historic sites are plentiful as the river meanders through the historic Shenandoah Valley. There are several old houses within the corridor. A Class A-Distinctive rating is assigned to the historic and cultural values.

Eligibility Determination: This 39-mile section of the North Fork of the Shenandoah River is eligible for designation under the National Wild and Scenic Rivers Act. It is free-flowing and has outstandingly remarkable scenic, geologic, historic, and cultural values.

Classification Determination: Because the North Fork Shenandoah River is eligible for designation, it is necessary to determine the classification that could result from designation. According to the criteria in FSH 1909, Chapter 8, the entire 39 miles qualifies for inclusion in the system under the recreational classification. This determination is based on the large number of houses and other developments located within the corridor.

South Fork Shenandoah River

This evaluation covers 36 miles of the South Fork of the Shenandoah River. Because the river and the surrounding corridor are so physically similar, the entire 36 miles will be studied as one segment. The segment begins at the Bixler Bridge located on Virginia secondary road 675, approximately 3 miles northwest of Luray. It ends at Karo Landing, approximately 6 miles south of the town of Front Royal. The evaluation segment is located within Page and Warren counties and is considered navigable. Forest property borders the west side of the river for 9.5 miles and borders both sides for 0.4 miles. Two low water bridges cross this segment. The area under consideration has good public access. Land uses along the river include agriculture, summer homes, and year-round residences. Evidence of human activity is abundant and increasing.

The river is suitable for fish and wildlife propagation, wading, canoeing, and other uses. Water quality is average. Portions of roads parallel the river and are evident from the river. A railroad is evident from the river in two locations. Page Power Company, now Potomac Edison, acquired flowage easements for a proposed dam at Overall in 1930. These easements are still in effect even though the dam has never been constructed. The state has recognized the segment of the South Fork from Goods Mill to Overall for inclusion in the Virginia Scenic Rivers System.

Eligibility of the South Fork Shenandoah River - 36-mile Segment by:

Scenic Value: The South Fork of Shenandoah River is typical of the larger rivers in and around the Forest. It is an attractive river. A couple of cliffs along the river add to the scenery. The river meanders over a gradual gradient from pool to pool. There are a few locations where the gradient increases and the flow becomes faster. The surrounding valley is gently rolling with mountains in the background. Forest cover consists of mixed hardwoods and pine with common understory species. There are numerous summer camps along the river. All in all, there are no features that rate as distinctive or outstanding. A Class B-Common rating is assigned to the scenic values.

Recreational Value: Current recreation use consists of fishing, canoeing, tubing, swimming, and hunting. There are canoe rental businesses at Bealers Ferry and Bentonville. There are also two canoe camps and a family campground at Hazard Mill that are accessible from the river. Several canoe launch sites are available to the public and canoe use is high. The river is considered navigable. A Class A-Distinctive rating is assigned to the recreational values.

Geologic Value: This river and its corridor contain no unusual rock outcroppings or other geological formations. There are a couple of small cliffs and several ledges that cross the channel. A Class B-Common rating is assigned to the geologic values.

Fish and Wildlife Values: This river supports a top quality smallmouth bass population. Catfish and sunfish are also important species in the Shenandoah River. The area provides habitat for wildlife species typical of the Forest. A Class A-Distinctive rating is assigned to the fish and wildlife values.

Historic and Cultural Values: There are several known archeological sites within the corridor. The area was settled in the 1700s and there are several old houses along the river. Additionally, the river was used to carry pig iron and farm products before the coming of the railroads. An Indian fish weir can still be seen at one location on the river. A Class A-Distinctive rating is assigned to the historic and cultural values.

Eligibility Determination: The South Fork of the Shenandoah River is eligible for designation under the National Wild and Scenic Rivers Act. It is free-flowing and has outstandingly remarkable recreation, fish and wildlife, and historic and cultural values.

Classification Determination: Because the South Fork of the Shenandoah River is eligible for designation, it is necessary to determine the classification that could result from designation. According to the criteria in FSH 1909, Chapter 8, the entire 36 miles qualifies for inclusion in the system under the recreational classification. This potential classification is based on the large number of houses and other developments located within the corridor.

Tye River

The Tye River is described in this evaluation from the town of Nash to its headwaters. Two segments of the Tye River, totaling 13 miles, are reviewed in this evaluation. These segments include those portions of the Tye River and the South Fork of the Tye River that are west of and within the George Washington National Forest boundary. East and south of the boundary, the Tye River was heavily disturbed by the floods of 1969, 1972, and 1985. Forest land ownership along this 13-mile segment of the river includes 1.00 mile on both sides of the stream (3 locations) and 0.2 miles on one side (4 locations). The river is not classified as navigable. The state did not find this stream worthy of inclusion in the Virginia Scenic River System.

Segment A - From Nash to Proclamation Boundary (8.3 miles)

This 8.3-mile segment is located within Nelson County. The majority of land bordering this segment is privately owned. Forest land borders both sides of the stream in two locations for approximately O.5 miles. The river is medium in size and except during storm periods, the rate of flow is slow. There are no impoundments along this section. State Highway 56 parallels and is visible along the entire segment from Nash to the boundary. The Appalachian Trail crosses the stream via a swinging foot bridge. There are several houses located within the corridor along this section. The stream and surrounding floodplain were heavily damaged during the floods of 1969, 1972, and 1985. Channelization of the river is prevalent along this segment. Lands bordering the river include a mixture of undeveloped forest and agricultural land. Some of the adjacent private land is posted. A section of this segment is stocked with trout under the state's put-and-take program.

Eligibility of Tye River - Segment A by:

Scenic Value: Segment A of the Tye River is typical of many rivers on the George Washington National Forest. It is an attractive river but has no distinctive or outstanding features. The stream is shallow with some small pools. For the most part, it has a gradual gradient so the rate of flow is fairly slow and uniform except during storm periods. Steep mountains rise above the river on both sides. No rock bluffs are evident. The forest cover is typical mixed hardwood and pine with common understory species. This segment has been heavily channelized. State Highway 56 is adjacent to this segment and several houses exist within the river corridor. A Class B-Common rating is assigned to the scenic values.

Recreational Value: Current recreation use of Segment A consists of fishing (put-and-take) and some canoeing and kayak use during early spring. There is also some swimming by adjacent landowners. This segment is not considered navigable. Public access for recreation purposes is limited. The Appalachian Trail crosses this segment by means of a swinging foot bridge. A Class B-Common rating is assigned to the recreational values.

Geologic Value: This segment contains no unusual geological formations. The corridor consists of farm land and forest typical of the George Washington National Forest. A Class C-Minimal rating is assigned to the geologic values.

Fish and Wildlife Values: A large portion of this segment is stocked with trout under the state's put-and-take system. The segment provides habitat for wildlife species typical of the Forest. A Class B-Common Rating is assigned to the fish and wildlife values.

Historic and Cultural Values: There are known prehistoric and historic sites along this segment. Since no systematic survey has been conducted along this section to determine their significance, a Class B-Common rating is assigned to the historic and cultural values.

Eligibility Determination: Segment A of the Tye River is not eligible for designation under the National Wild and Scenic Rivers Act. It has been channelized in many locations and does not have any outstandingly remarkable scenic, recreational, geologic, fish and wildlife or historic and cultural values. For these reasons, Segment A will not be studied further for designation under the National Wild and Scenic Rivers Act.

Segment B - From headwaters to Nash (4.7 miles)

This 4.7-mile segment is located within Nelson County. The majority of lands bordering this segment of the river are privately owned. Forest property touches this segment at several locations and totals approximately 0.70 miles. This segment of the river ranges in size from small to medium. The steep gradient along this segment results in small rapids, drop-offs, and cascades. Portions of the segment are paralleled by State Highway 56. The Crabtree Falls developed recreation site is located within the corridor where Crabtree Creek enters the river. The site consists of paved parking facilities, restrooms, and an observation trail to the top of Crabtree Falls.

While the majority of the shoreline is privately owned, the shoreline remains mostly undeveloped. With few exceptions, the adjacent private property is posted. Forestry and agricultural practices occur and are evident within the river corridor. The segment is suitable for fish and wildlife propagation, canoeing, and other water-based recreation uses. Water quality is average.

Eligibility of Tye River - Segment B by:

Scenic Value: Segment B of the Tye River is attractive. This segment is characterized by swift water, rapids, and cascades. The river bed is littered with large boulders that add variety to the visual resource. The upper portion of this segment flows through a gorge that contains waterfalls. The stream valley is relatively narrow and is bordered on both sides by steep mountains. Forest cover along the river consists of mixed hardwoods and pine and common understory species. A Class A-Distinctive rating is assigned to the scenic values.

Recreational Value: Current water based recreation use consists of fishing and white water canoeing when water levels are sufficient. There is an established wild trout population within this segment. Many people hike this segment to view the scenery. A Class A-Distinctive rating is assigned to the recreational values.

Geologic Value: The gorge area has some outstanding rock outcroppings. Scattered along the streambed are numerous boulders and rocks. A Class A-Distinctive rating is assigned to the geologic values.

Fish and Wildlife Values: This segment supports a wild trout fishery. The area provides habitat for wildlife species typical of the Forest. A Class B-Common rating is assigned to the fish and wildlife values.

Historic and Cultural Values: There are known archeological sites within this segment, including at least one potentially significant prehistoric site. A Class A-Distinctive rating is assigned to the historic and cultural values.

Eligibility Determination: Segment B of the Tye River is eligible for designation under the National Wild and Scenic Rivers Act. It is free-flowing and has outstandingly remarkable scenic, recreational, geologic, and historic and cultural values.

Classification Determination: Because Segment B of the Tye River is eligible for designation, it is necessary to determine the classification that could result from designation. According to the criteria in FSH 1909, Chapter 8, the entire 4.7 miles qualifies for inclusion in the system under the scenic classification.

TABLE D-1. Summary of River Eligibility Determinations

RIVER	COUNTY AND STATE	LENGTH (Miles)	ELIGIBLE	POTENTIAL CLASSIFICATION
BACK CREEK				
Segment A	Bath, VA	5.59	YES	Scenic
Segment B	Bath, VA	9.96	YES	Recreational
Segment C	Highland, VA	17.24	NO	Recreational
BULLPASTURE RIVER				
Segment A	Bath/High, VA	3.00	YES	Scenic
Segment B	Highland, VA	15.00	NO	
CEDAR CREEK	Shen/Fred, VA	25.00	YES	Scenic
COWPASTURE RIVER				
Segment A	Alleghany, VA	16.00	YES	Recreational
Segment B	Bath, VA	48.11	YES	Recreational
Segment C	Bath/High, VA	6.00	NO	
Segment D	Highland, VA	8.00	NO	
DRY RIVER	Rockingham, VA	22.00	NO	
IRISH CREEK	Rockbridge, VA	8.50	NO	
JACKSON RIVER				
Segment A	Bath/High, VA	14.30	NO	
Segment B	Bath, VA	7.06	YES	Scenic
Segment C	Bath, VA	8.33	YES	Scenic
Segment D	Alleghany, VA	13.00	YES	Recreational
NORTH RIVER				
Segment A	Augusta, VA	9.00	NO	
Segment B	Augusta, VA	5.00	YES	Scenic
Segment C	Augusta, VA	2.00	NO	
PASSAGE CREEK				
Segment A	Shenandoah, VA	6.30	NO	
Segment B	Shenandoah, VA	21.30	YES	Recreational
Segment C	Shenandoah, VA	6.90	YES	Recreational
ST. MARY'S RIVER				
Segment A	Augusta, VA	4.60	YES	Wild
Segment B	Augusta, VA	4.00	NO	
NORTH FORK SHENANDOAH	Shen/Fred, VA	39.00	YES	Recreational
SOUTH FORK SHENANDOAH	Page/Warren VA	36.00	YES	Recreational
TYE RIVER				
Segment A	Nelson, VA	8.30	NO	
Segment B	Nelson, VA	4.70	YES	Scenic

TABLE D-2. National Forest Ownership by River

RIVER	LENGTH (Miles)	ONE BANK (Miles)	BOTH BANKS (Miles)
BACK CREEK			
Segment A	5.59	0.01	2.35
Segment B	9.96	1.51	0.00
Segment C	17.24	0.00	0.00
BULLPASTURE RIVER	18.00	0.00	0.00
CEDAR CREEK	25.00	0.10	2.65
COWPASTURE RIVER			
Segment A	16.00	3.00	0.00
Segment B	48.11	4.33	4.28
Segment C	6.00	0.00	0.00
Segment D	8.00	0.00	0.00
DRY RIVER	22.00	0.00	0.00
IRISH CREEK	8.50	0.00	5.50
JACKSON RIVER			
Segment A	14.30	0.66	0.00
Segment B	7.06	0.42	6.62
Segment C	8.33	0.27	0.00
Segment D	13.00	0.25	0.00
NORTH RIVER		0.00	14.50
Segment A	9.00	To be determined	To be determined
Segment B	5.00	To be determined	To be determined
Segment C	2.00	To be determined	To be determined
PASSAGE CREEK			
Segment A	6.30	0.90	5.40
Segment B	21.30	0.00	0.00
Segment C	6.90	0.00	4.30
ST. MARY'S RIVER			
Segment A	4.60	To be determined	To be determined
Segment B	4.00	To be determined	To be determined
NORTH FORK SHENANDOAH	39.00	0.60	0.00
SOUTH FORK SHENANDOAH	36.00	9.50	0.40
TYE RIVER			
Segment A	8.30	0.00	0.50
Segment B	4.70	0.20	0.50

TABLE D-3. Lead Agency in Conducting Suitability Studies

AGENCY	RIVER SEGMENT
Virginia Department of Conservation and Recreation	Bullpasture River - Segment A Cedar Creek Cowpasture River - Segments A and B Jackson River - Segments C and D Passage Creek - Segment B South Fork Shenandoah North Fork Shenandoah Tye River - Segment B
USDA Forest Service	Jackson River - Segment B North River - Segment B St. Mary's River
USDA Forest Service/Virginia Department of Conservation and Recreation joint study	Back Creek - Segments A and B Passage Creek - Segment C

III. THE PROCESS: HOW RIVERS ARE EVALUATED FOR WILD AND SCENIC DESIGNATION

The National Wild and Scenic River designation process is a three-step process. The first step is the eligibility study. If a river is determined to be eligible, step two determines the potential classification of the river. The three potential classifications are wild, scenic, or recreational. Upon completion of steps one and two, step three assesses the suitability of the river for inclusion in the national system. The criteria associated with each step are discussed on the following pages.

Eligibility Criteria

The Wild and Scenic Rivers Act sets no specific requirements concerning the length of a river segment being considered, but states that a river segment is of sufficient length if, when managed as a wild, scenic, or recreational river area, the "outstandingly remarkable" values are protected.

The determination of whether a river or river segment contains outstandingly remarkable values is, for the most part, a judgement based on the qualities of a river relative to qualities of other rivers in the Forest and on adjoining private and state lands.

Rivers eligible for wild and scenic designation must be free-flowing and possess, with their adjoining land, one or more outstandingly remarkable values. The value categories are Scenic, Recreationa, Geologic, Fish and Wildlife, Historic, Cultural.

Within each value category, rivers are rated as either:

CLASS A - DISTINCTIVE with outstanding qualities when compared to other rivers;
CLASS B - COMMON with qualities common to most rivers;
CLASS C - MINIMAL with few or no outstanding qualities.

Scenic Values that are rated:

Class A-Distinctive indicate complex landforms with unusual or outstanding topographic features. Rock features, when present, stand out on the landform and are unusual or outstanding in size, color, or location. Forest cover is continuous or if broken, has a high degree of vegetative patterns and an unusual or outstanding diversity in plant species. Large or old-growth timber may be present. The stream volume ranges from medium to high with a variety of flow characteristics.

Class B-Common indicate some variety in the terrain, but landform features typical of the area. Rock features, when present, are obvious, but do not stand out and have no unusual characteristics. Forest cover is continuous with some variety in vegetative patterns and a common diversity in plant species. The stream volume ranges from medium to low with some variety in flow characteristics.

Class C-Minimal indicate terrain with little variety in slope, dissection, or features. Rock features are generally lacking. Forest cover is continuous with little diversity in the number or pattern of plant species. The stream typically has little or no variety in flow characteristics.

Recreational Values that are rated:

Class A-Distinctive indicate rivers and surrounding lands that provide both water-based and land-based activities and recreation experiences unique to a stream or to a limited number of streams, or which can occur only because of the character of the stream. The river might contain a high quality sport fishery.

Class B-Common indicate rivers and surrounding lands that provide water-oriented activities typical of most streams in the area. Activities include fishing, swimming, boating (motorized and non-motorized), and waterfowl hunting.

Class C-Minimal indicate stream size, flow or other characteristics that limit opportunities for water-based and land-based recreation.

Geological Values that are rated:

Class A-Distinctive indicate river corridors that clearly display significant or unusual geologic features. Also included are rivers that clearly expose geologic formations which are visible in few other sites. The amount of exposed rock is significant in that it provides excellent opportunities for geologic study.

Class B-Common indicate geomorphic features and formations that are typical of those commonly found in the area. There is some opportunities for geologic study.

Class C-Minimal indicate rivers with few or no exposed rock formations and no significant geologic features.

Fish and Wildlife Values that are rated:

Class A-Distinctive indicate resident fish and wildlife populations that occur only because of the character of the stream. This category includes streams identified as habitat for federally-listed threatened and endangered species.

Class B-Common indicate resident fish and wildlife populations that are common to the area.

Class C-Minimal indicate stream characteristics that limit the number and type of fish and wildlife species present. Included here are streams stocked by the states on a put-and-take basis.

Historical and Cultural Values that are rated:

Class A-Distinctive indicate river corridors that contain known sites of local, state, or national significance and meet criteria for the National Register of Historic Places.

Class B-Common indicate sites that are similar to sites in other locations and that contain limited scientific information. Some sites may have been disturbed prior to scientific investigation. Also included are known sites that have not been evaluated.

Class C-Minimal indicate sites that are not of local, state, or national significance and do not meet criteria for the National Register of Historic Places.

Classification Criteria

The Act (Section 2(b)) states that "if included (in the National Wild and Scenic Rivers System, each river) shall be classified, designated, and administered" as either a Wild, Scenic or Recreational river area. The classification selected is based on the conditions of the river and the adjacent land at the time of the evaluation. A river may be divided into segments by these classifications, based on current conditions.

The criteria to be met under each classification are: Water Resources Development, Shoreline Development, Accessibility, and Water Quality. These criteria are from the revised guidelines for Wild and Scenic Rivers developed jointly by the departments of Interior and Agriculture (Federal Register, Vol. 47, No. 173, September 7, 1982).

Classification as a WILD River requires:

Water Resources Development -- a river that is free of impoundments.

Shoreline Development -- a shoreline that is essentially primitive with little or no evidence of human activity. However, the presence of a few inconspicuous structures is acceptable. There is to be little or no evidence of past timber harvests and no ongoing timber harvests.

Accessibility -- a river area that is generally inaccessible except by trail. There are to be no roads, railroads, or other provisions for vehicular travel. However, a few existing roads leading to the boundary of the river corridor are acceptable.

Water Quality -- a river that meets or exceeds federally-approved state standards for aesthetics, propagation of fish and wildlife normally adapted to the river, and primary contact recreation.

Classification as a SCENIC River requires:

Water Resources Development -- a river that is free of impoundments.

Shoreline Development -- a shoreline that is largely primitive and undeveloped with no substantial evidence of human activity. However, the presence of small communities, dispersed dwellings or farm structures is acceptable. Evidence of past or ongoing timber harvests is acceptable if the Forest appears natural from the riverbank.

Accessibility -- a river area that may be accessible in places by roads. Roads may occasionally reach or bridge the river. The existence of short stretches of conspicuous or longer stretches of inconspicuous roads or railroads is acceptable.

Water Quality -- no criteria for water quality is prescribed in the Act. Poor water quality does not preclude classification provided a water quality improvement plan exists or is being developed.

Classification as a RECREATIONAL River requires:

Water Resources Development -- a river that may have some existing impoundments or diversions. The existence of low dams, diversions, or other modifications is acceptable if the waterway remains generally natural and riverine in appearance.

Shoreline Development -- a shoreline that may have some development with substantial evidence of human activity. The presence of extensive residential developments and a few commercial structures is acceptable. Lands may have been developed for a full range of agricultural or forestry uses and may show evidence of past or ongoing timber harvests.

Accessibility -- a river area readily accessible by roads or railroads. Parallel roads or railroads on one or both banks and bridge crossings are acceptable.

Water Quality -- no criteria for water quality is prescribed in the Act. Poor water quality does not preclude classification provided a water quality improvement plan exists or is being developed.

Suitability Criteria

Determinations of suitability for inclusion in the National Wild and Scenic Rivers System are made by state agencies, the Forest Service, and other federal agencies. Criteria that determine suitability include the following:

- the current status of land ownership and use in the area;
- the reasonably foreseeable uses of the land and water that would be enhanced, foreclosed, or curtailed if the area were included in the National Wild and Scenic Rivers System;
- the estimated cost of acquisition of land or of an interest in the land if the river area cannot be administered as a wild and scenic river without acquisition or easement as a means of control;
- the public, state, and local government interest in and potential involvement in management and administration;
- the amount and status of outstanding minerals;
- other issues and concerns that surface during scoping for public input.

Protection under the Forest Plan

The segments of rivers within Forest Service boundaries that are determined eligible for designation are managed in a manner that protects the values that made them eligible. The land adjacent to the river segments is afforded the same protection. The protection lasts until a final suitability determination is made by the responsible agency. Direction for management is in the standards for the Wild and Scenic River Management Prescriptions.

APPENDIX E – ECOSYSTEM DIVERSITY REPORT

George Washington National Forest

April 2011

Updated February 2013

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1.0 INTRODUCTION

The ecological sustainability framework used to support Forest Plan revision for the George Washington National Forest (GWNF) is built on a foundation of ecosystem diversity. By restoring and maintaining the key characteristics, conditions, and functionality of native ecological systems, the GWNF should be able to maintain and improve ecosystem diversity and also provide for the needs of diverse plant and animal species on the forest.

This Ecosystem Diversity Report describes the analysis process used to identify, evaluate, and develop guidance for sustaining ecological diversity. This report, and the Ecological Sustainability Evaluation database information from which it was derived, not only provide the overall framework for many of the plan components and the systems-based direction in the revised Forest Plan, but they are also expected to be an important source of data and guidance for sustaining native ecosystems and species when implementing the Plan.

The overall goal for ecological sustainability is to sustain native ecological systems and support diversity of native plant and animal species. Ecosystem diversity is defined as the variety and relative extent of ecosystem types including their composition, structure, and processes. The major characteristics of forest-wide ecosystem diversity and descriptions of the 24 ecological systems found across the GWNF are presented in this Ecosystem Diversity Report.

While most plant and animal species needs are expected to be met by sustaining ecosystem diversity, a corresponding species-specific analysis was also conducted to evaluate whether additional provisions were needed for federally listed species, sensitive species and locally rare species. This species-specific sustainability analysis is described in more detail in the companion document to this report entitled Species Diversity Report. These two reports focus on the terrestrial environment. The analysis of the aquatic systems is covered in the Aquatic Ecological Sustainability Analysis.

2.0 ECOLOGICAL SUSTAINABILITY EVALUATION PROCESS

The ecological sustainability framework for the GWNF was built around principles developed by The Nature Conservancy (TNC) in their Conservation Action Planning Workbook (TNC 2005). This basic structure was chosen because it is conceptually simple, flexible, and able to encompass guidance from the Planning Rule and Forest Service Manual and Handbook. It was also expected that its use would enhance opportunities for collaboration with TNC and other conservation partners in the future. Although built on the TNC structure, this document generally uses Forest Service terminology rather than TNC terms to refer to parts of the framework. Table 1 provides a crosswalk between relevant Forest Service and TNC terminology.

Table E-1. Crosswalk between conservation planning terms used in Forest Service Planning direction and The Nature Conservancy's Conservation Action Planning Workbook (2005)

Forest Service Terms	The Nature Conservancy Terms
Native ecological systems, Threatened and endangered species, Sensitive species, locally rare species and other species of management concern	Conservation Targets
Characteristics of ecosystem diversity (key attributes), Key ecological or habitat attributes for species or species groups	Key Ecological Attributes
Indicators	Indicators
Indicator Ratings	Indicator Ratings
Strategies (plan components)	Strategies

The Forest Service developed a relational database, the Ecological Sustainability Evaluation (ESE) tool, based on the structure of the TNC planning tool. The ESE tool served as the primary process record for ecological sustainability analysis. It included documentation of scientific and other sources consulted, uncertainties encountered, and strategic choices made during development of the database. In addition, the tool documented the many relationships among parts of the framework. For example, species were often related to one or more characteristics of ecosystems, and a given plan component frequently contributed to multiple ecological systems or species.

The following steps were used to build an ecological sustainability framework, with each step documented within the ESE tool. Although these steps are presented sequentially, the process required much iteration.

1. Identify and define ecological systems

To define terrestrial ecosystem diversity, all terrestrial ecological systems on the GWNF were identified using NatureServe's International Ecological Classification Standards (NatureServe 2004). Each system was defined in terms of existing Forest Service forest types and in terms of the LANDFIRE Vegetation Dynamic Models. Current acreage of each system was calculated using Forest Service GIS data. All identified terrestrial ecological systems were included in the ecological sustainability framework. These systems were also crosswalked with the Virginia Department of Conservation and Recreation Natural Heritage Program Vegetation Community types. The framework for diversity of aquatic ecological systems is described in the Aquatic Ecological Sustainability Analysis.

2. Identify species

To assess species diversity, a comprehensive list of plant and animal species was compiled by combining species lists from a variety of sources. These sources included federally-listed threatened and endangered (T&E) species obtained from the U.S. Fish and Wildlife Service; species that are tracked by the Virginia Department of Conservation and Recreation Natural Heritage Program and the West Virginia Division of Natural Resources; species identified in the Virginia and West Virginia State Comprehensive Wildlife Conservation Strategies as species of conservation concern; the Birds of Conservation Concern list compiled by the U.S. Fish and Wildlife Service; and the Regional Forester's list of sensitive species for the Southern Region. Species were then screened for inclusion in the framework. The criteria and process for identifying, screening and grouping species are detailed in the Species Diversity Report.

3. Identify and define characteristics of ecosystem diversity and related performance measures

To identify key characteristics and performance measures for terrestrial ecological systems, Forest Service biologists reviewed information in NatureServe, LANDFIRE, Virginia Department of Conservation and Recreation Natural Heritage Program community types, and other information.

4. Link species to the ecological systems and identify any additional needs of species

Species were then linked to terrestrial ecological systems. Where useful, species were grouped before linking them to systems. Where ecological conditions for these species were not covered by the ecosystem diversity framework, additional characteristics, performance measures, and rating criteria were added to the framework to cover these needs. All species have at least some of their needs covered by ecosystem diversity, but some species required additional plan components based on their major limiting factors. The ways in which individual species needs were addressed by ecosystem diversity components and additional plan provisions are described in the Species Diversity Report.

5. Assess current condition of performance measures

Current values and ratings of all performance measures were estimated using a variety of methods. Many current values were derived through analysis of existing GIS databases. Assumptions and methods for determining current values and ratings are recorded in the ESE tool.

6. Develop Forest Plan components

In this step, plan components were proposed that would be expected to provide for characteristics of ecosystem diversity and ecological conditions for species. This plan direction was then linked with characteristics and conditions within the ESE tool. In some cases, we identified where relevant provisions are made outside of the Forest Plan through other current requirements and processes. We ensured that all elements of the framework were addressed by appropriate management direction.

This report serves as a description of background, current status, and desired conditions for ecological systems on the GWNF. Current conditions for ecosystem characteristics reported here are based on a "snapshot in time." Conditions on the GWNF are constantly changing and new techniques improve how data can be used to measure progress. Ecosystem characteristics provide support for species diversity, and this report should be used in conjunction with the Species Diversity Report to obtain an accurate picture of ecological diversity on the GWNF.

3.0 ECOLOGICAL SYSTEMS

3.1 Background and Distribution of Ecosystems

The GWNF is interspersed with tracts of private and other publicly administered lands. National forest lands are significant from an ecological perspective in being relatively large parcels of vegetated and undeveloped lands with focused management goals. National forest lands contain a range of habitats and natural features that support a variety of locally rare species. These aspects plus the continued loss of forested land to developed uses on private lands is likely to make national forest lands even more important in the future for supporting ecological diversity.

Table E-2 lists the 24 ecological systems which were identified for the GWNF. Ecological systems represent recurring groups of biological communities that are found in similar physical environments and are influenced by similar dynamic ecological processes, such as fire or flooding. These systems have similar potential and opportunities for management. Ecosystems are specifically defined as a group of plant community types (associations) that tend to co-occur within landscapes with similar ecological processes, substrates, and/or environmental gradients. The ecological systems for the GWNF represent both major and rare community types. Many of our rare communities are currently not completely mapped or inventoried; however, they are important components for sustaining ecological and species diversity.

These ecological systems are fully described at NatureServe Explorer at www.natureserve.org/explorer/. The descriptions of structure and disturbance regimes were derived from LANDFIRE (www.landfire.gov/). As discussed previously, these systems can also be related to the communities described by the Virginia Natural Heritage Program. Descriptions of the systems identified and described by the Virginia Department of Conservation and Recreation Natural Heritage Program (VADNH) are found in their online edition of The Natural Communities of Virginia Classification of Ecological Community Groups Second Approximation (Version 2.3) found at http://www.dcr.virginia.gov/natural_heritage/ncintro.shtml.

Table E-2. Distribution of ecological systems on the George Washington National Forest

Ecological System	Associated VA Natural Heritage Community Types				
Central and Southern Appalachian Spruce-Fir Forest	Spruce and Fir Forests				
Appalachian (Hemlock)-Northern Hardwood Forest (includes Southern Appalachian Northern Hardwood Forest)	Central Appalachian Northern Hardwood Forests				
Southern and Central Appalachian Cove Forest	Rich Cove and Slope Forests	Eastern Hemlock-Hardwood Forests	Acidic Cove Forests	High-Elevation Cove Forests	
Northeastern Interior Dry-Mesic Oak Forest (includes Southern Appalachian Oak Forest in part and Southern Ridge and Valley/Cumberland Dry Calcareous Forest)	Eastern White Pine-Hardwood Forests	Acidic Oak-Hickory Forests	Dry-Mesic Calcareous Forests	Basic Oak-Hickory Forests	Basic Mesic Forests
Northeastern Interior Dry-Mesic Oak Forest (includes Southern Appalachian Oak Forest in part and Southern Ridge and Valley/Cumberland Dry Calcareous Forest)	Montane Dry Calcareous Forests and Woodlands	Mountain/Piedmont Basic Woodlands			
Central and Southern Appalachian Montane Oak Forest(includes Southern Appalachian Oak Forest in part)	High-Elevation Boulderfield Forests and Woodlands	Northern Red Oak Forests	Montane Mixed Oak and Oak-Hickory Forests		
Central Appalachian Dry Oak-Pine Forest	Oak/Heath Forests				
Southern Appalachian Montane Pine Forest and Woodland (includes Southern Appalachian Low-Elevation Pine Forest)					
Central Appalachian Pine-Oak Rocky Woodland	Pine-Oak/Heath Woodlands	Montane/Piedmont Acidic Woodlands	Low-Elevation Boulderfield Forests		
Southern and Central Appalachian Mafic Glade and Barrens					
Central Appalachian Alkaline Glade and Woodland					

Ecological System	Associated VA Natural Heritage Community Types				
Appalachian Shale Barrens	Central Appalachian Shale Barrens				
North-Central Appalachian Circumneutral Cliff and Talus	Northern White-Cedar Slope Forests	Low-Elevation Basic Outcrop Barrens	Mountain/Piedmont Calcareous Cliffs		
North-Central Appalachian Acidic Cliff and Talus	High-Elevation Outcrop Barrens	Low-Elevation Acidic Outcrop Barrens	Mountain/Piedmont Acidic Cliffs	Lichen/Bryophyte Boulderfields	
Central Appalachian River Floodplain	Piedmont/Mountain Floodplain Forests	Piedmont/Mountain Alluvial Forests			
Central Appalachian Stream and Riparian	Sand/Gravel/Mud Bars and Shores	Rocky Bars and Shores	Semi-permanent Impoundments	Spray Cliffs	Montane Woodland Seeps
Central Interior Highlands and Appalachian Sinkhole and Depression Pond	Montane Depression Wetlands				
Southern and Central Appalachian Bog and Fen	Appalachian Bogs				
North-Central Appalachian Acidic Swamp	Montane/Piedmont Acid Seepage Swamps	High-Elevation Seepage Swamps	Piedmont/Mountain Swamp Forests		
North-Central Appalachian Seepage Fen	Montane/Piedmont Basic Seepage Swamps	Calcareous Fens and Seeps	Calcareous Spring Marshes and Muck Fens	Mafic Fen and Seeps	Wet Prairies and Prairie Fens
Caves and Karstlands					

As we developed the ecosystem diversity analysis, we identified that many of the ecological systems had similar key attributes, indicators, species associates and resulting forest plan components. For purposes of analysis we combined the systems into Ecological System Groups to use in the following ESE Tool:

Table E-3. Ecological Sustainability Evaluation Tool Ecological Systems

Ecological System Groups	Ecological System
Spruce Forest	Central and Southern Appalachian Spruce-Fir Forest
Northern Hardwood Forest	Appalachian (Hemlock)-Northern Hardwood Forest
	Southern Appalachian Northern Hardwood Forest
Cove Forest	Southern and Central Appalachian Cove Forest
Oak Forests and Woodlands	Northeastern Interior Dry-Mesic Oak Forest
	Central and Southern Appalachian Montane Oak Forest
	Central Appalachian Dry Oak-Pine Forest
	Southern Appalachian Oak Forest
	Southern Ridge and Valley/Cumberland Dry Calcareous Forest
Pine Forests and Woodlands	Southern Appalachian Montane Pine Forest and Woodland
	Central Appalachian Pine-Oak Rocky Woodland
	Southern Appalachian Low-Elevation Pine Forest
Mafic Glade and Barrens and Alkaline Glades and Woodlands	Southern and Central Appalachian Mafic Glade and Barrens
	Central Appalachian Alkaline Glade and Woodland
Cliff, Talus and Shale Barrens	North-Central Appalachian Circumneutral Cliff and Talus
	North-Central Appalachian Acidic Cliff and Talus
	Appalachian Shale Barrens
Floodplains, Wetlands, and Riparian Areas	Central Appalachian River Floodplain
	Central Appalachian Stream and Riparian
	Central Interior Highlands and Appalachian Sinkhole and Depression Pond
	Southern and Central Appalachian Bog and Fen
	North-Central Appalachian Acidic Swamp
	North-Central Appalachian Seepage Fen
Caves and Karstlands	Caves and Karstlands

3.2 Descriptions of the Ecological Systems

The following information on descriptions of the ecological systems is derived largely from NatureServe.

3.2.1 Spruce Forest: Central and Southern Appalachian Spruce-Fir Forest

Background

Environment: This system occurs at elevations typically above 1300 m (4300 feet), up to the highest peaks. It occurs on most of the landforms that are present in this elevational range; most sites are strongly exposed and convex in shape. Elevation and orographic effects make the climate cool and wet, with heavy moisture input from fog as well as high rainfall. Strong winds, extreme cold, rime ice, and other extreme weather are periodically important. Concentration of air pollutants has been implicated as an important anthropogenic stress in recent years. Soils are generally very rocky, with the matrix ranging from well-weathered parent material to organic deposits over boulders. Soils may be saturated for long periods from a combination of precipitation and seepage. Any kind of bedrock may be present, but most sites have erosion-resistant felsic igneous or metamorphic rocks. **Vegetation:** Vegetation consists primarily of forests dominated by *Picea rubens* or occasionally by *Sorbus americana*. *Betula alleghaniensis*, Tsuga canadensis, and Quercus rubra are the only other locally common canopy species. *Acer rubrum*, *Betula lenta*, *Magnolia acuminata*, and *Magnolia fraseri* may occur. Lower strata are most typically dominated by mosses, ferns or forbs, but a few associations have dense shrub layers of *Rhododendron catawbiense, Rhododendron maximum*, or *Vaccinium erythrocarpum*. **Dynamics:** This system is naturally dominated by stable, uneven-aged forests, with canopy dynamics dominated by gap-phase generation on a fine scale. Despite the extreme climate, *Picea rubens* is long-lived (300-400 years). Both Picea and Abies seedlings are shade-tolerant, and advanced regeneration is important in stand dynamics. Natural disturbances include lightning fire, debris avalanches, wind events, and ice storms. Occasional extreme wind events disturb larger patches on the most exposed slopes. Fire is a very rare event under natural conditions, due to the wetness and limited flammability of the undergrowth, and return intervals have been estimated between 500-1000 years. If fires occur, they are likely to be catastrophic, because few of the species are at all fire-tolerant. Anthropogenic disturbances and stresses, beyond the effects of logging, have had major effects on dynamics in these systems in recent decades. Stress caused by concentrated air pollutants on the mountain tops has been suggested as a cause of observed growth declines in *Picea rubens*. Earlier, unnatural fires fueled by logging slash turned large expanses of this system into grass-shrub-hardwood scrub (e.g., Dolly Sods) that has not recovered to conifer dominance after 90 years but that in places has recovered to northern hardwoods forests. Climatic changes may affect this system severely. Climate change can be expected to raise the lower elevational limit and greatly reduce the land area available to this system.

Stresses and Threats

This system is very limited in extent on the Forest. It is currently only located in the Laurel Fork area. This system occupies about one-half of the area where it likely has the potential to exist. While the system is very limited on the GWNF, in adjacent West Virginia and on the Monongahela National Forest, it is more extensive. The greatest stresses and threats to this system include climate change and acid deposition.

3.2.2 Northern Hardwood Forest: Appalachian (Hemlock) - Northern Hardwood Forest

Background

Environment: This system occurs on somewhat protected low and midslopes and valley bottoms. In the central Appalachian center of its range, its ecological amplitude is somewhat broader, and it approaches matrix forest in some areas. It is considered a system of intermediate moisture regime. **Vegetation:** The canopy is characterized and often usually dominated by northern hardwoods (e.g., *Fagus grandifolia* and *Acer saccharum*), often with *Tsuga canadensis*, but may also contain large amounts of *Pinus strobus* and *Quercus* spp. The understory varies quite a bit, in some places dominated by evergreen shrubs and in others by herbs. **Dynamics:** This system is currently being devastated in large parts of its range by the hemlock woolly adelgid (*Adelges tsugae*). This sucking insect is continuing to cause close to 100% mortality as it spreads from the north into the southern United States. The insect will most likely cause canopy hemlocks to be replaced by other canopy trees. Historically, this system was probably only subject to occasional fires. Fires that did occur may have been catastrophic and may have led to even-aged stands of pine and hemlock. Fire suppression appears to have increased the extent of this system at the expense of oak-pine systems.

Stresses and Threats

The greatest stresses and threats to this system include climate change, acid deposition and invasive species (hemlock woolly adelgid).

3.2.3 Cove Forest: Southern and Central Appalachian Cove Forest

Background

Environment: This system occurs below 1525 m (5000 feet) elevation and generally below 1375 m (4500 feet) in low topographic positions such as valley bottoms and ravines. This cove type has two primary components, an acid cove of lower soil fertility that ranges from the lowest slope positions up the slope on north-facing protected slopes, and a rich, high-fertility cove forest that tends to occur only at the lowest slope positions. Both are sheltered from wind and may be shaded by topography, promoting moist conditions. Local slopes are usually concave. Bedrock may be of virtually any type. Acidic rocks, such as felsic igneous and metamorphic rocks, support rich cove forests in a more limited range of sites than do basic rocks, such as mafic metamorphic rocks or marble. Soils may be rocky or fine-textured, and may be residual, alluvial, or colluvial. In the southern Appalachians, the hemlock "phase" of this ("acidic cove forest") often occurs between "richer" examples of Southern and Central Appalachian Cove Forest (CES202.373) in the lowest areas and Southern Appalachian Oak Forest (CES202.886) on the midslopes. **Vegetation:** Vegetation consists of forests dominated by various combinations of mesophytic species, usually with many different species of primarily deciduous trees present. *Liriodendron tulipifera, Tilia americana, Tilia americana var. heterophylla, Fraxinus americana, Aesculus flava, Betula lenta, Magnolia acuminata, Magnolia fraseri, Halesia tetraptera, Prunus serotina*, and *Tsuga canadensis* are the most frequent dominant canopy species. Canopies are generally very diverse, with all species potentially occurring in one 20x50-meter plot in rich cove areas. A well-developed herb layer, often very dense and usually high in species richness, is present in all but the acid coves. Well-developed and fairly diverse subcanopy and shrub layers are often also present in all but the acid coves. Ulrey (1999) listed *Caulophyllum thalictroides, Actaea racemosa (=Cimicifuga racemosa), Laportea canadensis, Osmorhiza claytonii, Sanguinaria canadensis, Viola canadensis, Acer saccharum, Aesculus flava, Carya cordiformis,* and *Tilia americana var. heterophylla* as characteristic species. **Dynamics:** This system is naturally dominated by stable, uneven-aged forests, with canopy dynamics dominated by gap-phase regeneration on a fine scale. Occasional extreme wind or ice events may disturb larger patches. Natural fire dynamics are not well-known and probably only occurred in years that were extremely dry. Fires may have occurred at moderate frequency but were probably usually low enough in intensity to have only limited effects. Most of the component species are among the less fire-tolerant in the region.

Stresses and Threats

The greatest stresses and threats to this system are invasive plants due to the moist, rich soil conditions of these sites. Wild pigs are also a threat.

3.2.4 Oak Forests and Woodlands

3.2.4.a. Northeastern Interior Dry-Mesic Oak Forest

Background

Environment: These oak-dominated forests are one of the matrix forest systems in the northeastern and north-central U.S. Occurring in dry-mesic settings. They are typically closed-canopy forests, though there may be areas of patchy-canopy woodlands. They cover large expanses at low to mid elevations, where the topography is flat to gently rolling, occasionally steep. The typical landscape position is midslope to toeslope, transitioning to more xeric systems on the upper slopes and ridges. Soils are acidic and relatively infertile but not strongly xeric. Vegetation: Mature stands are dominated by oak species characteristic of dry-mesic conditions (e.g., Quercus rubra, Quercus alba, Quercus velutina, and Quercus coccinea), along with various Carya spp. Quercus prinus may be present but is generally less important than the other oak species. Castanea dentata was a prominent tree before chestnut blight eradicated it as a canopy constituent. Acer rubrum and Betula lenta are frequently common associates. Local areas of calcareous bedrock may support forests typical of richer soils (e.g., with Acer saccharum and/or Quercus muehlenbergii). In addition, Pinus strobus may be prominent in some stands in the absence of fire.

3.2.4.b. Central and Southern Appalachian Montane Oak Forest

Background

Environment: The habitat for this system includes high ridgelines and exposed upper slopes, primarily on south- to west-facing aspects, mostly between 915 and 1372 m (3000-4500 feet) elevation, and less commonly ranging up to 1680 m (5500 feet). It generally occurs as a transition between Southern Appalachian Oak Forest (CES202.886) and more mesic Southern Appalachian Northern Hardwood Forest (CES202.029) that occurs on less-exposed ridgetops and cooler, moister upper slopes (e.g., north- and east-facing aspects). At high elevations (e.g., above 1372 m [4500 feet]), this system is generally less common than Southern Appalachian Northern Hardwood Forest (CES202.029) since the habitat on most slopes at this elevation tends to favor those species adapted to a more mesic environment. **Vegetation:** This system is dominated by *Quercus rubra* and, more rarely, *Quercus alba*. Often the trees are stunted or at least not as tall as they would be in other systems farther downslope. Species richness is low to moderate. Tree associates include *Prunus serotina, Betula lenta*, and *Betula alleghaniensis*. Typical small trees and shrubs include *Ilex montana, Hamamelis virginiana, Acer pensylvanicum, Menziesia pilosa, Rhododendron prinophyllum, Vaccinium pallidum, Corylus cornuta var. cornuta*, and sprouts of *Castanea dentata*. The understory is usually dominated by ericaceous shrubs, but some communities are dominated by graminoid species or ferns. *Dennstaedtia punctilobula, Carex pensylvanica*, and *Deschampsia flexuosa* are common. Only rarely are the communities dominated by other herbs. **Dynamics:** The communities of this system inhabit some of the most inhospitable parts of the Appalachians. Their occurrence on exposed high ridges means they are subject to frequent ice and wind storms in the summer and high winds throughout the year. This probably explains the forests' stunted appearance. In addition, lightning-caused fires may create ground fires that change the understory composition and inhibit some ericaceous shrub species in some areas. Presettlement forests are likely to have experienced lightning-caused fires every 40-60 years (Fleming et al. 2005). In some locations, fire exclusion and competing understory vegetation are a factor in poor oak regeneration, with replacement by more mesophytic species such as Acer saccharum (Fleming et al. 2005). Despite the high elevation, chestnut had been a fairly substantial component of this system and can still be seen as rotting stumps in the forest. In the northern Blue Ridge, gypsy moth infestations have caused widespread tree mortality and pose a threat to these systems (Fleming et al. 2005).

3.2.4.c Central Appalachian Dry Oak-Pine Forest

Background

Environment: These oak and oak-pine forests cover large areas in the low- to mid-elevation central Appalachians and middle Piedmont. The topography and landscape position range from rolling hills to steep slopes, with occasional occurrences on more level, ancient alluvial fans. The soils are coarse and infertile; they may be deep (on glacial deposits in the northern part of the system's range), or more commonly shallow, on rocky slopes of acidic rock (shale, sandstone, other acidic igneous or metamorphic rock). The well-drained soils and exposure create dry conditions. **Vegetation:** Stands of this forest system are mostly closed-canopied but can include more open woodlands. They are dominated by a variable mixture of dry-site oak and pine species, including *Quercus prinus, Pinus virginiana*, and *Pinus strobus*. The system may include areas of pine forest and mixed oak-pine forest. Heath shrubs such as *Vaccinium pallidum, Gaylussacia baccata*, and *Kalmia latifolia* are common in the understory. Within these forests, hillslope pockets with impeded drainage may support small isolated wetlands with *Acer rubrum* and *Nyssa sylvatica* characteristic. **Dynamics:** Disturbance agents include fire, windthrow, and ice damage.

Stresses and Threats

The greatest stresses and threats to this system are lack of disturbance to create regeneration and open woodland structure and non-native invasive species including the gypsy moth.

3.2.5 Pine Forests and Woodlands

3.2.5.a Southern Appalachian Montane Pine Forest and Woodland

Background

Environment: This system occurs on ridgetops, usually only on the sharpest and narrowest spur ridges, and adjacent convex upper slopes. These sites are the extreme of convex landforms. Rapid drainage of rainfall and exposure to wind, sun and lightning are probably the important characteristics. Bedrock may be of any acidic type, including felsic igneous and metamorphic rocks, sandstone and quartzite. Soils are shallow and rocky residual soils. Fire appears to be an important factor. **Vegetation:** Vegetation consists of open forests or woodlands dominated by *Pinus pungens*, often with *Pinus rigida* or less commonly *Tsuga caroliniana*, and sometimes with *Pinus virginiana* or rarely *Pinus echinata* codominant. In examples that have not had fire in a long time, *Quercus prinus, Quercus coccinea*, or other oaks are usually present and are sometimes abundant, as are *Nyssa sylvatica* and *Acer rubrum*. *Castanea dentata* may also have once been abundant. A dense heath shrub layer is almost always present. *Kalmia latifolia* is the most typical dominant, but species of *Rhododendron, Vaccinium*, or *Gaylussacia* may be dominant. Herbs are usually sparse but probably were more abundant and shrubs less dense when fires occurred more frequently. **Dynamics:** Fire is apparently a very important process in this system (Harrod and White 1999). Pines may be able to maintain dominance due to shallow soils and extreme exposure in some areas, but most sites appear eventually to succeed to oak dominance in the absence of fire. Fire is also presumably a strong influence on vegetation structure, producing a more open woodland canopy structure and more herbaceous ground cover. Occurrence in highly exposed sites may make this system more prone to ignition, but most fires probably spread from adjacent oak forests. Fires could be expected to show more extreme behavior in this system than in oaks forests under similar conditions, due to the flammability of the vegetation and the dry, windy and steep location. Both intense catastrophic fires and lower-intensity fires probably occurred naturally. Natural occurrences probably include both even-aged and uneven-aged canopies. Southern pine beetles are an important factor in this system, at least under present conditions. Beetle outbreaks can kill all the pines without creating the conditions for the pines to regenerate. If the pines are lost, the distinction between this system and Southern Appalachian Oak Forest (CES202.886) or Central Appalachian Pine-Oak Rocky Woodland (CES202.600) becomes blurred.

3.2.5.b Central Appalachian Pine-Oak Rocky Woodland

Background

Environment: This system encompasses open or sparsely wooded hilltops and outcrops or rocky slopes in the Central Appalachians, High Allegheny Plateau, and Lower New England / Northern Piedmont. It occurs mostly at lower elevations, but occasionally up to 1220 m (4000 feet) in West Virginia. **Vegetation:** The vegetation is patchy, with woodland as well as open portions. *Pinus rigida* and (within its range *Pinus virginiana* are diagnostic and often are mixed with xerophytic *Quercu*s spp. and sprouts of *Castanea dentata*. Some areas have a fairly well-developed heath shrub layer, others a graminoid layer. **Dynamics:** Conditions are dry and nutrient-poor, and at many, if not most, sites, a history of fire is evident. In the Central Appalachians ecoregion, this system is sometimes found on sandy soils rather than rock. The southern extent overlaps with Southern Appalachian Montane Pine Forest and Woodland (CES202.331), which is characterized by *Pinus pungens*. This type is differentiated from the similar Central Appalachian Dry Oak-Pine Forest CES202.591) by its mosaic nature of wooded and open patches, as opposed to being merely a "thin forest."

Stresses and Threats

The greatest stresses and threats to this system are lack of disturbance to create regeneration and open woodland structure and invasive species including the native pine bark beetle and climate change that could reduce rainfall and make insect outbreaks more common.

3.2.6 Mafic Glade and Barrens and Alkaline Glades and Woodlands

3.2.6.a Southern and Central Appalachian Mafic Glade and Barrens

Background

Environment: Occurs on upper to mid slopes, usually on gentle to moderate slopes but occasionally steeper. The ground is mostly shallow soil over bedrock, usually with significant areas of rock outcrop. The rock usually has few fractures but may have a pitted or irregular surface. This rock structure supports more extensive and deeper soil development than in Southern Appalachian Granitic Dome (CES202.297), but has few of the crevices and deeper rooting sites available in Southern Appalachian Rocky Summit (CES202.327). Micro-scale soil depth and presence of seepage are important factors in determining the vegetation patterns. Shallow soil, unable to support a closed tree canopy, separates this system from forest systems. Bedrock includes a variety of igneous and metamorphic rock types. Some examples are on mafic substrates such as amphibolite, some are on felsic rock such as granitic gneiss but have flora that suggests a basic influence, and a few occur on felsic rocks and are clearly acidic. Rock or soil chemistry appears to be the most important factor affecting different associations on sites that have the physical structure to belong to this system. Elevation may also be an important factor causing variation. **Vegetation:** Vegetation is a fine mosaic of different physiognomies, with open woodland and grassy herbaceous vegetation or short shrubs predominating. Some instances may have closed canopies of small trees or large shrubs, but no examples have large canopy trees with a closed canopy. Bare rock outcrops are usually present in a minority of the area. The canopy species are species tolerant of dry, shallow soils, most commonly *Quercus prinus, Pinus* spp., and *Juniperus virginiana*. Basic examples may also have *Carya glabra, Fraxinus americana*, and other species abundant. Shrubs may be dense, with species determined by soil chemistry. The herb layer is usually fairly dense and dominated by grasses, both in treeless areas and beneath open canopy. An abundant forb component is also usually present, especially in the more basic examples. The forbs include species characteristic of other rock outcrops and grassland species, with a smaller number of forest species present. **Dynamics:** The dynamics of this system are not well known. The occurrence of the system appears to be primarily determined by site physical properties, with physical and chemical properties determining vegetational variation. Fire may be an important influence on vegetation, and may in the long run be important for keeping the vegetation structure open, though the patchy distribution of vegetation might limit fire intensity. Periodic drought and wind storms may also be an important factor limiting canopy density and stature. The shallow soil would make these sites particularly prone to all three. These glades do not appear to be undergoing the kind of cyclic succession that has been described for granitic domes, but some balance of soil accumulation and destruction may be occurring on a longer term or coarser scale. It is possible that the slightly irregular curved surface of some examples represents a late stage in the weathering of old exfoliation surfaces that once supported granitic domes, but most known examples are not spatially associated with existing granitic domes.

3.2.6.b Central Appalachian Alkaline Glade and Woodland

Background

Environment: This system occupies mid-elevation rocky ridges, slopes, and outcrops with thin soils and calcareous bedrock. Large amounts of exposed mineral soils and/or gravel are characteristic. Soils are high in pH and rich in calcium and magnesium. Although these areas are subject to prolonged droughts, local areas of ephemeral vernal seepage occur in microtopographic concavities, and they may have distinctive vegetation (e.g., colonies of Dodecatheon meadia). A series of glades in western Virginia is somewhat distinctive because of the dolostone, which contains a high magnesium content. These glades are located on low dolomite knobs and foothills of Elbrook dolomite that occupy middle to upper slopes and crests of south- or southwest-facing spur ridges at relatively low elevations. **Vegetation:** In some cases, the woodlands grade into closed-canopy forests. *Juniperus virginiana* is a common tree, filling in in the absence of fire, and *Quercus muehlenbergii* is indicative of the limestone substrate. *Rhus aromatica, Cercis canadensis*, and *Ostrya virginiana* may occur. Prairie grasses are the dominant herbs (*Andropogon gerardii, Schizachyrium scoparium, Bouteloua* spp.); forb richness is often high. Characteristic forbs include *Asclepias verticillata*, *Monarda fistulosa*, *Salvia lyrata*, *Symphyotrichum oblongifolium*, and *Brickellia eupatorioides* (Braun 1950). **Dynamics:** Fire is an important natural disturbance vector.

Stresses and Threats

These systems are uncommon on the Forest so their limited distribution is a stress. Other important stresses and threats to these systems include the lack of fire, non-native invasive plants, and trampling from excessive recreation use.

3.2.7 Cliff, Talus and Shale Barrens

3.2.7.a North-Central Appalachian Circumneutral Cliff and Talus

Background

Environment: This cliff system occurs at low to mid elevations from central New England south to Virginia and West Virginia. It consists of vertical or near-vertical cliffs and steep talus slopes where weathering and/or bedrock lithology produce circumneutral to calcareous pH and enriched nutrient availability. Substrates include limestone, dolomite and other rocks. Vegetation: The vegetation varies from sparse to patches of small trees, in places forming woodland or even forest vegetation. *Fraxinus* spp., *Tilia americana*, and *Staphylea trifolia* are woody indicators of the enriched setting. *Thuja occidentalis* may occasionally be present but is more characteristic of the related Laurentian-Acadian system to the north. The herb layer is typically not extensive but includes at least some species that are indicators of enriched conditions, e.g., *Impatiens pallida, Pellaea atropurpurea, Asplenium platyneuron*, or *Woodsia obtusa*.

3.2.7.b North-Central Appalachian Acidic Cliff and Talus

Background

Environment: This system comprises sparsely vegetated to partially wooded cliffs and talus slopes in the Central Appalachians and adjacent ecoregions, occurring on rocks of acidic lithology and lacking any indicators of enriched conditions. This cliff system occurs at low to mid elevations from central New England south to Virginia, and up to 1500 m in West Virginia. It consists of vertical or near-vertical cliffs and the talus slopes below, formed on hills of granitic, sandstone, or otherwise acidic bedrock. In some cases, especially in periglacial areas, this system may take the form of upper-slope boulderfields without adjacent cliffs, where talus forms from freeze/thaw action cracking the bedrock. Most of the substrate is dry and exposed, but small (occasionally large) areas of seepage are often present. **Vegetation:** Vegetation in seepage areas tends to be more well-developed and floristically different from the surrounding dry cliffs. The vegetation is patchy and often sparse, punctuated with patches of small trees that may form woodlands in places. *Juniperus virginiana* is a characteristic tree species, *Toxicodendron radicans* a characteristic woody vine, and *Polypodium virginianum* a characteristic fern. Within its range, *Pinus virginiana* is often present.

3.2.7.c Appalachian Shale Barrens

Background

Environment: This system is found at low to mid elevations in the central and southern Appalachians. Most shale barrens occur between 305 and 610 m (1000-2000 feet) elevation and have a generally southern exposure. Slopes are steep and often undercut by a stream at the base. Soils are thin, with a layer weathered rock fragments covering the surface. The exposure and lack of soil create extreme conditions for plant growth. The chemistry and pH vary somewhat from site to site, and this variability may be reflected in the vegetation. The substrate includes areas of solid rock as well as unstable areas of shale scree, usually steeply sloped. **Vegetation:** Although stunted trees of several species such as Quercus prinus, Pinus virginiana, and *Carya glabra* are common, Central Appalachian Shale Barrens are strongly characterized by their open physiognomy and by a suite of uncommon and rare plants found almost exclusively in these habitats (Fleming et al. 2004). Endemic or near-endemic shale barren species include shale-barren rock-cress (*Arabis serotina*), white-haired leatherflower (*Clematis albicoma*), Millboro leatherflower (*Clematis viticaulis*; also endemic to Virginia), shale-barren wild buckwheat (*Eriogonum allenii*), shale-barren evening-primrose (*Oenothera argillicola*), shale-barren ragwort (*Packera antennariifolia*), and Kate's Mountain clover (*Trifolium virginicum*). Other more-or-less widespread and characteristic herbaceous species of Virginia shale barrens include Pennsylvania sedge (*Carex* *pensylvanica*), little bluestem (*Schizachyrium scoparium*), poverty oatgrass (*Danthonia spicata*), wavy hairgrass (*Deschampsia flexuosa var. flexuosa*), moss phlox (*Phlox subulata*), mountain nailwort (*Paronychia montana*), rock spike-moss (*Selaginella rupestris*), shale-barren pussytoes (*Antennaria virginica*), Canada cinquefoil (*Potentilla canadensis*), smooth sunflower (*Helianthus laevigatus*), false boneset (*Brickellia eupatorioides* var. *eupatorioides*), hairy woodmint (*Blephilia ciliata*), and western wallflower (*Erysimum capitatum* var. *capitatum*; Bath and Alleghany counties). **Dynamics:** Aspect with increased exposure to drying and extremes in temperature plus dynamic downslope creep of shale fragments along with water erosion when undercut by a stream are the primary natural dynamics influencing this system. Fire may play a role in surrounding xeric to dry pine-oak woodlands by limiting encroachment of trees and shrubs onto barren.

Stresses and Threats

The major stresses and threats to these systems include the lack of fire, non-native invasive plants, problematic native species (deer browsing), trampling from excessive recreation use, and altering the normal disturbance regimes that maintain the character of the cliff, talus and barren features (rock slides, stream erosion).

3.2.8 Floodplains, Wetlands, and Riparian Areas

This group consists of a number of relatively small systems that can be difficult to map. All known locations of these systems are included in the group along with all lands within 100 feet of perennial streams, lakes, seeps and wetlands and all lands within 50 feet of intermittent streams.

3.2.8.a Central Appalachian Floodplain

Background

Environment: This system encompasses floodplains of medium to large rivers in Atlantic drainages from southern New England to Virginia. This system can include a complex of wetland and upland vegetation on deep alluvial deposits and scoured vegetation on depositional bars and on bedrock where rivers cut through resistant geology. **Vegetation:** This complex includes floodplain forests in which *Acer saccharinum*, Populus deltoides, and *Platanus occidentalis* are characteristic, as well as herbaceous sloughs, shrub wetlands, riverside prairies and woodlands. Most areas are underwater each spring; microtopography determines how long the various habitats are inundated. Depositional and erosional features may both be present depending on the particular floodplain.

3.2.8.b Central Appalachian Riparian

Background

Environment: This riparian system ranges from southern New England to Virginia and West Virginia and occurs over a wide range of elevations. It develops on floodplains and shores along river channels that lack a broad flat floodplain due to steeper sideslopes, higher gradient, or both. It may include communities influenced by flooding, erosion, or groundwater seepage. **Vegetation:** The vegetation is often a mosaic of forest, woodland, shrubland, and herbaceous communities. Common trees include *Betula nigra*, *Platanus occidentalis*, and *Acer negundo*. Open, flood-scoured rivershore prairies feature *Panicum virgatum* and *Andropogon gerardii*, and *Carex torta* is typical of wetter areas near the channel. **Classification Comments:** This is a high-gradient system, unlike the low-gradient system described in Central Appalachian River Floodplain (CES202.608). To the south in the Appalachians and interior, this system is replaced by South-Central Interior Small Stream and Riparian (CES202.706).

3.2.8.c Central Interior Highlands and Appalachian Sinkhole and Depression Pond

Background

Environment: Examples of this system occur in basins of sinkholes or other isolated depressions on uplands. Soils are very poorly drained, and surface water may be present for extended periods of time, rarely becoming dry. Water depth may vary greatly on a seasonal basis, and may be a meter deep or more in the winter. Some examples become dry in the summer. Soils may be deep (100 cm or more), consisting of peat or muck, with parent material of peat, muck or alluvium. **Vegetation:** Ponds vary from open water to herb-, shrub-, or tree-dominated types. Tree-dominated examples typically contain *Quercus* species, *Platanus occidentalis, Fraxinus pennsylvanica, Acer saccharinum*, or *Nyssa* species, or a combination of these. In addition, *Liquidambar styraciflua* may be present in southern examples. *Cephalanthus occidentalis* is a typical shrub component. The herbaceous layer is widely variable depending on geography. **Dynamics:** Water depth may vary greatly on a seasonal basis, and may be a meter deep or more in the winter. Some examples become dry in the summer.

3.2.8.d Southern and Central Appalachian Bog and Fen

Background

Environment: This system occurs in patches in flat valley bottoms, usually on the outer edges of stream floodplains at elevations below 1220 m (4000 feet). The soil is saturated most or all of the year, at least in the wettest parts, and may be very mucky. Although sites rarely flood, wetness results from a combination of groundwater input, rainfall, seepage from adjacent slopes, and impeded drainage. The groundwater is usually highly acidic and low in dissolved bases, but one or a few examples have somewhat calcareous water input because groundwater flows through mafic rock substrates. Overland flow and stream flooding are presumably only rare events. The geologic substrate is usually alluvium. Often, but not always, there is an adjacent slope with a seep at its base or some visible microtopographic feature, such as a stream levee or ridge, that impedes water drainage out of the area. Some occurrences have substantial microtopography of abandoned stream channels or ridge-and-swale systems that pond water in low areas. **Vegetation:** Vegetation is a complex of zones or patches with a mix of physiognomies. The wettest areas have herbaceous vegetation dominated by Carex spp., usually with abundant Sphagnum. Scattered trees and shrubs may be present in the herbaceous zones. Most examples also have a dense shrub zone around the edges. Some examples have forest zones as well, around the edges or as a matrix in which numerous small herbaceous openings are embedded. Characteristic tree species are *Tsuga canadensis, Acer rubrum, Nyssa sylvatica*, and *Pinus rigida*. Characteristic shrubs include *Rhododendron maximum, Alnus serrulata, Viburnum nudum var. cassinoides, Viburnum nudum var. nudum*, and *Toxicodendron vernix*. A number of plant species are shared with northern bogs, including some that are disjunct long distances and occur in the south only in bogs. Other species are narrow endemics, such as *Helonias bullata*. In the more southern examples, some species are shared with bog communities in the Coastal Plain. The very rare richer fen examples have very distinctive vegetation, sharing a number of species with northern rich fens. **Dynamics:** The natural dynamics of this system are not well known and are subject to debate. The factors that created and naturally maintain this system are unclear. Most examples show a strong tendency at present for shrubs and trees to increase in density in the open areas, threatening to eliminate the characteristic herb species. This suggests that an important process has been altered or lost. One hypothesis is that bogs are an ephemeral feature developing from abandoned beaver ponds. Another hypothesis is that they result from a narrow combination of moisture and nutrient conditions, which have been widely altered in an obscure way that has changed ecosystem stability. The cattle grazing that was nearly universal in examples of this system in the past appears to have delayed woody succession but may also have altered the natural characteristics. Fire is sometimes considered as a factor, but most examples do not appear flammable enough to burn. Besides woody encroachment, bogs may be altered by changes in adjacent drainage, such as entrenchment by streams.

3.2.8.e North-Central Appalachian Acidic Swamp

Background

Environment: These swamps are distributed from central New England through the Central Appalachians south to Virginia and west to Ohio. They are found at low to mid elevations (generally <700 m) in basins or on gently sloping seepage lowlands. The acidic substrate is mineral soil, often with a component of organic muck; if peat is present, it usually forms an organic epipedon over the mineral soil rather than a true peat substrate (although peat layers up to 1 m deep have been found in some of these swamps). **Vegetation:** *Tsuga canadensis* is usually present and may be dominant. It is often mixed with deciduous wetland trees such as *Acer rubrum* or *Nyssa sylvatica*. Sphagnum is an important component of the bryoid layer. Basin swamps tend to be more nutrient-poor and less species-rich than seepage swamps; in some settings, the two occur adjacent to each other with the basin swamp vegetation surrounded by seepage swamp vegetation on its upland periphery.

3.2.8.f North-Central Appalachian Seepage Fen

Background

Environment: This system is found in scattered locations in the central Appalachians and eastern Great Lakes regions. Mostly non-forested, these open fens develop on shallow to deep peat over a sloping substrate, where seepage waters provide nutrients. Conditions are often circumneutral to alkaline. **Vegetation:** Sedges are the major dominants. *Packera aurea*, *Symplocarpus foetidus*, and *Lobelia kalmii* are among the characteristic forbs. **Dynamics:** Some of these areas are kept open by grazing, and succession to shrublands may occur in the absence of disturbance.

Stresses and Threats

The greatest threat or stress on the systems is alteration of the hydrology that supports the system. This includes the loss of beaver activity that is important to many of these systems. Other stresses and threats include recreation use (including off road vehicles), acid deposition, and climate change. Non-native invasive plants are another stress and riparian areas can provide important dispersal corridors for many species.

3.2.9 Caves and Karstlands

Background

This system includes the terrestrial and aquatic subterranean habitat. The landscapes are formed in limestone and dolostone bedrock and are generally found in valley bottoms but occasionally on ridges and mountains depending on bedrock geology, strata location and outcrops. Passages are formed by water flowing over many millennia and can provide habitat for a variety of species, some quite rare and specialized. It is not a separate ecological system from the others, since it has vegetation defined by the previously discussed systems. It is the underground environment and the features that sometimes manifest themselves at the surface, like sinkholes, caves and springs. The location is defined by broad scale geologic mapping, so the actual areas of caves and karst terrain occupy only a small portion of the entire area.

Stresses and Threats

The greatest threats or stresses on the system are alteration of the hydrology that supports the system and degradation of water quality. This includes changes to the groundwater and surface water flow and human caused impacts to water quality such as improper pesticide use or disposal of harmful materials in sinkholes.

A summary of the stresses and threats identified for each ecosystem are displayed in Appendix E-1.

4.0 SPECIAL BIOLOGICAL AREAS

Special Biological Areas

The 121 Special Biological Areas on the GWNF support ecosystem diversity at a fine scale by recognizing and managing for rare natural communities and assemblages of rare plant and animal species. Some of these areas represent the best representatives of ecological systems and other represent unique assemblages of vegetation, animals and the physical environment. These areas include rare habitats such as sinkhole ponds, seepage swamps, bogs, and fens, mafic and limestone outcrops, spruce forest, shale barrens, and, in limited situations, habitat for single species such as sweet pinesap, coal skink, sword-leaved phlox, and Bentley’s coralroot. All known locations of T&E plant species on the Forest are included in Special Biological Areas. The following table summarizes the communities represented.

Table E-4. Community Types Represented in Special Biological Areas

Community Type	Acres
Stream	173
Riparian	27
Montane Depression Wetlands	19,414
Appalachian bog	45
Mountain/Piedmont Seepage Swamp	2,642
Montane Calcareous Seepage Swamp	304
Calcareous fen	672
Cave/karst	1,799
Dry calcareous forest, cave/karst	1,135
Montane Dry Calcareous Forest/Woodland	661
Dry/Mesic Calcareous Forest	24
Calcareous cliff	1,062
Cliff/Talus, calcareous	56
Dry - Mesic Calcareous Forests, Calcareous cliff, cave	838
Cliff/Talus	775
Outcrop	17
Outcrop barren	179
Central Appalachian Shale Barren, calcareous	769
Central Appalachian Shale Barren	10,681
High elevation	5,224
Juniper woodland	163
Mafic glade	366
Sandstone glade	141
Montane Mixed Oak/Oak - Hickory Forest,	380
Mountain/Piedmont Acidic Woodland	483
Pine - Oak/Heath Woodland	2,208
Spruce/Fir	6,694
Other	5,835
Shenandoah Mountain Crest	58,000

5.0 FORESTWIDE ECOSYSTEM DIVERSITY – ALTERNATIVES AND EFFECTS

5.1 Ecosystem Diversity Characteristics

Attributes and Indicators

The following key attributes were identified for each ecosystem along with the indicator to be used to measure the key attribute.

Table E-5. Key Attributes and Indicators for ESE Ecological Systems

Ecosystem	Key Attribute	Indicator
Mafic Glade and Barrens and Alkaline Glades and Woodlands	Ecological System Abundance	Total Occurrences at Desired Condition
Mafic Glade and Barrens and Alkaline Glades and Woodlands	Fire Regime	% Burned at Desired Frequency
Mafic Glade and Barrens and Alkaline Glades and Woodlands	Invasive Species Abundance	Compliance with Invasive Species Guidelines
Mafic Glade and Barrens and Alkaline Glades and Woodlands	Vegetation Structure	% Open Canopy
Caves and Karstlands	Ecological System Abundance	Total Occurrences at Desired Condition
Caves and Karstlands	Physical Structure	Compliance with cave, karst physical settings including hydrologic, biologic and chemical setting
Cliff, Talus and Shale Barrens	Ecological System Abundance	Total Occurrences at Desired Condition
Cliff, Talus and Shale Barrens	Invasive Species Abundance	Compliance with Invasive Species Guidelines
Cliff, Talus and Shale Barrens	Vegetation Structure	% Open and Open Canopy
Cove Forest	Forest Age Diversity	% in mid to late successional stages
Cove Forest	Forest Age Diversity	% Late Successional
Cove Forest	Forest Age Diversity	% Regenerating Forest
Cove Forest	Vegetation Structure	% open canopy in mid to late successional stages
Northern Hardwood Forest	Forest Age Diversity	% in mid to late successional stages
Northern Hardwood Forest	Forest Age Diversity	% Late Successional
Northern Hardwood Forest	Forest Age Diversity	% Regenerating Forest
Northern Hardwood Forest	Vegetation Structure	% open canopy in mid to late successional stages

Ecosystem	Key Attribute	Indicator
Oak Forests and Woodlands	Fire Regime	% Burned at Desired Frequency
Oak Forests and Woodlands	Forest Age Diversity	% in mid to late successional stages
Oak Forests and Woodlands	Forest Age Diversity	% Mature Forest
Oak Forests and Woodlands	Forest Age Diversity	% Regenerating Forest
Oak Forests and Woodlands	Vegetation Structure	% open canopy in mid to late successional stages
Oak Forests and Woodlands	Vegetation Structure	% open grasslands or forbs
Pine Forests and Woodlands	Fire Regime	% Burned at Desired Frequency
Pine Forests and Woodlands	Forest Age Diversity	% in mid to late successional stages
Pine Forests and Woodlands	Forest Age Diversity	% Regenerating Forest
Pine Forests and Woodlands	Vegetation Structure	% open canopy in mid to late successional stages
Floodplains, Wetlands and Riparian Areas	Habitat Element Abundance	Compliance with Riparian Guidelines
Spruce Forest	Ecological System Abundance	Total System Acres at Desired Condition

Abundance and Distribution

Table E-6. Current abundance of ecological systems on the George Washington National Forest

Ecological System	Approximate Existing Acres
Spruce Forest	582
Northern Hardwood Forest	13,478
Cove Forest	61,022
Oak Forests and Woodlands	756,058
Pine Forests and Woodlands	162,129
Mafic Glade and Barrens and Alkaline Glades and Woodlands	3,842
Cliff, Talus and Shale Barrens	13,637
Floodplains, Wetlands, and Riparian Areas	51,430
Water	3,284
Total Acres	1,065,462
Caves and Karstlands (included in above acres)	119,000

Structure and Tree Age Diversity

Structure and tree age diversity are both characteristics that are important to all forested ecological systems. Structure is also important to non-forested systems. Every forested community requires a balance of age-class conditions representing a diversity of vertical structure that allows for recruitment of young growth to replace losses due to storm events, pest infestations, wildland fires, and loss of over-mature trees. An appropriate balance of vertical structure within each community provides critical habitat for associated species that require either grass/forb-seedling/shrub (early seral), and/or trees (late seral).

Canopy structure reflects the general health and sustainability of the community by the amounts and arrangement of early seral and mature stands. Canopy closure, as a surrogate for horizontal structure, was measured as a combination of stem density, basal area and extent of canopy cover. This measure was used primarily to delineate forested (closed canopy) from open canopy and woodland conditions.

Table E-7. Definitions of Structural Classes

Open	Land with less than 10 percent canopy cover in permanent or long-term open condition (grasslands, barrens, etc.; not newly cut forest regeneration.)
Early Successional or Regenerating Forest	Stands developing after a major disturbance, generally less than 11 years in age in the most common systems, but can be up to 24 years.
Mid-Successional Open Canopy	Stands beyond regeneration that stay in a relatively open canopy (canopy closure of 25-60%)
Mid-Successional Closed Canopy	Stands beyond regeneration where the canopy closes (canopy closure of 61% or greater)
Late Successional Closed Canopy Forest	Stands reaching older ages of mature trees (50-100 years or greater) and more lasting structural conditions with a largely closed canopy (all layers) greater than 60 percent. Includes natural canopy gaps.
Late Successional Open Canopy Forest	Stands reaching older ages of mature trees (50-100 years or greater) and more lasting structural conditions with overall open canopy (canopy closure of 25-60 percent; typical of thinned forests)

Old Growth

Summary of Old Growth Guidance

In 1989 then-Chief Dale Robertson issued a national position statement on old growth. This included a national generic definition and description of old growth forests that is still applicable today:

> Old growth forests are ecosystems distinguished by old trees and related structural attributes. Old growth encompasses the later stages of stand development that typically differ from earlier stages in a variety of characteristics that may include tree size, accumulation of large dead woody material, number of canopy layers, species composition, and ecosystem function.
>
> The age at which old growth develops and the specific structural attributes that characterize old growth will vary widely according to forest type with climate, site conditions, and disturbance regime. For example, old growth in fire-dependent forest types may not differ greatly from younger forests in the number of canopy layers or accumulation of downed woody material.
>
> Old growth is typically distinguished from younger growth by the following structural attributes and characteristics:
>
> 1. Large trees for that species and site.
> 2. Uneven age structure with tree species in several size classes resulting in multiple canopy layers.

3. Accumulations of large-size dead standing and fallen trees that are high relative to earlier stages and in all stages of decay.
4. Broken or deformed tops or bole and root decay primarily resulting from weather phenomena such as ice or wind storms.
5. Single or multiple tree-fall gaps usually resulting from windthrow and resulting in understory patchiness and increased micro-topography relief.
6. Undisturbed soils and soil macropores usually with a well-developed surface organic layer (0 horizon).
7. On mesic sites a well-developed fungal component.

Beginning in 1990, the Southern and Eastern Regions of the Forest Service; the Forest Service Southern, Northeastern, and North Central research stations; and The Nature Conservancy began efforts to develop science-based old growth definitions for the east. The effort proved to be problematic in large part because so few representatives of old growth conditions exist and their history for their entire life so poorly known that quantifying the range of natural variability was imprecise. But after five years of effort, in December of 1995, the Southern Regional Forester chartered the Region 8 Old Growth Team to make the draft scientific old growth definitions 'operational and useful'. In June of 1997 the Team completed a report entitled *Guidance for Conserving and Restoring Old-Growth Forest Communities on National Forests in the Southern Region*, hereafter called the 'old growth report' (Forest Service 1997). It is this report that continues to guide management of old growth on the Southern Region Forests.

The old growth report recognized old growth forests as a valuable natural resource worthy of protection, restoration, and management that provides a variety of ecological, social, and spiritual values. Old growth communities are rare or largely absent in the southeastern forests from Virginia south to Florida. Existing old growth areas (referred to as 'primary forests') may represent around 0.5% (approx. 482,000 acres) of the total forested acreage of 88,079,000 acres (Davis 1996). For these reasons the Southern Region's National Forests are making efforts to restore more of this portion of forest ecosystems.

The old growth report gave operational definitions for sixteen old growth community types that encompassed nearly all of the forest cover types in the Southeast. Factors used to define old growth forest type (OGFT) groups are those that most strongly influence the structural and functional characteristics of old growth forests. These include site factors that directly or indirectly affect productivity and spacing of trees, disturbance regimes, physiognomy, dominant tree species, and geography (in that geography is related to climate, which controls productivity, in part). A few forest cover types were not included such as those considered rare communities plus the tropical forests of the Caribbean.

For each old growth forest type, minimum ages were determined at which a stand will begin to develop attributes characteristic of old growth conditions. Several accepted definitions used to describe old growth state that a given old growth forest type will begin to develop old growth characteristics at an age approximately one-half the maximum longevity (lifespan) of the dominate tree(s) found in that type (Cogbill 1983; Leverett 1996; Loehle 1988). The nine old growth forest type groups that occur on the Forest have five different ages at which they begin to develop old growth characteristics ranging from 100 to 140 years. These groups not only reflect the longevity of dominate trees, but natural disturbance regimes (fire, ice storms, gap formation, etc.) and edaphic conditions (rainfall, slope, aspect, etc.) where they're found.

The operational definitions established four criteria which had to be met before a stand would be considered 'existing' old growth: (1) AGE - minimum age in the oldest age class; (2) PAST DISTURBANCE - no obvious human-caused disturbance that conflicts with old growth characteristics for that type; (3) BASAL AREA - minimum basal areas of stems 5" d.b.h. and larger; and (4) TREE SIZE - a minimum diameter at breast height (d.b.h.) of the largest trees. Except for number two, the values for these criteria vary by old growth type. The report also generally charged each Forest to provide: (1) a distribution of large (more than 2,500 acres), medium (100 thru 2,500 acres), and small (1 thru 99 acres) potential old growth patches; and (2) representation of all potential and applicable old growth forest types for each ecological section unit (e.g. physiographic region). An exception to the large block requirement was made for forests in the Northern and Southern Cumberland Plateau and the Appalachian Piedmont ecological sections because of land ownership patterns. The distribution guidance did not specify an amount, such as acres or percent of area, to be in each patch size. In addition, old growth patches were assumed to be occurring on National Forests in a matrix of mid- to late successional forest conditions, providing connectivity without old growth allocations being physically contiguous. Representation was limited to ensuring that old growth community types were present, not a total amount nor an amount per each type. Amounts (i.e. acres) were to be based on public issues and ecological capabilities of the land.

The Biological Significance of Old Growth

To date no species of plant or animal had been identified in the Southeastern United States that is considered an old growth obligate; that is, requiring old growth for some portion or all of their life cycle. Therefore, the provision of existing or future old growth is not directly linked in a cause and effect relationship to the viability of any species.

However, old growth and associated late successional forests & woodlands are a condition that is particularly rich in habitat attributes for a variety of species and these attributes occur in close association (intra-stand) with one another as opposed to a landscape scale (inter-stand) distribution. A wider variety of habitat niches are available than in earlier life stages of the same community. The long development period is conducive to the formation of complex vertical structure that may include 'emergent' trees, dominant and co-dominant trees, suppressed trees, and a forest floor shrub layer and/or a herb/forb/grass layer. Canopy gaps of various sizes caused by: (a) the death in-place of a single tree; or (b) the deaths in-place of small groups of trees; or (c) the falling of a group of trees, in comparison with their immediate surroundings provide micro-sites with higher light regimes, higher stem counts, and an 'edge effect' both around the edge of the gap and back into the surrounding stand. Standing dead trees provide large and small diameter snags for foraging, perching, and cavity excavation. Down logs and limbs provide a substrate for wood decomposing fungi and insects; cover for small mammals, amphibians, and insects; and in later stages a 'nurse log' for the establishment of new tree seedlings. Large-diameter living trees, with a long-term exposure to natural damaging agents, have the potential through wood-rotting fungi activity for the formation of large cavities suitable for bear, raccoon, squirrel, bats, or other cavity users. The heavy limb structure that develops in some tree species as they age provides sturdy nest platforms for species such as bald or golden eagles.

The Social Significance of Old Growth

Whether biologically necessary to species or not, old growth is of value. There seems to be a general sense that it is intelligent to be sure to have this habitat condition on the landscape. In Aldo Leopold's words, '*The first rule of intelligent tinkering is to keep all the parts.'* As with Wilderness, there also appears to be a desire for places almost completely unmodified by humans whether or not those holding such a value ever visit them; that is, an 'existence' value. There can be, and often is, a historical, cultural or spiritual value associated with old growth whether it's a few acres, hundreds of acres, or even thousands of acres. There also is value in providing old growth of different types on a variety of landscapes that each person holding that value can readily relate to. That is, it is not enough to say something valued is being provided simply 'somewhere'.

In more pragmatic terms, old growth has other recognized social values. It is a desirable recreation setting, both for its biological variety and for the associated state of mind from knowing one is in an 'old growth' setting perhaps surrounded by an open forest of big trees. It serves as a 'biological time machine' in that it is a reference area for what ecologically-comparable areas may have been previously and can be restored to given a similar amount of time and disturbance history. They are a valuable part of showing a comprehensive whole of ecological dynamics in conservation education. They are also a source of scientific information for research such as dendrochronology (tree ring analysis) used in studies of disturbance regimes and climate fluctuations.

Implementation of Old Growth Guidance in Forest Plan

The GWNF has used the 1997 Regional Guidance to help address this component of biodiversity and in the delineation of old growth, both potential and existing. Small, medium, and large sized patches have been identified using stand ages contained in FSVeg and analyzed their spatial arrangement using GIS. Existing Wilderness, Recommended Wilderness study areas, Remote Backcountry, and other prescriptions with large acreages, such as Special Biological Areas and Shenandoah Mountain Crest, provide for the large blocks both now and in the future.

Successional Forests, Early Successional Habitat, Openings, Open Woodlands

Successional stages of forests are the determining factor for presence, distribution, and abundance of a wide variety of wildlife. Some species depend on early successional forests, some depend on late successional forests, and others depend on a mix of both occurring within the landscape (Franklin 1988; Harris 1984; Hunter et al. 2001; Hunter 1988; Litvaitis 2001). These habitat conditions are also important as wintering and stopover habitats for migrating species (Kilgo 1999; Suthers 2000; Hunter et al. 2001). Therefore, it is important that varying amounts of both types of habitat be provided within national forest landscapes.

For analysis purposes, forest succession is generally divided into three stages: early, mid, and late. Early successional forest is defined as regenerating forest of 0 to 24 years of age for depending upon the ecological system. It is characterized by dominance of woody growth of regenerating trees and shrubs, often with a significant grass/forb component, and relatively low density or absent overstory. This condition is distinguished from most permanent opening habitats by dominance of relatively dense woody vegetation, as opposed to dominance of grasses and forbs. Such conditions may be created by even-aged and two-aged regeneration cutting, and by natural disturbance events, such as windstorms, severe wildfire, and some insect or disease outbreaks. Ages defining the remaining successional stages vary by ecological system. Mid-successional forest often begins to develop with the sapling/pole forest characterized by canopy closure of dense tree regeneration, with tree diameters typically smaller than 10 inches. It then proceeds through stratification of over-, mid-, and understory layers. Late successional forests, from 50 to 100 years in age and older, include old growth conditions. This stage contains the largest trees and often has well-developed canopy layers and scattered openings caused by tree mortality. Of particular importance as habitat are forest conditions that exist at both extremes of the forest successional continuum-early successional and late successional forests.

Another important type of forest that combines elements of both early and mid – to late successional forest is open woodlands. Created and maintained largely by periodic fire disturbance regimes, open woodlands are characterized by an overstory of trees that are spaced far enough apart to allow sunlight to reach the forest floor. This structural condition allows the development of a grassy/shrubby/herbaceous/woody understory more typical of early successional forest and grassland/shrublands. Many high priority species depend on the juxtaposition of both overstory mature and a well-developed grassy/shrubby/herbaceous understory for their life cycle needs. Northern bobwhite quail, red-headed woodpecker, brown-headed nuthatch, northern flicker, Appalachian yellow-bellied sapsucker, eastern wood-pewee, golden-winged warbler, Indiana bat, pine snake, grizzled skipper, box huckleberry, shale-barren rockcress, small-spreading pogonia, sword-leaf phlox, variable sedge, and smooth coneflower are just a few high priority species dependent upon open woodland habitat.

Early successional forests are important because they are highly productive in terms of forage, diversity of food sources, insect production, nesting and escape cover, and soft mast. Early successional forests have the shortest lifespan (usually about 10 years) of any of the forest successional stages, and are typically in short supply and declining on national forests in the Southern Appalachians (SAMAB 1996:28), and in the eastern United States (Thompson 2001). Early successional forests are also not distributed regularly or randomly across the landscape (Lorimer 2001). These habitats are essential for some birds (ruffed grouse, chestnut-sided warbler, golden-winged warbler, prairie warbler, yellow-breasted chat, blue-winged warbler, Swainson's warbler); key to deer, turkey, and bear in the South; and sought by hunters, berry pickers, crafters, and herb gatherers for the wealth of opportunities they provide (Gobster 2001). Many species commonly associated with late successional forest conditions also use early successional forests periodically, or depend upon it during some portion of their life cycle (Hunter et al. 2001).

The need for seedling/sapling conditions to provide habitat for birds associated with early successional habitats is a current topic of concern. Old fields can provide conditions required by many early seral species, but this habitat type itself is very uncommon on the National Forest. The minimal area that is required by each species varies and is not fully understood. Kirpez and Stauffer (1994) documented local research findings that harvest groups of approximately 0.5 to 2 acres in size provide suitable habitat for such early seral dependent birds as the indigo bunting and rufous-sided towhee. In addition, local U.S. Forest Service bird monitoring efforts have identified the chestnut-sided warbler, an early seral species, inhabiting group harvest areas of less than 1 acre in size. In a discussion of management of early-successional habitats, Thompson and Dessecker (1997) identified group selection areas of less than 0.5 acres as inadequate for a variety of forest songbirds. Thus, there is a group of forest songbirds, such as the prairie and golden-winged warblers, which require disturbance patches that are less than 10 years of age and greater than 2 acres is size. Thus, the early successional forest habitat that will be created in patches greater than 2 acres, will result from even-aged timber harvest.

In addition to structure and patch size, the elevation at which early seral habitats exist plays a role in providing habitat for some species. The chestnut-sided warbler typically occurs at higher elevations on the GWNF. Thus, provision of seedling/sapling habitat needs to be considered at both high and lower elevations.

Eastern hardwood stands begin to produce significant amounts of hard mast at about age 40. Hard mast is a very important component for many wildlife species such as bear, squirrel, and turkey. Therefore, the age at which hardwood stands begin to produce adequate amounts of hard mast, especially upland hardwood stands dominated by oak species, is an important stage in stand development. Hard mast production is highly variable between species as well as individuals of the same species. Hard mast production in any given year is dependent upon many factors including climate and weather, insects and disease, stand density, size of trees, stand composition, and stand age. Many of these factors are either beyond control (e.g. weather) or more appropriately considered at site specific levels (e.g. stand density). For the purposes of effects analysis and disclosure at the Forest Plan level, stand age and stand composition are excellent indicators of a stand's hard mast production capability.

The five major oak species (*Quercus alba, Q. prinus, Q. velutina, Q. rubra*, and *Q. coccinea*) all begin hard mast production at ages from 20 to 25 years old. Maximum acorn production is achieved at 40 to 50 years old. *Carya glabra, C. tomentosa*, and *Fagus grandifolia* produce hard mast in quantity at ages of 30 to 40 years. Finally, *Tilia americana* can begin producing adequate amounts of hard mast as early as 15 years old. (Burns and Honkala 1990.) Goodrum and others found that acorn yields tended to be largest in the classes from 40 to 49 years old up to 90 to 99 years old, but declined thereafter (Goodrum et al. 1971). Shaw arrived at a similar conclusion when he found that stands in his study area ranging from 40 to 80 years old comprised 50% of the management unit, but produced 90 percent of the acorn crop. (Shaw 1971.) Thus, the age of 40 years old as the beginning of significant hard mast production in eastern hardwood forests is widely accepted.

Like early successional forests, late successional forests provide habitats and food supplies for a suite of habitat specialists as well as habitat generalists. These habitats are important providers of high canopy nesting, roosting, and foraging habitat, suitable tree diameters for cavity development and excavation, and relatively large volumes of seed and hard mast. Although it takes many decades for late successional forest conditions to develop, these habitats are more common and contiguous across the national forest and are dominant features in the SAA area (SAMAB 1996:28).

At the time of the SAA, National Forest System lands had only 3% of forest habitats in the early successional stage, while 89% was in the mid- and late successional classes; 45% of this was late successional forest (SAMAB 1996:168). Other public lands were similar to the National Forest. Conversely, private industrial lands had 22% in early successional forest and only 4% in late successional forest; private non-industrial had 8% in early successional forest and 9% in late successional forest (SAMAB 1996:168-169). The 20-year trends (SAMAB 1996:28) show early successional forest on National Forests decreasing by 4%, with late successional forest increasing by 34%. Trends for private forests are mixed, with increases in both early- and late successional forest percentages. These results likely reflect the mixed objectives of private landowners, with some focusing on commodity production and others on amenity values. In general, on National Forest System lands forest conditions are weighted heavily toward total acres of older forests, while private forests are providing a more balanced distribution of forest successional conditions from young to old (Trani-Griep 1999).

Quality of forest successional habitats may also vary between private and national forest system lands. Objectives on national forests to provide for wildlife habitat needs, recreational activities, scenic integrity objectives, and water quality often result in greater vegetation structure retained in early successional forests than in similar habitats on private lands. On private lands, more intensive management may simplify structure and composition, reducing habitat quality. Similarly, effort to restore and maintain desired ecological conditions and processes in mid- and late successional forests also often enhances habitat quality over that found on private lands. For these reasons, conclusions regarding cumulative habitat availability from both private and national forest system lands must be made with caution.

Hurricanes (Foster 1992), lightning frequency (Delcourt 1998), fire frequency (Whitney 1986), and pre-settlement cultural activities (Delcourt 1987) were probably the major sources of disturbance events that created early successional forests prior to European occupation. Less drastic perturbations such as mortality events from tornadoes, insect or disease outbreaks, or defoliation (passenger pigeon roosts) were typically less extensive and cyclic but nonetheless provided a source of early successional forest conditions. Natural disturbances, however, are unpredictable, episodic, and heterogeneous (Lorimer 2001); influential at a landscape scale; and are neither uniform nor random in distribution. Anthropogenic disturbances occurred more frequently in floodplains along major rivers and in "hunting grounds." In a recent review paper by disturbance ecologist Craig Lorimer (Historical and ecological roles of disturbance in eastern North American forests: 9,000 years of change. Wildlife Society Bulletin 2001, 29(2):425-439), Lorimer states that predicting frequency of more severe natural disturbances (the kind that would create desired early-successional forest patches) is difficult because they are highly episodic and spatially heterogeneous. Lorimer goes on to state: "…the episodic nature of large natural disturbances creates a sort of 'feast or famine' environment that may subject early successional animal populations to erratic fluctuations…" Such feasts and famines may be especially extreme when looking at the smaller natural landscapes represented by national forests, surrounded by private lands that may be converted to nonforest. Successional forest objectives are designed to reduce the feast and famine swings for early-successional forest species, while providing ample habitat for mature forest species.

Overall, landscape patterns more consistently contain a component of early successional forests in places more "likely" to be susceptible to disturbances, i.e., south and west facing slopes, sandy or well drained soils, or in fire adapted plant communities. Fire suppression, intensive agriculture resulting in massive soil losses, land use changes, and urban sprawl have drastically altered the variables that would perpetuate a landscape with a significant component of early- successional forests. With many species associated with early successional forests in the southeast in decline (Hunter et al. 2001), it is imperative that management actions include some provision for perpetuating early successional forest conditions. At the same time, many of these same factors, especially land use conversion, have reduced the distribution and abundance of quality late successional forests across the larger landscape. Maintenance of these on public lands is equally imperative.

Permanent grass/forb and seedling/sapling/shrub habitats are important elements of early successional habitat. Permanent openings typically are maintained for wildlife habitat on an annual or semi-annual basis with the use of cultivation, mowing, or other vegetation management treatments. These openings may contain native grasses and forbs or may be planted to non-native agricultural species such as clover, orchard grass, wheat, or small grains. Old fields are sites that are no longer maintained, are maintained on a less frequent basis (5-10 year intervals, usually with burning and mowing) or are succeeding to forest. They are largely influenced by past cultural activities and may be dense sod or a rapidly changing field of annual and perennial herbs, grasses, woody shrubs and tree seedlings.

Permanent openings are used by a variety of wildlife, both game and non-game species. Parker and others (1992) reported use of agricultural openings by 54 species of birds and 14 species of mammals in a study on the Chattahoochee National Forest. Bird species observed included wild turkey, several species of raptors and woodpeckers, and numerous songbirds including a number of neotropical migrants such as pine warbler, ovenbird, and black-throated green warbler. The greatest number of avian species and highest bird species diversity was found within the edge zone of the openings. Mammals observed included species such as white-tailed deer, striped skunk, woodchuck, bobcat, black bear, red bat, eastern cottontail, opossum, and several other small mammals.

The benefits of permanent openings to white-tailed deer are well documented. Permanent openings, especially those containing grass-clover mixtures, are used most intensively in early spring, but also are an important source of nutritious forage in winter, especially when acorns are in short supply (Wentworth et al. 1990; Kammermeyer et al. 1993). Kammermeyer and Moser (1990) found a significant relationship between openings and deer harvest with only 0.13% of the land area in high quality openings. Forest openings also are a key habitat component for wild turkeys throughout the year (Thackston et al. 1991; Brenneman et al. 1991). Maintained openings provide nutritious green forage in the winter and early spring and seeds during late summer and fall. Because of the abundance of insects and herbaceous plants produced in these openings, they are especially important as brood rearing habitat for young turkeys (Nenno and Lindzey 1979; Healy and

Nenno 1983). Linear openings, especially those associated with young regenerating forests, provide optimal brood habitat conditions for ruffed grouse (Dimmick et al. 1996).

There also are numerous wildlife benefits from openings maintained in native species. Native warm season grasses provide nesting, brood-rearing, and roosting habitat for northern bobwhite and other grassland species of wildlife (Dimmick et al. 2001). Native species are well adapted to local environments and generally require less intensive maintenance following establishment.

Old fields provide food and cover for a variety of wildlife species. A number of disturbance-dependent birds, such as northern bobwhite, grasshopper sparrow, golden-winged warbler, and blue winged warbler, are associated with old field habitat (Hunter et al. 2001). Recently abandoned fields are important for rabbits and many small mammals (Livaitis 2001). Woodcock use old fields as courtship, feeding, and roosting sites (Straw et al. 1994; Krementz and Jackson 1999). Although managed less intensively than other types of permanent openings, some degree of periodic management is necessary to maintain these habitats.

Fire Regime

The presence of fire begins long before humans arrived in North America. Evidence of lightning fires exists as fusain in coal layers and as lightning scars on petrified trees (Pyne 1982). Even today, lightning and thunderstorms are abundant, and Pyne surmised, "A phenomenon of such magnitude and longevity has unquestionably kindled profound evolutionary consequences". This great and persistent selecting force has influenced ecosystem traits and characteristics since fuels and lightning first interacted. The result is a forest with diversity and flexibility that is well adapted to fire occurrence. Fire has no doubt been a major selection force in our forest ecosystems, both lightning and anthropogenic. Many communities and species require fire to sustain populations. Oak and southern yellow pine communities have been major components of these forests for thousands of years. These communities promote and require fire. Recurring fire has been a part of the ecosystem for thousands of years. Burning is the oldest sustained land management force on these forests. No other practice can be said to have such a track record with known results.

A clearer picture of change over time is gained when we focus on the period since the last ice age. Dramatic changes in plant and animal communities have occurred during this post-glacial period. Importantly, humans made their way onto the North American scene during this period. The ecosystems developed within the influences of both climatic and human forces. The question often debated is whether human ignition, for those thousands of years, should be considered when determining the “natural” state of ecosystems. Several points seem clear. The forests have been continually changing. The diversity and flexibility of these natural systems are necessary to react to change. Fire is an important mechanism to retain that diversity and flexibility.

Early human occupation of Virginia dates back to approximately 11,500 BP during the Paleoindian period (Barber, 1996). European contact was relatively early in the region of the George Washington and Jefferson National Forests, Barber (1996) notes European contact did not occur in the Ridge and Valley area until the 1670's, and the written historical record of fire is rich with accounts from travelers and explorers. The obvious conclusion, common to each account, was the extensive use of fire by Native Americans. The effect, likewise, was extensive. Early observations describe vast areas of grassy savannas, commonplace smoke and fire, clearings and fields and apparent utilization of fire-managed vegetation (Maxwell 1910; Day 1953; Pyne 1982; Hammett 1992; Brown 2000). Maxwell contains a great number of accounts, but his perspective certainly reflects the bias and prejudices of the opponents to light burning. From all accounts, regardless of their perspective, burning by the Native Americans was a commonplace practice, serving many needs.

Methods of constructing fire histories in the east for pre-European settlement times have relied largely on sediment records (Craig 1969; Watts 1979; Patterson and Backman 1988; Patterson and Sassaman 1988; Wilkins et al. 1991; Kneller and Peteet 1993; Patterson and Stevens 1995; Delcourt and Delcourt 1996). These studies typically extract a core of sediment from a pond or bog, and that core is then sampled for pollen, plant macrofossils, and/ or charcoal.

Though a scarcity of suitable sites has limited the number of such investigations, ponds and bogs have provided a number of valuable sites in the Central Appalachians. Sites within or near the Forests are: Potts Pond (Watts 1979) in Alleghany County; Hack (Spring) Pond and Quarles Pond (Craig 1969), in Augusta County;

Brown's Pond (Kneller and Peteet 1993) in Bath County; and another study that includes Brown's Pond and also Green Pond, in Augusta County, near Sherando Lake (Patterson and Stevens 1995).

Common to each study is the dynamic nature of the composition of plant communities. Climate is the determinant mechanism that propels this continuum of change along a geologic time scale (Patterson and Backman 1988). Fire acts within this continuum on a shorter scale, to provide an important catalyst that selects one plant over another. Watts (1979) agrees that this "migration of single species is an opportunistic response to changes in climate and environmental circumstances independent of other species". From 7,880 BP to the present, oak has been the dominant genus, comprising more than 50% of the pollen record. Pine is also present, increasing within this time period from 3% to 22%, with both white pine and yellow pines being represented. Chestnut stays below 1% until the upper, later half of the profile. The continued dominance of oak corresponds with relatively greater amounts of charcoal deposits. Blackgum was also found on Potts Mountain (Watts 1979) during this period. Watts had also noted an earlier rise in American chestnut at Potts Mountain.

Patterson and Stevens (1995) correlated charcoal surface area to pollen abundance, signifying the relative importance of fire for sampled time periods. Brown's Pond (Bath County) and Green Pond (Augusta County) were examined. Similar to other studies, they agree that the vegetation around Brown's Pond has changed little over the past 1,000 to as much as 4,000 years, with oak, hickory and chestnut representing important taxa. Also, ragweed was consistently present during this period, an indicator of agricultural activity.

Green Pond, on the other hand, showed a marked increase in total pine pollen, from <20% before the chestnut decline to over 40% more recently. Diploxylon pines (hard pines; i.e. pitch, table mountain, shortleaf, and Virginia) are more important than at Brown's Pond. Also of significance is the recent reduction in oak pollen since the chestnut decline, from > 40% to less than 30%, suggesting local vegetative changes.

They then looked at the amount of charcoal surface area found, relative to the pollen samples. At Green Pond, evidence suggests fire presence both before and after European settlement. They determined that fire had a significant impact on vegetation around the time of European settlement. Those high charcoal values are followed by a sharp increase in pine pollen. This charcoal peak was between the increase in agricultural pollen and before the chestnut decline. The data suggests that fire in early post-European settlement resulted in a dramatic change in vegetation.

At Brown's Pond, high charcoal to pollen ratios appear at 650 years BP, ~2,000 BP, and 4,210 years BP. The average ratio prior to European settlement is slightly higher than post-settlement, with two fires clearly evident since Euro-settlement. The higher pre-euro-settlement values indicate the long historical role fire has played in the hardwoods. The authors suggest that long interval fire regimes have been important in maintaining the vegetative composition typical of the central Appalachians.

Patterson and Sassaman (1988) compared amounts of sedimentary charcoal to archaeological sites and found that fires were common near larger Native American populations and where their land-use practices were greatest. Charcoal records prior to European settlement and post-settlement show little difference, except during the slash fires associated with the logging boom at the turn of the century.

These records clearly suggest that fires have been important in that area for the past 4,000 years, during a period of low lightning incidence. Human use of fire has been important in determining plant community composition (see also Sutherland et al. 1993).

Delcourt and Delcourt conclude by stating, "If management goals of the U.S. Forest Service include maintaining populations of fire-adapted pines and certain oak species that are currently declining because of active fire suppression, then future management tools clearly must include prescribed burning. The lesson from the Horse Cove example of prehistoric human use of fire is that fires of limited extent, focused on particular portions of the landscape, and excluded from others, can promote a heterogeneous mosaic of different vegetation types, some of which include clearly fire-adapted species, and others of which include fire-intolerant species. In order to maintain both old growth mesic hardwoods and fire-adapted pines within the same forest district, an optimal management plan would be based upon an understanding of the effects of different frequencies and intensities of fire applied to varying portions of the topographic-edaphic gradient and different areal extents of impact. Work of vegetation ecologists such as Runkle (1982, 1985) and Barden (1980, 1981) indicates that equilibrium, old growth mixed mesophytic forests will regenerate only under a disturbance regime that includes infrequent windthrow to open canopy gaps but which explicitly excludes fire (see also Clark and Royall 1996). Promotion of Appalachian oak forests, including relatively widely spaced oak groves or "oak orchards" with sparse understory of grass and bracken fern (Stephenson et al. 1993), on the other hand requires use of frequent ground fires such as may have been used by prehistoric Native Americans to maintain their hunting and gathering grounds. Furthermore, periodic crown fires along exposed ridge crests may be necessary for regeneration of fire-adapted endemic pine species".

The George Washington National Forest was established in 1918 and the national direction regarding fire was quite clear in the early days of the Forest Service (Pyne 1982)..."Forest fires have no place in any forest but as a result of ignorance, carelessness, and indifference (Anonymous 1936)". The practitioners of "controlled burning" battled against an enormous campaign set at the national level to stop all fire. With that new direction of suppressing all fires, that major force of selection that had been present since the ice age was suddenly altered. The consequences of that well-intentioned but misguided policy would not be obvious for several decades. The selection process that influenced plant and animal communities now changed with the absence of fire.

Perhaps, though, in defense of the dedicated firefighters during these times, this is the way it had to happen. The use of fire-fighting equipment, intelligence, weather forecasts, budgets and fire behavior prediction have only recently enabled prescribed burning on a substantial level. Recent scientific literature regarding plant and animal reactions and effects are now better known. We have better data on pre-Euro-American settlement conditions. And now we are beginning to understand some of the more dramatic long-term impacts of fire exclusion, as plant and animal populations and conditions of forest ecosystems are altered.

Several other studies have approached the issue of fire occurrence, what it has been in the past and the implications of fire exclusion. Dendropyrochronology studies provide valuable information such as the season of fire occurrence since trees lay down early season and late season wood in each tree ring per year; the number of fire scars on an individual tree provides data on fire frequency; and, by cross dating fire scars on different trees that occurred in the same year one is able to approximate the spatial extent of a fire.

Sutherland and others 1993, sought to “reconstruct the historical relationship between fire and community structure using both the age and species composition approach in combination with tree-ring fire history analysis”. Their study was one of the first in the Central Appalachians to use fire scars on pines to examine fire history. The study site on Brush Mountain in southwest Virginia west of Blacksburg, noted the loss of table mountain pine (*Pinus pungens*) recruitment since fire suppression in the late 1930s. Major recruitment of P. pungens occurred twice during the 1800’s, probably due to exceptionally hot fires. The fire scar chronology indicated that fire occurred frequently (every 9-11 years) throughout the 19th century and early 20th century. Most of those fires occurred during the dormant season, most likely in early spring. The hot recruitment fires may have been during the growing season. They stated, “Fire suppression is most likely the cause of a dramatic change in the composition of the Brush Mountain communities during the last 60 years (Williams and Johnson 1990). In the past, fire clearly promoted integrity of the Pinus pungens community on Brush Mountain”.

Subsequent fire history studies using dendrochronology at multiple sites and a larger sample size of scarred trees on both the GWNF and Jefferson National Forest found that the fire interval from the early 1700s to the 1930s ranged from 2 to 9 years (Aldrich et al. 2010; DeWeese 2007; Lafon and Grissino-Mayer 2005). Additional unpublished work by Aldrich has pushed this timeframe back to the mid-1600’s which pre-dates European settlement in western Virginia. Work by Lafon in the southern Blue Ridge has found similar intervals for the same timeframe.

To examine fire history further back in time recent studies have examined and dated charcoal found in soil layers. A study on southwestern North Carolina found that fires burned regularly across the studied landscape for at least the past 4,000 years. These fires were not confined to the dry oak-pine dominated ridges but extended downslope into areas that are today dominated by mesic hardwood forests (Fesenmyer and Christensen 2010).

Habitat Fragmentation

Habitat fragmentation is a key issue for viability of local populations of breeding birds and other species like salamanders in some mature mesic deciduous forest settings. Birds in this group avoid forest edges during nesting and are adapted to forest interior conditions. Most are neotropical migrants that primarily nest and raise young in the temperate Americas. These species are grouped for effects analysis due to their sensitivity to forest fragmentation and edge effects (Hamel 1992).

Studies conducted in the mid-western U.S. have documented that forest interior species may not successfully breed in small patches of otherwise suitable habitat. Quality of their forest interior habitat is measured in part by proportion of edge, an artifact of juxtaposing forested and non-forested habitats. Edges fragment forest interior habitats and are associated with increased predation and brood parasitism by the brown-headed cowbird in agricultural settings (Primack 1993; Yahner 1998). However, characteristics of the surrounding landscape, such as percent forest cover, determine the magnitude of local edge effects. Findings of Robinson and others (1995) indicate that large landscapes with at least 70-80% forest cover offer high potential as quality habitat for forest interior species, where adverse effects of edge are reduced to levels compatible with productive populations.

Donovan and others (1997) found that abundance of the brown-headed cowbird in a midwestern U.S. setting was significantly greater in highly fragmented landscapes (< 15% forested) than in moderately fragmented (45-55% forested) or unfragmented (>90% forested) landscapes, but abundance in moderate and unfragmented landscapes did not differ. Landscape-scale habitat patterns significantly influenced overall nest predation patterns and cowbird abundance. However, local effects of livestock grazing and horse corrals caused high variation between landscape units with similar percent forest characteristics. The specific types of non-forested habitats present may be important.

As a general rule, parasitism levels of 25% or less and daily nest predation rates of 4% or less should give most forest interior species "at least a chance" (Robinson 1995) of having self-sustaining local populations (also May and Robinson 1985; Donovan et al. 1995). Based on the work of Robinson and others (1995), these parasitism rates are associated with a minimum of 70-80% forest cover at a landscape (75,000 acre) scale for a midwestern U.S. setting.

Duguay and others (2001) found that in a forested setting in West Virginia (Monongahela National Forest, >88% forest cover), "fifteen years after harvest, cuts placed within otherwise extensively forested areas do not result in the type of edge effects (population sinks) observed in areas fragmented by agriculture in the midwestern U.S." They also concluded that implementing relatively small cuts that create edge on a small proportion of the landscape may not result in increased nest failure, provided that other factors such as proximity to cowbird feeding sites are not prominent. The study involved tracking 556 nests of 46 species over a four-year period and calculation of daily nest survival rates.

Other habitat factors are known to influence productivity of this species group. Presence of young forest patches within a forested landscape is likely to have positive benefits for immature birds. Vega Rivera (1998) and Anders and others (1998) found that after fledging, juvenile wood thrushes disperse from mature forest habitats and enter early successional forests where they fed on invertebrates and fruit. Use of these habitats was very high relative to their availability. Later in the season, they shifted back into mature forest habitats. Fledglings preferred areas with dense understory and ground cover with species such as blackberry, sumac, and grape. Such areas may be provided by relatively small even-aged regeneration areas or by smaller dispersed canopy gaps. Scattered canopy gaps and associated dense understories likely were characteristic of old growth mesic deciduous forests. Open habitats such as pastures, old fields, and managed wildlife openings were rarely used.

The significance of National Forest System lands to this species group was analyzed at both regional and forest scales in the Southern Appalachian Assessment (SAMAB 1996b: 69-73). This analysis of forest interior habitat focused primarily on patterns of land use (forested vs. non-forested) and measures of edge effects at a landscape scale. Based on this analysis, there are approximately 9 to 10.5 million acres of suitable habitat in the Southern Appalachian Assessment (SAA) Area with about 4.7 to 5.4 million acres (52%) located within tracts greater than 5,000 acres.

Approximately 70% of suitable habitat and 51% of the largest tracts are privately owned, while 23% of suitable habitat and 39% of the largest tracts are on national forest land. A notable difference is found within the Blue Ridge Mountains, where approximately 40% of suitable habitat and half of the largest tracts occur on national forest land. Within the SAA area, the majority of forest interior habitat occurs within the Blue Ridge Mountains, followed by the Northern Ridge and Valley/Cumberland Mountains. The Southern Ridge and Valley and Southern Cumberland Plateau have the smallest relative amount (SAMAB 1996b:73).

To determine the landscape context of the GWNF, a shifting window analysis was conducted using 1990 National Land Cover Data (U.S. EPA 2002). Percent forest cover within a surrounding landscape of 75,000 acres (per Donovan et al. 1997) was calculated for each 90-meter grid cell located on the national forest and nearby private land. For this analysis, Deciduous, Evergreen, and Mixed Forest, and Woody Wetlands were classified as forested lands. All other land cover types, including recent clearcuts (transitional cover type), were classed as non-forest cover. This analysis indicates the great majority of the GWNF occurs within a landscape that is more than 70 to 90% forested. A similar analysis was recently completed by the Nature Conservancy for the Central Appalachians. Termed landscape integrity analysis, TNC incorporated publicly available spatial data to analyze distance of forested habitat with known landscape disturbing features such as roads, residential and urban development, transportation corridors, and mining and other industries (Dougerty and Byers 2008). This analysis for the GWNF showed similar forested landscape patterns to the shifting window analysis.

There are several areas within the GWNF that have settings that are less than 70% forested, where edge effects could adversely affect productivity of forest interior birds and other species. In all cases, either urban and/or agricultural influences create a landscape that is less than 70% forested. The major river valleys of the Potomac and Shenandoah are largely privately owned and dominated by either residential and urban development, or agricultural activities.

Non-native Invasive Species (NNIS)

Non-native invasive plant and animal species can have severe detrimental effects on native species and natural communities, and are problematic across the GWNF. They currently occur on every district. NNIS degrade biological diversity by displacing native species, altering natural community structure and processes, and changing food webs. The desired condition for non-native invasive plants (NNIP) is to reduce or eliminate percent coverage across the GWNF. Because of their contribution to biological diversity, threatened, endangered, and sensitive (TES) species habitat and rare communities, including Special Biological Areas, are a high priority for NNIP control efforts. This key characteristic is addressed in the revised Forest Plan by forest-wide desired conditions, objectives for eradication and treatment of NNIP, and standards to help control NNIP at the project level. Although we do not have a complete inventory of all occurrences of NNIP, preliminary data indicate that they are widespread on all units. Based upon current and projected program levels NNIP will be treated more aggressively under the revised Forest Plan. Some NNIP will be more easily controlled than others. While we may have good results in some cases, NNIP will remain a difficult challenge and it is likely that species new to the Forest will appear during the life of the Forest Plan.

Non-native invasive insects such as hemlock woolly adelgid and gypsy moth are also a significant deterrent to ecological sustainability on the GWNF.

5.2 Ecosystem Diversity Indicators by Alternative

The following tables display the current condition of each indicator identified for each ecological system. It also displays the estimated condition of the indicator after 10 years (Table E-8), or 50 years (Table E-9), of implementation of each alternative. Please note that some of the indicators overlap each other (acres of late successional are included in the acres of mid to late successional stages and acres of open canopy are included in the acres of mid to late successional stages). Table E-10 identifies a description (poor, fair, or good) for the indicator based on the indicator values.

Table E-8. Condition of Indicators of Ecosystem Characteristics after Ten Years of Implementation

Ecosystem Indicator	Current Condition	Condition of Indicator at end of 10 years									
		Alt A	Alt A[1]	Alt B	Alt C	Alt D	Alt D*	Alt E	Alt F	Alt G	Alts H and I
Mafic Glade and Barrens and Alkaline Glades and Woodlands	3,842	3,842	3,842	3,842	3,842	3,842	3,842	3,842	3,842	3,842	3,842
Acres Burned at Desired Frequency	277	880	1,060	1,296	1,296	674	504	1,296	1,296	1,296	1,296
Compliance with Invasive Species Guidelines	No	No	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Acres of Open Canopy	50	880	1,060	1,296	1,296	674	504	1,296	1,296	1,296	1,296
Caves and Karstlands	119,000	119,000	119,000	119,000	119,000	119,000	119,000	119,000	119,000	119,000	119,000
Total Occurrences at Desired Condition	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
Compliance with cave, karst guidelines	No	No	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Cliff, Talus and Shale Barrens	13,637	13,637	13,637	13,637	13,637	13,637	13,637	13,637	13,637	13,637	13,637
Compliance with Invasive Species Guidelines	No	No	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Acres of Open and Open Canopy	241	1,408	1,590	4,822	4,822	2,509	1,092	4,822	4,822	4,822	4,822

Ecosystem Indicator	Current Condition	Condition of Indicator at end of 10 years									
		Alt A	Alt A[1]	Alt B	Alt C	Alt D	Alt D*	Alt E	Alt F	Alt G	Alts H and I
Cove Forest	61,022	61,022	61,022	61,022	61,022	61,022	61,022	61,022	61,022	61,022	61,022
Acres in mid to late successional stages	59,777	59,745	60,725	58,245	60,745	57,950	57,950	59,745	58,165	57,445	58,231
Acres of Late Successional	26,307	36,627	37,233	35,699	37,246	35,517	35,517	36,627	35,650	35,204	35,690
Acres of Regenerating Forest	968	1,000	20	2,500	0	2,795	2,795	1,000	2,580	3,300	2,514
Acres of open canopy in mid to late successional stages	712	712	712	712	712	712	712	712	712	712	712
Northern Hardwood Forest	13,478	13,478	13,478	13,478	13,478	13,478	13,478	13,478	13,478	13,478	13,478
Acres in mid to late successional stages	13,233	13,295	13,295	13,295	13,295	13,295	13,295	13,295	13,295	13,295	13,295
Acres of Late Successional	12,413	12,619	12,619	12,619	12,619	12,619	12,619	12,619	12,619	12,619	12,619
Acres of Regenerating Forest	244	182	182	182	182	182	182	182	182	182	182
Acres of open canopy in mid to late successional stages	251	386	386	386	386	386	386	386	386	386	386

Ecosystem Indicator	Current Condition	Condition of Indicator at end of 10 years									
		Alt A	Alt A[1]	Alt B	Alt C	Alt D	Alt D*	Alt E	Alt F	Alt G	Alts H and I
Oak Forests and Woodlands	756,058	756,058	756,058	756,058	756,058	756,058	756,058	756,058	756,058	756,058	756,058
Acres Burned at Desired Frequency	21,457	27,874	41,672	74,583	0	49,894	34,966	74,583	74,583	74,583	74,583
Acres in mid to late successional stages	721,059	709,049	730,219	707,049	731,049	691,844	691,844	716,059	727,629	706,359	705,573
Acres of Mature Forest	650,442	630,526	651,696	628,526	652,526	613,321	613,321	637,536	649,156	627,836	627,050
Acres of Regenerating Forest	25,111	37,121	15,951	39,121	15,121	54,326	54,326	30,111	18,541	39,811	40,597
Acres of open canopy in mid to late successional stages	15,220	42,995	56,793	89,704	15,121	65,015	50,087	89,704	89,704	89,704	89,704
Acres of open grasslands or forbs	2,773	3,609	4,023	5,010	2,773	4,270	3,822	5,010	5,010	5,010	5,010

Ecosystem Indicator	Current Condition	Condition of Indicator at end of 10 years									
		Alt A	Alt A[1]	Alt B	Alt C	Alt D	Alt D*	Alt E	Alt F	Alt G	Alts H and I
Pine Forests and Woodlands	162,129	162,129	162,129	162,129	162,129	162,129	162,129	162,129	162,129	162,129	162,129
Acres Burned at Desired Frequency	4,169	5,693	9,233	18,328	0	11,422	7,293	18,328	18,328	18,328	18,328
Acres in mid to late successional stages	156,988	158,488	159,438	155,988	159,488	158,488	158,488	157,478	155,488	157,478	157,478
Acres of Regenerating Forest	4,121	2,621	1,671	5,121	1,621	2,621	2,621	3,631	5,621	3,631	3,631
Acres of open canopy in mid to late successional stages	4,055	7,315	10,855	19,949	1,621	13,043	8,915	19,949	19,949	19,949	19,949
Floodplains, Wetlands and Riparian Areas	51,430	51,430	51,430	51,430	51,430	51,430	51,430	51,430	51,430	51,430	51,430
Compliance with Riparian Guidelines	Yes	Yes - 1993	Yes - 1994	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Spruce Forest	582	582	582	582	582	582	582	582	582	582	582
Total System Acres at Desired Condition	582	582	582	582	582	582	582	582	582	582	582

*This version of Alternative D uses a level of prescribed burning of 5,000 acres per year

Alt A[1] represents the effects of the level of activities accomplished during the past three years (2009 through 2011) under the 1993 Forest Plan.

Table E-9. Condition of Indicators of Ecosystem Characteristics after Fifty Years of Implementation

Ecosystem / Indicator	Current Condition	Condition of Indicator at end of 50 years									
		Alt A	Alt A[1]	Alt B	Alt C	Alt D*	Alt D	Alt E	Alt F	Alt G	Alts H and I
Mafic Glade and Barrens and Alkaline Glades and Woodlands	3,842	3,842	3,842	3,842	3,842	3,842	3,842	3,842	3,842	3,842	3,842
Acres Burned at Desired Frequency	277	1,567	2,800	2,588	2,588	1,469	1,093	2,588	2,588	2,588	2,588
Compliance with Invasive Species Guidelines	No	No	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Acres of Open Canopy	50	1,567	2,800	2,588	2,588	1,469	1,093	2,588	2,588	2,588	2,588
Caves and Karstlands	119,000										
Total Occurrences at Desired Condition	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
Compliance with cave, karst guidelines	No	No	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Cliff, Talus and Shale Barrens	13,637	13,637	13,637	13,637	13,637	13,637	13,637	13,637	13,637	13,637	13,637
Compliance with Invasive Species Guidelines	No	No	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Acres of Open and Open Canopy	241	2,507	4,570	9,631	9,631	5,469	2,767	9,631	9,631	9,631	9,631

Ecosystem Indicator	Current Condition	Condition of Indicator at end of 50 years									
		Alt A	Alt A[1]	Alt B	Alt C	Alt D*	Alt D	Alt E	Alt F	Alt G	Alts H and I
Cove Forest	61,022	61,022	61,022	61,022	61,022	61,022	61,022	61,022	61,022	61,022	61,022
Acres in mid to late successional stages	59,777	59,745	60,725	58,245	60,745	57,950	57,950	59,745	58,165	57,445	58,231
Acres of Late Successional	26,307	47,723	52,195	40,959	52,287	39,613	39,613	47,723	40,574	37,366	40,870
Acres of Regenerating Forest	968	1,000	20	2,500	0	2,795	2,795	1,000	2,580	3,300	2,514
Acres of open canopy in mid to late successional stages	712	712	712	712	712	712	712	712	712	712	712
Northern Hardwood Forest	13,478	13,478	13,478	12,637	13,478	12,637	12,637	12,637	13,478	12,637	12,637
Acres in mid to late successional stages	13,233	13,342	13,342	12,511	13,342	12,511	12,511	12,511	13,342	12,511	12,511
Acres of Late Successional	12,413	13,233	13,233	12,401	13,233	12,401	12,401	12,401	13,233	12,401	12,401
Acres of Regenerating Forest	244	135	135	126	135	126	126	126	135	126	126
Acres of open canopy in mid to late successional stages	251	386	386	377	386	377	377	377	386	377	377

Ecosystem / Indicator	Current Condition	Condition of Indicator at end of 50 years									
		Alt A	Alt A[1]	Alt B	Alt C	Alt D*	Alt D	Alt E	Alt F	Alt G	Alts H and I
Oak Forests and Woodlands	756,058	756,058	756,058	756,058	756,058	756,058	756,058	756,058	756,058	756,058	756,058
Acres Burned at Desired Frequency	21,457	31,581	61,314	125,739	0	81,484	50,304	125,739	125,739	125,739	125,739
Acres in mid to late successional stages	721,059	709,049	730,219	707,049	731,049	691,844	691,844	716,059	727,629	706,359	705,573
Acres of Mature Forest	650,442	611,059	716,909	601,059	721,059	525,034	525,034	646,109	703,959	597,609	593,679
Acres of Regenerating Forest	25,111	37,121	15,951	39,121	15,121	54,326	54,326	30,111	18,541	39,811	40,597
Acres of open canopy in mid to late successional stages	15,220	46,702	76,435	140,860	15,121	96,605	65,425	140,860	140,860	140,860	140,860
Acres of open grasslands or forbs	2,773	3,720	4,612	6,545	2,773	5,218	4,282	6,545	6,545	6,545	6,545

Ecosystem Indicator	Current Condition	Condition of Indicator at end of 50 years									
		Alt A	Alt A[1]	Alt B	Alt C	Alt D*	Alt D	Alt E	Alt F	Alt G	Alts H and I
Pine Forests and Woodlands	162,129	162,129	162,129	162,129	162,129	162,129	162,129	162,129	162,129	162,129	162,129
Acres Burned at Desired Frequency	4,169	7,066	18,674	32,684	0	20,258	12,493	32,684	32,684	32,684	32,684
Acres in mid to late successional stages	156,988	158,488	159,438	155,988	159,488	158,488	158,488	157,478	155,488	157,478	157,478
Acres of Regenerating Forest	4,121	2,621	1,671	5,121	1,621	2,621	2,621	3,631	5,621	3,631	3,631
Acres of open canopy in mid to late successional stages	4,055	8,687	20,295	34,305	1,621	21,880	14,114	34,305	34,305	34,305	34,305
Floodplains, Wetlands and Riparian Areas	51,430	51,430	51,430	51,430	51,430	51,430	51,430	51,430	51,430	51,430	51,430
Compliance with Riparian Guidelines	Yes	Yes-1993	Yes-1994	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Spruce Forest	582	582	582	1,423	582	1,423	1,423	1,423	582	1,423	1,423
Total System Acres at Desired Condition	582	582	582	1,423	582	1,423	1,423	1,423	582	1,423	1,423

*This version of Alternative D uses a level of prescribed burning of 5,000 acres per year

Alt A[1] represents the effects of the level of activities accomplished during the past three years (2009 through 2011) under the 1993 Forest Plan.

Table E-10. Description of Indicator Condition

Ecosystem Indicator	Current Condition	Poor	Fair	Good
Mafic Glade and Barrens and Alkaline Glades and Woodlands	3,842			
Acres Burned at Desired Frequency	277	<33% (<1,268 acres)	33-80%	> 80% (>3,074 acres)
Compliance with Invasive Species Guidelines	No	No		Yes
Acres of Open Canopy	50	<33% (<1,268 acres)	33-80%	> 80% (>3,074 acres)
Caves and Karstlands	119,000			
Total Occurrences at Desired Condition	100%	<70%	70-90%	>90%
Compliance with cave, karst guidelines	No	No		Yes
Cliff, Talus and Shale Barrens	13,637			
Compliance with Invasive Species Guidelines	No	No		Yes
Acres of Open and Open Canopy	241	<33% (<4,500 acres)	33-80%	> 80% (>10,910 acres)
Cove Forest	61,022			
Acres in mid to late successional stages	59,777	0-60% (<36,613 acres)or >99% (60,412 acres)	61-91 % (36,613 - 55,530 acres) or 97-99% (59,191 - 60,411 acres)	92-96% (55,530 - 59,191 acres)
Acres of Late Successional	26,307	<40% (24,409 acres) or greater than 80% (48,818 acres)	40-54% (24,409 - 32,952 acres) or 60-80% (36,613 - 48,818 acres)	55-59% (32,952 - 36,613 acres)
Acres of Regenerating Forest	968	0-1% (610 acres) or > 20% (12,204 acres)	1-3% (610 - 1,831 acres) or 9-20% (5,492- 12,204 acres)	4-8% (1,831 - 5,492 acres)
Acres of open canopy in mid to late successional stages	712	0-2 % (1,220 acres) or >25% (15,256 acres)	3 -5 % (1,220 - 3,051 acres) or 13-24 % (7,933 - 15,256 acres)	6 - 12 % (3,051 - 7,933 acres)
Northern Hardwood Forest	13,478			
Acres in mid to late successional stages	13,233	99-100 % (8,087 acres) or <60% (13,343 acres)	61 - 93 % (8,087 - 12,534 acres) or 97 to 98 % (13,073 - 13,343 acres)	94 - 96% (12,534 - 13,073 acres)
Acres of Late Successional	12,413	<40% (5,391 acres) or >90% (12,130 acres)	40-69% (5,391 - 9,300 acres) or 75-90% (10,108 - 12,130 acres)	70-74% (9,300 - 10,108 acres)
Acres of Regenerating Forest	244	0-1 %(135 acres) or >13% (1,752 acres)	2-4% (135 - 539 acres) or 7-12% (943 - 1,752 acres)	4-6% (539 - 943 acres)
Acres of open canopy in mid to late successional stages	251	0-3 % (404 acres) or >25% (3,370 acres)	4-7% (404 - 944 acres) or 13-24% (1,752 - 3,370 acres)	8-12% (944 - 1,752 acres)

Ecosystem Indicator	Current Condition	Poor	Fair	Good
Oak Forests and Woodlands	756,058			
Acres Burned at Desired Frequency	21,457	<33% (249,499 acres)	33-80%	>80% (604,846 acres)
Acres in mid to late successional stages	721,059	>96% (725,815 acres) or <50 % (378,029 acres)	94-95% (710.694-725,815 acres) or 51-90% (378,029 – 680,452 acres)	91-93% (680,452-710,694 acres)
Acres of Mature Forest	650,442	<30% (226,817 acres) or >89% (672,891 acres)	30-39% (226,817 – 294,862 acres) or 61-89% (461,195 – 672,891 acres)	40-60% (294,862 – 461,195 acres)
Acres of Regenerating Forest	25,111	0-3% (22,681 acres) or >30% (226,817 acres)	4-6% (22,681 - 45,363 acres) or 9 - 29% (68,045 – 226,817 acres)	7-9% (45,363 - 68,045 acres)
Acres of open canopy in mid to late successional stages	15,220	0-20 % (151,211 acres) or >80% (604,846 acres)	21-54% (151,211 – 408,271 acres) or 66-80% (498,998 – 604,846 acres)	55-65% (408,271 – 498,998 acres)
Acres of open grasslands or forbs	2,773	0-1% (10,654 acres)	1 - 3 %	3-5% (31,963 – 53,273 acres)
Pine Forests and Woodlands	162,129			
Acres Burned at Desired Frequency	4,169	<33% (53,503 acres)	33-80%	>80% (129,703 acres)
Acres in mid to late successional stages	156,988	>96% (155,644 acres) or <60% (97,277 acres)	60-88% (97,277 - 142,673 acres) or 94-95% (152,401 - 155,644 acres)	89-93% (142,673 - 152,401 acres)
Acres of Regenerating Forest	4,121	0-4% (6,485 acres) or >35% (56,745 acres)	5-7% (6,485 - 11,349 acres) or 12-35% (19,455 - 56,745 acres)	7-11% (11,349 - 19,455 acres)
Acres of open canopy in mid to late successional stages	4,055	<30 % (48,639 acres) or >90% (145,916 acres)	81-90% (48,639 - 111,869 acres) or 31 to 69% (131,324 - 145,916 acres)	70-80 % (111,869 - 131,324 acres)
Floodplains, Wetlands and Riparian Areas	51,430			
Compliance with Riparian Guidelines	Yes	No		Yes
Spruce Forest	582			
Total System Acres at Desired Condition	582	<90% (473 acres) of current acres	90-99% of current acres	current (582 acres)

6.0 FOREST PLAN DESIRED ECOLOGICAL CONDITIONS

6.1 Plan Components Needed for Ecosystem Diversity

Plan components that would provide for ecosystem diversity include desired conditions, objectives, and standards. Desired conditions and objectives for ecosystem diversity would be addressed not only under Ecosystem Diversity but also in plan components for species diversity, healthy watersheds, and healthy forests. The following sections describe recommendations for desired conditions, objectives and standards to address ecological diversity needs.

6.2 Extent of Ecological Systems

Table E-11. Current and desired ecological systems by unit on the George Washington National Forest

Ecological System	Approximate Existing Acres	Desired Acres
Spruce Forest	582	1,423
Northern Hardwood Forest	13,478	12,637
Cove Forest	61,022	61,022
Oak Forests and Woodlands	756,058	756,058
Pine Forests and Woodlands	162,129	162,129
Mafic Glade and Barrens and Alkaline Glades and Woodlands	3,842	3,842
Cliff, Talus and Shale Barrens	13,637	13,637
Floodplains, Wetlands, and Riparian Areas	51,430	51,430
Water	3,284	3,284
Total Acres	1,065,462	1,065,462
Caves and Karstlands (included in above acres)	119,000	119,000

Changes in desired conditions reflect spruce restoration (changes from northern hardwoods to spruce) and restoration of pine plantations (changes from pine forests to oak forests).

6.3 Forestwide Desired Conditions

Forestwide desired conditions should be found in the following sections and include the following concepts:

Ecosystem diversity
Native ecological systems occupy appropriate sites and sustain strong, resilient populations of associated terrestrial and aquatic species.

There is a mix of closed canopy forest, intermittent canopy, and open canopy conditions. Forest and woodland ecological systems support a diversity of tree ages, from regeneration to old growth, providing a relatively stable mix of ecological conditions across the landscape over time. Ecological systems are intact and as resilient as possible to absorb negative effects associated with various natural and human-caused stresses.

Species Diversity
Natural ecological communities exist in amounts, arrangements, and conditions capable of supporting native and desired non-native species within the planning area.

Natural disturbances, such as fire, wind, insects and diseases, ice storms, and floods, modify the landscape, providing habitat for disturbance dependent species.
Threatened and endangered species are recovered or moving towards recovery. Risks and threats are reduced or eliminated, especially during critical life stages such as nesting or raising offspring. The potential for sensitive species to become listed as threatened or endangered is reduced.

Watersheds
Watersheds within the Forest are resilient, have intact hydrologic function, and support the quality and quantity of water necessary for channel maintenance, aquatic habitats, riparian habitats and beneficial water uses, including public water supplies.

Soils
Forest soils have adequate physical, biological, and chemical properties to maintain or improve vegetative growth, hydrologic function, nutrient cycling and slope stability.

Geology
Groundwater is protected. Management activities in karst areas are not adversely affecting groundwater. Groundwater-dependent ecosystems are protected and sustained. Caves, sinkholes and other karst features function to maintain groundwater quality and provide habitat for species that depend on these features.

Fire
Fire regimes across the GWNF are within historical ranges (Fire Condition Class 1). Low-intensity fires periodically burn through forests removing surface fuels and maintaining an open understory. Native vegetation patterns, species composition, and structure are intact and functioning within natural limits. The risk of losing key ecosystems is low. Fire is allowed to operate in its historic ecological role as close as possible.

6.4 Standards

Standards convey information and guidance that supplements agency policies and are applied to projects or activities aimed at achieving desired conditions. Many of the forestwide and Management Prescription Area standards are designed to assure projects are completed to best restore and maintain ecological systems.

6.5 Forestwide Management Strategies

Program emphasis for managing for ecosystem and species diversity should be placed on restoring composition, structure, and relative abundance of all native ecological systems. Restoration efforts should be implemented utilizing the vegetation management program practices to achieve desired conditions. Forest Plan strategies for wildlife and vegetation management programs should emphasize the need for using an integrated fire management program to restore and maintain all fire-dependent ecological systems. Future project work should examine needs for rare and wetland community restoration, T&E species sustainability, and restoring relative abundance of appropriate sites across the landscape. Program and project work should incorporate key ecological characteristics and work toward achieving desired conditions to support associated species. Based on current budgetary constraints, ecological restoration progress is expected to occur at a slow pace; therefore project work should explore alternative means such as stewardship projects and partnerships to restore ecological systems on the GWNF.

6.6 Ecological System Specific Direction

The following information is derived from the ESE database and describes the 24 ecological systems identified for the GWNF. Each description includes recommended desired ecological conditions, management strategies and objectives. The ages of the various structural condition classes may need to be adjusted in the Forest Plan to better correlate with ten-year age classes traditionally used for management descriptions.

6.6.1 Spruce Forest

Desired Ecological Condition

Found only in the higher elevations near West Virginia this system is a predominately mature or old-growth forest with a diversity of vertical and age structure on sites to which this species is appropriate and of historical occurrence. Overstories are typically dominated by red spruce, but this system grades into northern hardwoods. Often other tree species found with red spruce include American beech, yellow birch, and sugar maple. The herbaceous layer is most typically dominated by mosses, ferns, sedges, and forbs, The Spruce Forest system supports populations of associated rare species, including the West Virginia northern flying squirrel. Regenerating forests (0-35 years old) comprise less than 18% percent of system acreage and is generally in small canopy gaps. Mature forest (66 years old or older) comprise approximately 57 percent of system acreage. Fire is rare in this system and the canopy is predominantly closed.

Structural conditions are as follows:

Structure	Early	Mid-Successional Closed Canopy	Mid-Successional Open Canopy	Late Successional Closed Canopy
% of ecological system	18	14	11	57
Age	0-35	36-65	36-65	66+

Management Strategy

The Spruce Forest system is currently limited to the Laurel Fork area. Strategies for restoring and maintaining the Spruce Forest system should emphasize restoring spruce to those sites where Norway spruce and red pine have been planted and maintaining conditions favorable to continued growth of existing stands. The Laurel Fork area should continue to be managed to restore and maintain the Spruce Forest including active planting of red spruce seedlings and releasing red spruce seedlings that are suppressed by hardwoods.

Objectives

Objectives should focus on the extent of this system and on restoration needs.

6.6.2 Northern Hardwood Forest

Desired Ecological Condition

Usually found in the highest elevations on the Forest this forest is dominated by overstories that include American beech, sugar maple and yellow birch with some eastern hemlock. Midstories and understories are usually well developed. The understory varies quite a bit, in some places dominated by evergreen shrubs and in others by herbs. Regenerating forests occupy around 10% of the area. Late successional forests make up around 72 percent of the area. Since these sites are predominantly at high elevation and are mesic, fire is not a major disturbance mechanism. Weather events such as high wind, ice, heavy wet snow, and the combinations of these account for most disturbances where open canopies exist in about 10 percent of the area.

Structural conditions are patterned after the Southern Appalachian Northern Hardwood Forest System since it has a greater emphasis on closed canopy conditions which are more like the situation on the GWNF. They are as follows:

Structure	Early Successional	Mid-Successional Closed Canopy	Late Successional Closed Canopy	Late Successional Open Canopy
% of ecological system	10	18	62	10
Age	0-20	21-74	75+	75+

Management Strategy

Forest strategies for restoring, maintaining, and enhancing the Northern Hardwood Forest ecological system should emphasize maintaining this system on the lands where it occurs. Some regeneration management activities could take place, but it would not be a high priority.

Objectives

Objectives should focus on the extent of this system on the landscape.

6.6.3 Cove Forest

Desired Ecological Condition

These closed-canopy forests are found on concave landforms and often associated with riparian areas. Overstories are typically dominated by yellow poplar, hemlock, birch, magnolia, basswood, and red maple. Midstories are well developed and fairly diverse in acidic coves rhododendron is often abundant. Understories have a well-developed herb layer, often very dense and usually high in species richness, and it is present in all but the acid coves. Well-developed and fairly diverse subcanopy and shrub layers are often also present in all but the acid coves.

This system supports populations of associated rare species, such as ginseng. Regenerating forests (0-10 years old) comprise around 4 percent of system acreage. Late successional forests (100 years old or older) comprise around 57 percent of system acreage. Fire is not a major disturbance in this system and typically occurs only in driest of conditions. Open canopy structure is present on only about 9 percent of the area. On the Forest this type is interspersed with the oak dominated systems. Cove Forest often occupies land along riparian areas and adjacent to upland areas in concave landforms at upper ends of watersheds.

Structural conditions are as follows:

Structure	Early	Mid-Successional Closed Canopy	Late Successional Open Canopy	Late Successional Closed Canopy
% of ecological system	4	39	9	48
Age	0-10	11-99	100+	100+

Management Strategy

The management strategy for the Cove Forest is to utilize timber harvest to approach the early successional habitat objective since fire is not a common disturbance in this system except in the driest of conditions.

Objectives

Objectives should focus on the structural conditions for early and late successional stages.

6.6.4 Oak Forests and Woodlands

Desired Ecological Condition

This is the most common ecological system on the Forest and can be viewed as the matrix forest in which all other vegetation types occur. Oak forests range from those found on moist (or mesic) sites to dry sites that then grade into yellow pine. Overstory trees on mesic sites are typically dominated by red oak, white oak, and hickory with chestnut oak, black oak and scarlet oak on drier sites. Heath shrubs such as blueberry, huckleberry and mountain laurel are common in the understory, especially on drier sites and often form a dense shrub layer along with grasses and sedges. Fewer heath shrubs are found on mesic sites and the understory often consists of various perennial herbaceous plants. Regenerating forests (0-15 years old) comprise around 12 percent of system acreage. Fire is a very important component of this system and results in open canopy structure on about 65 percent of the area. In many of the woodland areas native grasses are common.

Structural conditions are as follows:

Structure	Early	Mid-Successional Closed Canopy	Mid-Successional Open Canopy	Late Successional Open Canopy	Late Successional Closed Canopy
% of ecological system	12	7	10	57	14
Age	0-15	16-69	16-69	70+	70+

The mid and late successional open canopy represents most of the system where frequent low intensity fire and other disturbances such as ice and wind maintains open canopy conditions. The late successional closed canopy condition occurs where fire is excluded due to topographic and moist fuel conditions resulting in more mesophytic species composition that then makes opportunities for fire even more uncommon.

Open areas (including permanent and semi-permanent grasslands, shrublands and old fields) occupy around 4% of the GWNF. While often within the oak forests and woodlands, they may occupy any of the ecological system groups.

Management Strategy

Forest strategies for maintaining, and enhancing the oak systems rely heavily on utilizing fire to restore and maintain the open canopy conditions and the openings. Openings will also be maintained through direct creation and maintenance activities. Timber harvest will be another frequent technique of creating regenerating forests and creating desired open canopy conditions. Given its importance as a food source for many wildlife species, maintaining a high percentage of oak in ages that produce mast is also important.

Objectives

Objectives should focus on structural conditions for early succession and mature forest with open canopy conditions through restoration of the fire regime. Objectives also include the need for open conditions and widespread restoration of American chestnut.

6.6.5 Pine Forests and Woodlands

Desired Ecological Condition

Next to Oak Forest and Woodlands this ecological system is the most common on the Forest and occupies the upper slopes and south to west exposures. Overstories are typically dominated by table mountain pine, pitch pine, and some Virginia pine along with dry site oaks such as chestnut oak, scarlet oak, and bear oak. A dense heath shrub layer is almost always present. Mountain laurel is the most typical and dominant, but species of blueberry and huckleberry along with fetterbush may also be dominant. Native grasses and sedges are common along with dry site herbs and forbs. Their density varies depending on shrub cover. Regenerating forests (0-15 years old) comprise about 13 percent of system acreage. Mid to late successional forests comprise approximately 87 percent of system acreage. Frequent fire occurring about every 3-9 years is a very important component of this system and result in open canopy structure on about 80 percent of the area.

Structural conditions are as follows:

Structure	Early	Mid-Successional Closed Canopy	Mid-Successional Open Canopy	Late Successional Open Canopy	Late Successional Closed Canopy
% of ecological system	13	3	25	54	5
Age	0-15	16-70	16-70	71+	71+

Management Strategy

Fire will be the prime strategy for maintaining and enhancing the pine forests and woodlands. Timber harvest will also be used to a lesser extent for regeneration.

Objectives

Objectives should focus on structural conditions, particularly the need for open canopy conditions and restoration of the fire regime.

6.6.6 Mafic Glade and Barrens and Alkaline Glades and Woodlands

Desired Ecological Condition

The alkaline systems consist of woodlands and open glades on thin soils over limestone, dolostone or similar calcareous rock. In some cases, the woodlands grade into closed-canopy forests. Eastern red cedar is often a common tree, and along with chinkapin oak is indicative of the limestone substrate. Warm season grasses such as big and little bluestem are often the dominant herbs; forb richness is often high. The mafic systems found in the Blue Ridge consist of vegetation associated with shallow soils over predominantly mafic bedrock (which is rich in iron and magnesium), usually with significant areas of rock outcrops. These areas support a patchy mosaic of open woodland and grassy herbaceous vegetation sometimes with a predominant woody short-shrub community present. The canopy species are species tolerant of dry, shallow soils, most commonly chestnut oak, pines and eastern red cedar. Shrubs may be dense, with species determined by soil chemistry and often include redbud and fragrant sumac. The herb layer is usually fairly dense and dominated by grasses, both in treeless areas and beneath open canopy. The forbs include species characteristic of other rock outcrops and grassland species, with a smaller number of forest species present.

Edaphic features largely control these areas, but the open nature of the glades, woodlands and barrens continue to be maintained through fire which is operating in its natural regime. Non-native invasive plants are not significant influence on vegetation in these areas. Recreation use is managed so that it does not adversely affect the native vegetation. This system supports populations of associated rare species, including the marsh muhly, stiff goldenrod, drooping bluegrass, tall cinquefoil, and Rand's goldenrod.

Management Strategy

Forest strategies for maintaining, and enhancing this system include prescribed fire and managing wildfire, control of non-native invasive plants and monitoring and managing recreation use in the areas.

Objectives

Objectives should focus on the extent of the ecological system and the need for retaining open canopy conditions.

6.6.7 Cliff, Talus and Shale Barrens

Desired Ecological Condition

Vegetation on and near shale barrens is mostly classified as woodland, overall, but may include large open areas of sparse vegetation. Dominant trees are primarily chestnut oak, pitch pine, table mountain pine and Virginia pine, although on higher-pH substrates the common trees include eastern red cedar and white ash. Shale barren endemic plants are diagnostic in the herb layer. The substrate includes areas of solid rock as well as unstable areas of shale scree, usually steeply sloped.

The cliff and talus systems comprise sparsely vegetated to partially wooded cliffs and talus slopes. It consists of vertical or near-vertical cliffs and the talus slopes below. In some cases, this system may take the form of upper-slope boulderfields without adjacent cliffs, where talus forms from freeze/thaw action cracking the bedrock. Most of the substrate is dry and exposed, but areas of seepage are often present. The vegetation is patchy and often sparse, punctuated with patches of small trees that may form woodlands in places.

Edaphic conditions and landform features largely control the disturbance regime of these areas, but the open nature of the talus and edges of shale barrens continue to be maintained through fire which is occurring in adjacent forests and woodlands. Non-native invasive plants are not a significant influence on vegetation in these areas. Deer browsing is not impacting native vegetation. Recreation use is managed so that it does not adversely affect the native vegetation. This system supports populations of associated rare species, including the shale barren rockcress, Millboro leatherflower, shale -barren blazing star, shale-barren evening primrose, Appalachian grizzled skipper, bristly sarsaparilla, chestnut lipfern, mountain sandwort, and three-toothed cinquefoil.

Management Strategy

Strategies for maintaining, and enhancing these systems include prescribed fire and managing wildfire, control of non-native invasive plants, managing deer browsing, and monitoring and managing recreation use in the areas.

Objectives

Objectives should focus on the extent of the ecological system and the need for retaining open canopy conditions.

6.6.8 Floodplains, Wetlands, and Riparian Areas

Desired Ecological Condition

Overstories are typically dominated by the same trees occupying the oak and cove forest types. Midstories and Understories are often well developed and diverse. This system supports populations of many associated rare species. Regenerating forests (0-10 years old) are uncommon, though small openings are present and are important for key species. Open wetlands and open beaver meadows and ponds, including flooded forests, provide much of the open habitat conditions. Late successional forest is common and makes up most of the canopy. Fire is rare.

Riparian corridors reflect the physical structure, biological components, and ecological processes that sustain aquatic, riparian, and associated upland functions and values. The preferred management for riparian corridors is one that maintains, or moves toward, the restoration of processes that regulate the environmental and ecological components of riparian areas. However, due to the high value that these areas have for many uses, evidence of human activity (developed recreation areas, roads and trails, dams and reservoirs, and pastoral areas) may be present.

Riparian corridors are managed to emphasize the maintenance, restoration, and enhancement of habitat for species that depend on riparian resources for at least a part of their life-cycle. Management may also occur to maintain, restore, or enhance habitat for other species that benefit from riparian resources as long as the needs of species that depend on riparian resources for at least a part of their life-cycle are met.

The soils of riparian corridors have an organic layer (including litter, duff, and/or humus) of sufficient depth and composition to maintain the natural infiltration capacity, moisture regime, and productivity of the soil (recognizing that floods may periodically sweep some areas within the floodplain of soil and vegetation). Exposed mineral soil and soil compaction from human activity may be present but are dispersed and do not impair the productivity and fertility of the soil. Any human-caused disturbances or modifications that cause environmental degradation through concentrated runoff, soil erosion, or sediment transport to the channel or water body are promptly rehabilitated or mitigated to reduce or eliminate impacts.

Trees within the corridors are managed to provide sufficient amounts and sizes of woody debris to maintain habitat complexity and diversity for aquatic and riparian wildlife species. Recruitment of woody debris typically occurs naturally; however, woody debris may be purposefully introduced to enhance aquatic and terrestrial habitat. Both in-stream and terrestrial woody debris are regarded as essential and generally left undisturbed.

The riparian corridor functions as a travel-way for aquatic and terrestrial organisms. The corridor serves as a connector of habitats and populations allowing gene flow to occur, thus keeping populations genetically viable. Stream structures -- such as bridges, culverts, and aquatic habitat improvement structures -- may be evident in some streams and water bodies. With the exception of some dams, most structures do not decrease in-stream connectivity.

Suitable habitat is provided in the riparian corridor for riparian flora and fauna; especially threatened, endangered, sensitive (TES) and locally rare species. Vegetation (dead and alive) reflects the potential natural diversity of plant communities with appropriate horizontal and vertical structure needed to provide the shade, food, shelter, and microclimate characteristics for aquatic and terrestrial species. Rehabilitation of past and future impacts (both natural and human-caused) may be necessary to protect resource values and facilitate recovery of riparian structure and functions.

Vegetative communities within the riparian corridor are diverse and productive, providing for a rich variety of organisms and habitat types. The vegetative community within the riparian corridor is predominately forested; however, some native non-forested communities such as wet meadows and grass or shrub dominated plant communities may occur. The desired vegetative condition of non-forested communities is determined by site-specific analysis.

The forest contains multiple canopy layers, which provide diverse habitat structure, and thermal and protective cover for wildlife. Snags used by birds, bats, and other small animals are abundant. Dying and down trees are common, often in naturally occurring patches. Wet meadows, non-forest communities, and open forest canopies, created by flooding, wind damage, wildland fire, insect infestations, disease, restoration, and vegetation management may be seen.

Streams are in dynamic equilibrium; that is, stream systems normally function within natural ranges of flow, sediment movement, temperature, and other variables. The geomorphic condition of some channels may reflect the process of long-term adjustment from historic watershed disturbances (e.g., past intensive farming or logging practices). The combination of geomorphic and hydrologic processes creates a diverse physical environment, which, in turn, fosters biological diversity. The physical integrity of aquatic systems, stream banks and substrate, including shorelines and other components of habitat is intact and stable. Where channel shape is modified (e.g., road crossings), the modification preserves channel stability and function.

The range of in-stream flows is maintained to support channel function, aquatic biota and wildlife habitat, floodplain function, and aesthetic values. Water uses and other modifications of flow regimes are evaluated in accordance with the national Forest Service in-stream flow strategy and site-specific analysis.

Water quality remains within a range that ensures survival, growth, reproduction, and migration of aquatic and riparian wildlife species; and contributes to the biological, physical, and chemical integrity of aquatic ecosystems. Water quality meets or exceeds State and Federal standards. Water quality (e.g. water temperature, sediment level, dissolved oxygen, and pH) will be improved where necessary to benefit aquatic communities.

Floodplains properly function as detention/retention storage areas for floodwaters, sources of organic matter to the water column, and habitat for aquatic and riparian species. Modification of the floodplain is infrequent but may be undertaken to protect human life and property or to meet other appropriate management goals (e.g., restoration). There may be evidence of some roads, trails, and recreation developments. Some wetland habitats may show signs of restoration.

The biological integrity of aquatic communities is maintained, restored, or enhanced. Aquatic species distributions are maintained or are expanded into previously occupied habitat. The amount, distribution, and characteristics of aquatic habitats for all life stages are present to maintain populations of indigenous and desired non-native species. Habitat conditions contribute to the recovery of species under the Endangered Species Act. Species composition, distribution, and relative abundance of organisms in managed habitats is comparable to reference streams of the same region. Some streams and lakes, however, may be stocked with non-native fish by the respective State natural resource agency.

Beavers are recognized as a keystone species that increase landscape heterogeneity and species diversity. Beaver ponds beneficially modify water flow rates, enhance groundwater recharge rates, raise water tables, sequester sediment, increase aquatic productivity, and modify water chemistry. Over time, beavers create a mosaic of habitats that are utilized by numerous plants, amphibians, fish, insects, birds, and mammals that would not otherwise occur.

Management Strategy

Forest strategies for maintaining, and enhancing these systems rely on implementation of the standards originally developed to protect threatened and endangered fish and mussels on the Jefferson National Forest. Beaver populations are encouraged and allowed to provide a variety of benefits.

Objectives

Objectives should focus on retaining the extent and the character of the areas.

Standards

Standards for the riparian corridor are established in the guidance for the Riparian Management Prescription Area. These should be the same as the standards developed for the Federally Listed Mussel and Fish Conservation Plan that were incorporated into the Jefferson Forest Plan.

6.6.9 Caves and Karstlands

Desired Ecological Condition

This important ecological system is found to a limited degree on the Forest where it is associated with carbonate bedrock (limestone and dolostone) and often characterized by internal drainage. This bedrock type is typically found in valleys where it is dissolved by groundwater creating surface depressions (sinkholes) and underground caves and tunnels. These features are protected both from recreational damage and from polluted water, which, in turn, protects the species that depend on them.

Standards

Compliance with Cave and Karstland Guidelines should be met through use of forest-wide standards like:

> FW: A minimum of 200 foot buffers are maintained around cave entrances, sinkholes, and cave collapse areas known to open into a cave's drainage system. There are no soil-disturbing activities or harvest of trees within this buffer. Wider buffers are identified through site-specific analysis when necessary to protect caves from potential subterranean and surface impacts. Perennial, intermittent, channeled ephemeral stream standards will apply beyond the first 200 feet.
>
> FW: The use of caves for disposal sites or the alteration of cave entrances is prohibited except for the construction of cave gates or similar structures to ensure closure.
>
> FW: Management activities within any area draining into a cave are limited if they may affect the cave ecosystem through sedimentation, soil sterilization, the addition of nutrients or other chemicals (including pesticides and fertilizers), or if they change the cave's natural hydrology or micro-climate.
>
> FW: Post and enforce seasonal closure orders around entrances of caves and abandoned mines occupied by significant populations of bats, to reduce the frequency and degree of human intrusion. Prohibit camping and campfires at the entrance to caves, mines, and rock shelters used by bats.
>
> FW: If such closure orders are found to be ineffective, construct and maintain gates or other structures that allow for entrance and egress by bats. If necessary to further discourage human disturbance to

caves occupied by significant populations of bats, close non-essential public access routes controlled by the Forest Service within ¼ mile of cave entrances during periods of use by bats.

FW: Human access to caves for educational and recreation use may be allowed during periods when bats are not present. If damage to a cave occurs as a result of such use, close the cave. Allow human access (i.e. scientific study) on a case-by-case basis when bats are present.

FW: The specific location of a Significant cave cannot be made available to the public unless it is determined that disclosure of this information would not create a substantial risk of harm, theft, or destruction of the cave. Significant and potentially significant caves on the Forest are managed in accordance with the Cave Resources Protection Act of 1988 (16 U.S.C. 4301-4309) to protect them through regulating their use, requiring permits for removal of their resources, and prohibiting destructive acts.

FW: Identify, using the appropriate type and scale of geologic mapping, the geologic components (processes, structures, materials, and landforms), such as groundwater and karst, relevant to proposed projects, and integrate the components into: 1) siting and design of the project; 2) restoration; 3) ecological sustainability; and 4) environmental analysis.

FW: Locate and design projects to minimize potential adverse effects on groundwater and groundwater dependent ecosystems. In karst areas, integrate geologic assessment in project design and monitoring.

FW: Identify caves or abandoned mines that contain significant populations of bats as smoke-sensitive targets. Avoid smoke entering these caves or mines when bats are hibernating (generally this is Nov 1 to April 1).

Indiana bat Standards

Management Strategy

Forest strategies for maintaining and enhancing caves and karstlands include management to maintain the hydrology and not affect water quality in area draining into cave systems or in karst terrain. Monitoring of cave use and gating caves when needed to protect cave features and the biota are also components.

6.6.10 Special Biologic Areas

Desired Ecological Condition

Botanical-Zoological areas are managed for the following: (1) protection of threatened, endangered, sensitive, or locally rare species from human taking or human-caused detrimental habitat changes; (2) stable or increasing populations of threatened, endangered, sensitive, or locally rare species; and (3) functioning ecosystems.

Specific management activities necessary to maintain, restore, or enhance threatened, endangered, sensitive, and locally rare species for each special biological area are described in the Virginia Department of Conservation and Recreation, Division of Natural Heritage, Reports of Special Biological Areas (1991, 2000) and other pertinent biological reference material.

These management activities will result in a forest successional stage appropriate for maintaining the threatened, endangered, sensitive, and locally rare species. All areas are protected from human-caused detrimental habitat change, the taking of threatened or endangered species, and the collection of living plants or animals unless such collections are used for achieving the stated management goals. Access to these areas may be limited.

Management Strategy

The 121 Special Biological Areas on the GWNF all support ecosystem diversity and rare natural communities and assemblages of rare plant and animal species are represented there. These conditions of these communities are maintained or enhanced from their current condition. Management strategies are developed for each the Special Biological Areas that include needed management actions and monitoring needs.

6.6.11 Additional Guidance

Indicators for two of the ecological systems include compliance with Non-Native Invasive Species (NNIS) Guidelines. These NNIS guidelines include the following management strategies and standards:

Management Approach

Management of non-native invasive species will focus on four components: 1) prevention of new infestations; 2) elimination of new infestations before they become established; 3) containment or reduction of established infestations; and 4) reclamation of native habitats and ecosystems.

Post and maintain signs at trailheads and use other opportunities to inform OHV and ATV users to thoroughly wash their OHVs and ATVs to remove all soil, seeds, and other attached material prior to coming on the Forest.

Utilize public notification such as posting signs in campgrounds to control the movement of firewood into Forest campgrounds and other dispersed campsites.

NNIP parts capable of starting new plants (seeds, rhizomes, etc.) need proper disposal. Options include piling and burning on site, or bagging-and moving off site. Bagged plants should either be incinerated or should receive standard garbage disposal. For large woody bushed that are difficult to move, treatments should be scheduled prior to seed set, as practical.

Use of mowing as a NNIP control method should be timed to avoid spreading seeds (e.g., before seed set).

Retain native vegetation and limit soil disturbance as much as possible.

Following NNIP treatments, exposed soils will be promptly revegetated to avoid recolonization by NNIP or potential soil erosion. Only approved seed mixtures and weed seed-free mulch should be used.

Forestwide Standards

FW: The use of Category 1 Species is prohibited.

FW: The establishment or encouragement of Category 2 Species is prohibited in areas where ecological conditions would favor invasiveness and is discouraged elsewhere. Projects that use Category 2 Species should document why no other (non-invasive) species will serve the purpose and need.

FW: Favor use of native grasses and wildflowers beneficial as wildlife foods when seeding temporary roads, skid roads, log landings and other temporary openings when slopes are less than 5%. On slopes greater than 5%, favor use of vegetation that best controls erosion.

FW: Planning for management activities includes consideration of existing and potential non-native invasive plant (NNIP) threats. Site-specific plans should include control/eradication treatments and follow up monitoring of those treatments for effectiveness. Examples include inventory and treatment of log landing and haul road sites for timber sales, control lines (particularly those with soil disturbance) and areas near existing seed sources for prescribed burns, and trail corridors for trail construction.

FW: A contractor's sources of fill, soil, shale, and related materials will be pre-approved. Contractors will submit a description of the source. The project inspector or a qualified designee will inspect the supply source. Use of the source will be prohibited if contaminated by transferable agents of invasive species.

FW: Forest sources of fill, borrow or road surfacing material will be examined for NNIP and treated as necessary to prevent transfer of invasive plants to other parts of the Forest.

FW: Mechanical equipment, such as that used for logging, mowing, firefighting and earth moving (including road graders), should be free of soil, seeds, and other attached material prior to coming on the Forest or being moved from areas on the Forest with NNIP infestations to areas free from noticeable infestations. Such equipment should be examined by qualified Forest Service personnel before allowed on the Forest.

FW: Personnel treating NNIP infestation will take appropriate measures to prevent transporting seeds or other propagules to other sites. Such measures may include cleaning equipment at the treatment site after treatment, bagging the equipment until such time that it can be cleaned (e.g. hand sprayers), removing and bagging outer garments after treatment, brushing clothing and boots thoroughly before departing the treatment site.

FW: Fueling of oiling of mechanical equipment will occur away from aquatic habitat.

FW: When work is conducted in areas containing TESLR plant species, those plants will be flagged, marked or identified for applicators to avoid spraying. A physical barrier will be used to protect non-target species when they occur immediately adjacent to the treatment area.

Management Area Prescription Standards

Rx 1A: Forest insect and disease outbreaks are controlled only if necessary to prevent unacceptable damage to resources on adjacent land, prevent an unacceptable loss to the wilderness resource due to non-native pests, or protect threatened, endangered, and sensitive species.

Rx 1A: Eradicate non-native invasive plants when the infestations are isolated. Use hand-applied chemicals, with Regional Forester approval, when necessary.

Rx 2C2: Eradicate non-native invasive plants when the infestations are isolated. Use hand-applied chemicals, with Forest Supervisor approval, when necessary.

Rx 2C3: Aggressively control insect and disease outbreaks when threatening the outstandingly remarkable values of the river corridor or when needed for safety or legal reasons. Consider eradication of recently established non-native pests. Favor the most effective control method.

Rx 4B: Native forest insect and disease outbreaks are controlled only to protect threatened, endangered, and sensitive species or to prevent unacceptable damage to resources on adjacent land. Non-native invasive insects and diseases may be eradicated or suppressed. Favor biological control methods.

Rx 4B: Eradicate non-native invasive plants when the infestations are isolated. Use hand-applied pesticides, with Forest Supervisor approval, when necessary.

Rx 4C1: Native forest insect and disease outbreaks are controlled only to prevent unacceptable damage to resources on adjacent land or to protect threatened, endangered, and sensitive species. Non-native invasive insects and diseases may be eradicated or suppressed. Favor biological control methods.

Rx 4C1: Eradicate non-native invasive vegetation when the infestations are isolated. Use hand-applied pesticides, with Forest Supervisor approval, when necessary

Rx 4D: Native forest insect and disease outbreaks are controlled only to prevent unacceptable damage to resources on adjacent land or to protect threatened, endangered, sensitive, or locally rare species. Non-native, invasive insects and diseases may be eradicated or suppressed to prevent a loss of the special biological community. Favor biological control methods.

Rx 4D: Eradicate non-native invasive plants when the infestations are isolated. Use hand-applied pesticides, with Forest Supervisor approval, when necessary.

Rx 4D: Control non-native invasive species (plants, animals, insects, and diseases) where they are causing negative effects to rare communities. Do not introduce non-native species in or near rare communities, unless it is a natural enemy of an non-native pest.

Rx 4E: Control insect and disease outbreaks when necessary to protect the cultural/historic values, to reduce hazards to visitors, or for safety or legal reasons. Eradicate recently established non-native pests when possible. Favor the most effective control method.

Rx 5A: Aggressively control forest insects, diseases, and non-native invasive plants using the most effective control method. Salvage is allowed.

Rx 5B: Aggressively control non-native, invasive plant species within these areas.

Rx 5C: Aggressively control non-native, invasive plant species within these corridors.

Rx 7A1: Control insect and disease outbreaks, when necessary, to protect the scenic values, to reduce hazards to visitors, or for safety or legal reasons. Eradicate recently established non-native pests when possible. Favor the most effective control method.

Rx 7B: Control insect and disease outbreaks, when necessary, to protect the scenic values, to reduce hazards to visitors, or for safety or legal reasons. Eradicate recently established non-native pests when possible. Favor the most effective control method.

Rx 7C: The forest health strategy is to diminish the occurrence of pest problems by managing host-type conditions at low hazard. Use appropriate and practical suppression of pests, both non-native and native, with all available tools as the normal practice.

Rx 7D: The forest health strategy is to prevent the occurrence of pest problems by managing host-type conditions at low hazard. Aggressive suppression of pests, both non-native and native, with all available integrated pest management tools is normal practice. Favor the most effective control method. Salvage, cut and leave, and pruning are rapid and complete to protect the health and safety of visitors and facilities.

Rx 7E: Native forest insect and disease outbreaks are controlled only to prevent unacceptable damage to resources on adjacent land or to protect threatened, endangered, and sensitive species. Non-native, invasive insects and diseases may be eradicated or suppressed to prevent a loss of the old growth community. Favor biological control methods.

Rx 7E: Eradicate non-native invasive plants when the infestations are isolated. Use approved hand-applied pesticides, when necessary.

Rx 7F: Control insect and disease outbreaks, when necessary, to protect the scenic values, to reduce hazards to visitors, or for safety or legal reasons. Eradicate recently established non-native pests when possible. Favor the most effective control method.

Rx 7G: Eradicate non-native invasive plants.

Rx 8E7: Native forest insect and disease outbreaks are controlled only to prevent unacceptable damage to resources on adjacent land or to protect threatened, endangered, sensitive, or locally rare species. Non-native, invasive insects and diseases may be eradicated or suppressed to prevent a loss of the special biological community. Favor biological control methods.

Rx 8E7: Control or eradicate non-native invasive plants using hand-applied herbicides, with Forest Supervisor approval, when necessary.

Rx 8E7: Control non-native invasive animals, insects, and diseases where they are causing negative effects to rare communities. Do not introduce non-native species in or near rare communities, unless it is a natural enemy of a non-native pest.

Rx 12D: Suppression and eradication of non-native pests are allowed.

Rx 13: The forest health strategy is to minimize the occurrence of pest problems by managing host-type conditions. Suppression of pests, both non-native and native, is accomplished with all available integrated pest management tools.

Rx 13: Proactively manage species composition and tree vigor in stands at a level that reduces susceptibility to damage from insect and disease infestations and other forest health problems like oak decline. Suppress native and non-native insects and diseases using an integrated pest management approach.

6.7 Forest Plan Strategies for Addressing Ecological Stresses and Threats

Appendix E-1 contains a summary of some of the strategies considered in alternatives to address the identified stresses and threats to the ecological systems.

APPENDIX E1 - ECOLOGICAL SYSTEMS STRESSES, THREATS AND STRATEGIES

Target Name	Stress	Threat	Strategy
Mafic Glade and Barrens and Alkaline Glades and Woodlands	1.2 Modification of vegetation	6.1 Recreational activities	Establish desired condition Alkaline Glade and Woodlands and Mafic Glades and Barrens
Mafic Glade and Barrens and Alkaline Glades and Woodlands	1.2 Modification of vegetation	6.1 Recreational activities	Objective to maintain or increase acres of spruce forest
Mafic Glade and Barrens and Alkaline Glades and Woodlands	1.2 Modification of vegetation	7.33 Lack of disturbance; succession	Establish desired condition Alkaline Glade and Woodlands and Mafic Glades and Barrens
Mafic Glade and Barrens and Alkaline Glades and Woodlands	1.2 Modification of vegetation	7.33 Lack of disturbance; succession	Establish fire objective of 12,000 to 20,000 acres per year
Mafic Glade and Barrens and Alkaline Glades and Woodlands	1.2 Modification of vegetation	7.33 Lack of disturbance; succession	Utilize timber harvest to create early successional habitat, annual harvest of 1,800 - 3,000 acres
Mafic Glade and Barrens and Alkaline Glades and Woodlands	1.2 Modification of vegetation	8.1 Non-native invasive species	Establish desired condition Alkaline Glade and Woodlands and Mafic Glades and Barrens
Mafic Glade and Barrens and Alkaline Glades and Woodlands	1.2 Modification of vegetation	8.1 Non-native invasive species	Establish Invasive Species Control Guidelines
Mafic Glade and Barrens and Alkaline Glades and Woodlands	1.3.1 Limited existing distribution of system/habitat	0 None or Unknown	Establish desired condition Alkaline Glade and Woodlands and Mafic Glades and Barrens
Caves and Karstlands	1 Terrestrial System/Habitat Stresses	6 Human intrusions and disturbance	Establish guidelines for caves and karstlands
Caves and Karstlands	2 Aquatic System/Habitat Stresses	7 Modification of natural systems	Establish guidelines for caves and karstlands
Caves and Karstlands	2 Aquatic System/Habitat Stresses	7 Modification of natural systems	Utilize Jefferson riparian standards
Cliff, Talus and Shale Barrens	1 Terrestrial System/Habitat Stresses	6.1 Recreational activities	Establish guidelines for cliff and talus and shale barren areas
Cliff, Talus and Shale Barrens	1.1 Conversion and fragmentation	A.4 Roads and rights-of-way	Establish desired condition for shale barrens
Cliff, Talus and Shale Barrens	1.1 Conversion and fragmentation	A.4 Roads and rights-of-way	Establish guidelines for cliff and talus and shale barren areas
Cliff, Talus and Shale Barrens	1.1 Conversion and fragmentation	A.4 Roads and rights-of-way	Protect and maintain occurrences of rare communities in SBAs in addition to those in 1993 Plan
Cliff, Talus and Shale Barrens	1.2 Modification of vegetation	7.1 Fire and fire suppression	Establish desired condition for shale barrens

Target Name	Stress	Threat	Strategy
Cliff, Talus and Shale Barrens	1.2 Modification of vegetation	7.1 Fire and fire suppression	Establish guidelines for cliff and talus and shale barren areas
Cliff, Talus and Shale Barrens	1.2 Modification of vegetation	8.2 Problematic native species	Establish desired condition for shale barrens
Cliff, Talus and Shale Barrens	1.2 Modification of vegetation	8.2 Problematic native species	Establish guidelines for cliff and talus and shale barren areas
Cliff, Talus and Shale Barrens	1.2.1 Modification of vegetation structure	7.33 Lack of disturbance; succession	Establish desired condition for shale barrens
Cliff, Talus and Shale Barrens	1.2.1 Modification of vegetation structure	7.33 Lack of disturbance; succession	Establish fire objective of 12,000 to 20,000 acres per year
Cliff, Talus and Shale Barrens	1.2.1 Modification of vegetation structure	7.33 Lack of disturbance; succession	Establish guidelines for cliff and talus and shale barren areas
Cliff, Talus and Shale Barrens	1.2.2 Modification of vegetation composition	8.1 Non-native invasive species	Establish desired condition for shale barrens
Cliff, Talus and Shale Barrens	1.2.2 Modification of vegetation composition	8.1 Non-native invasive species	Establish guidelines for cliff and talus and shale barren areas
Cliff, Talus and Shale Barrens	1.2.2 Modification of vegetation composition	8.1 Non-native invasive species	Establish Invasive Species Control Guidelines
Cliff, Talus and Shale Barrens	1.3 Limited distribution of the system/habitat	0.1 None	Establish desired condition for shale barrens
Cliff, Talus and Shale Barrens	1.3 Limited distribution of the system/habitat	0.1 None	Establish guidelines for cliff and talus and shale barren areas
Cove Forest	1.2.2 Modification of vegetation composition	8 Invasive & problematic species	Establish desired condition for cove forests
Cove Forest	1.2.2 Modification of vegetation composition	8 Invasive & problematic species	Establish Invasive Species Control Guidelines
Northern Hardwood Forest	1 Terrestrial System/Habitat Stresses	9.5.1 Acid deposition	Continue air resource management activities to reduce impacts of acid deposition
Northern Hardwood Forest	1 Terrestrial System/Habitat Stresses	9.5.1 Acid deposition	Establish management strategy for climate change incl land allocation, obj and desired conditions
Northern Hardwood Forest	1.2.2 Modification of vegetation composition	8 Invasive & problematic species	Establish Invasive Species Control Guidelines
Northern Hardwood Forest	1.3 Limited distribution of the system/habitat	11.1 Geographic shifts in climate	Establish management strategy for climate change incl land allocation, obj and desired conditions
Oak Forests and Woodlands	1.2 Modification of vegetation	7.33 Lack of disturbance; succession	Establish fire objective of 12,000 to 20,000 acres per year

Target Name	Stress	Threat	Strategy
Oak Forests and Woodlands	1.2 Modification of vegetation	7.33 Lack of disturbance; succession	Utilize timber harvest to create early successional habitat, annual harvest of 1,800 - 3,000 acres
Oak Forests and Woodlands	1.2 Modification of vegetation	8.1 Non-native invasive species	Establish Invasive Species Control Guidelines
Oak Forests and Woodlands	1.2.1 Modification of vegetation structure	7.1 Fire and fire suppression	Establish fire objective of 12,000 to 20,000 acres per year
Pine Forests and Woodlands	1.2 Modification of vegetation	11.3 Temperature extremes	Establish objective for mature pine forests
Pine Forests and Woodlands	1.2 Modification of vegetation	11.3 Temperature extremes	Establish objective for pine open woodlands
Pine Forests and Woodlands	1.2 Modification of vegetation	7.33 Lack of disturbance; succession	Establish fire objective of 12,000 to 20,000 acres per year
Pine Forests and Woodlands	1.2 Modification of vegetation	7.33 Lack of disturbance; succession	Utilize timber harvest to create early successional habitat, annual harvest of 1,800 - 3,000 acres
Pine Forests and Woodlands	1.2 Modification of vegetation	8.1 Non-native invasive species	Establish Invasive Species Control Guidelines
Pine Forests and Woodlands	1.2.1 Modification of vegetation structure	7.1 Fire and fire suppression	Establish fire objective of 12,000 to 20,000 acres per year
Pine Forests and Woodlands	1.2.2 Modification of vegetation composition	8 Invasive & problematic species	Establish desired conditions for Pine Forests and Woodlands
Floodplains, Wetlands and Riparian Areas	1.1 Conversion and fragmentation	7.32 Off Road Vehicles	Utilize Jefferson riparian standards
Floodplains, Wetlands and Riparian Areas	1.2 Modification of vegetation	8.1 Non-native invasive species	Establish Invasive Species Control Guidelines
Floodplains, Wetlands and Riparian Areas	1.2 Modification of vegetation	8.1 Non-native invasive species	Utilize Jefferson riparian standards
Floodplains, Wetlands and Riparian Areas	1.3 Limited distribution of the system/habitat	0.1 None	Utilize Jefferson riparian standards
Floodplains, Wetlands and Riparian Areas	1.3.1 Limited existing distribution of system/habitat	7.33 Lack of disturbance; succession	Utilize Jefferson riparian standards
Floodplains, Wetlands and Riparian Areas	1.3.2 Limited potential distribution of system/habitat	7.34 Loss of beaver activity	Utilize Jefferson riparian standards
Floodplains, Wetlands and Riparian Areas	2 Aquatic System/Habitat Stresses	11 Climate Change and Weather	Establish management strategy for climate change incl land allocation, obj and desired conditions
Floodplains, Wetlands and Riparian Areas	2 Aquatic System/Habitat Stresses	11 Climate Change and Weather	Utilize Jefferson riparian standards

Target Name	Stress	Threat	Strategy
Floodplains, Wetlands and Riparian Areas	2 Aquatic System/Habitat Stresses	6 Human intrusions and disturbance	Utilize Jefferson riparian standards
Floodplains, Wetlands and Riparian Areas	2 Aquatic System/Habitat Stresses	7 Modification of natural systems	Utilize Jefferson riparian standards
Floodplains, Wetlands and Riparian Areas	2.1 Stream flow modification	7 Modification of natural systems	Utilize Jefferson riparian standards
Floodplains, Wetlands and Riparian Areas	2.1 Stream flow modification	7.2 Dams and water management	Utilize Jefferson riparian standards
Floodplains, Wetlands and Riparian Areas	2.4 Water chemistry modification	9.5.1 Acid deposition	Utilize Jefferson riparian standards
Floodplains, Wetlands and Riparian Areas	2.5 Aquatic/Riparian system modification	11.2 Droughts	Utilize Jefferson riparian standards
Floodplains, Wetlands and Riparian Areas	2.5 Aquatic/Riparian system modification	8 Invasive & problematic species	Utilize Jefferson riparian standards
Spruce Forest	1 Terrestrial System/Habitat Stresses	11 Climate Change and Weather	Establish management strategy for climate change incl land allocation, obj and desired conditions
Spruce Forest	1 Terrestrial System/Habitat Stresses	11 Climate Change and Weather	Objective to maintain or increase acres of spruce forest
Spruce Forest	1.2 Modification of vegetation	9.5.1 Acid deposition	Continue air resource management activities to reduce impacts of acid deposition

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APPENDIX F – SPECIES DIVERSITY REPORT

George Washington National Forest

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1.0 INTRODUCTION

Planning for ecological sustainability is an iterative two-stage process that involves first providing for a diversity of ecosystems and then by developing additional direction to meet the biological needs of specific species or species groups. Most plant and animal species will be sustained by managing for a diversity of ecosystems in the Plan area. However, additional provisions may be needed to help provide ecological conditions for specific species such as federally listed threatened and endangered (T&E) species, sensitive species and locally rare species.

This Species Diversity Report is a supplement to the Ecosystem Diversity Report, which described how the ecological characteristics for ecosystems on the George Washington National Forest (GWNF) were identified. Ecosystem characteristics were evaluated through development of an Ecological Sustainability Evaluation (ESE) database or tool, best available science, consideration of data and trends documented in the Evaluation of the Need for Change Report/Analysis of the Management Situation (AMS), annual monitoring evaluations, and internal reviews. A similar analysis process was also used to assess species diversity. This report describes the species evaluation process and uses the understanding gained from analysis of ecosystem diversity to develop additional plan components for species diversity.

2.0 SPECIES DIVERSITY

2.1 Ecosystem Context for Species

Twenty-three native ecosystems were identified for the GWNF. A system was added to cover caves and karstlands. Current acreage of each system was calculated using Forest Service GIS data. All identified terrestrial ecological systems were documented in a relational database, the ESE tool, which was based on the structure of The Nature Conservancy (TNC) planning tool. The ESE tool served as the primary process record for ecological sustainability analysis. It included documentation of scientific and other sources consulted, uncertainties encountered, and strategic choices made during development of the database.

Ecological conditions that provide for ecosystem diversity are described in detail in the Ecosystem Diversity Report. These ecological conditions were further analyzed to understand the environmental context and ability for National Forest System (NFS) lands to contribute to the diversity of plant and animal species. The following analysis process was used to determine whether, in addition to plan components for maintaining ecosystem diversity, further species-specific plan components were necessary to sustain species diversity.

As we developed the ecosystem diversity analysis, we identified that many of the ecological systems had similar key attributes, indicators, species associates and resulting forest plan components. For purposes of analysis we combined the systems into the following Ecological System Groups for the ESE Tool.

Table F-1. Ecological Systems

Ecological System Groups	Ecological System
Spruce Forests	Central and Southern Appalachian Spruce-Fir Forest
Northern Hardwood Forests	Appalachian (Hemlock)-Northern Hardwood Forest
	Southern Appalachian Northern Hardwood Forest
Cove Forests	Southern and Central Appalachian Cove Forest
Oak Forests and Woodlands	Northeastern Interior Dry-Mesic Oak Forest
	Central and Southern Appalachian Montane Oak Forest
	Central Appalachian Dry Oak-Pine Forest
	Southern Appalachian Oak Forest
	Southern Ridge and Valley/Cumberland Dry Calcareous Forest
Pine Forests and Woodlands	Southern Appalachian Montane Pine Forest and Woodland
	Central Appalachian Pine-Oak Rocky Woodland
	Southern Appalachian Low-Elevation Pine Forest
Mafic Glade and Barrens and Alkaline Glades and Woodlands	Southern and Central Appalachian Mafic Glade and Barrens
	Central Appalachian Alkaline Glade and Woodland
Cliff, Talus and Shale Barrens	North-Central Appalachian Circumneutral Cliff and Talus
	North-Central Appalachian Acidic Cliff and Talus
	Appalachian Shale Barrens
Floodplains Wetlands and Riparian Areas	Central Appalachian River Floodplain
	Central Appalachian Stream and Riparian
	Central Interior Highlands and Appalachian Sinkhole and Depression Pond
	Southern and Central Appalachian Bog and Fen
	North-Central Appalachian Acidic Swamp
	North-Central Appalachian Seepage Fen
Caves and Karstlands	Caves and Karstlands

Key attributes and indicators were identified for each of these systems to determine if the systems are performing to their desired conditions.

2.2 Identification and Screening of Species

The GWNF started with statewide species lists compiled from a variety of sources including the Birds of Conservation Concern list, Virginia and West Virginia State Heritage Programs tracked plant and animal lists, Virginia and West Virginia State Comprehensive Wildlife Strategy species of greatest conservation need list, Regional Forester's Sensitive Species list, federally listed Threatened and Endangered Species, and demand species. The original list consisted of about 474 plant and animal species with ranges occurring throughout Virginia and West Virginia.

Appendix F1 lists the 97 species which were removed from the list because they did not occur or have potential to occur on National Forest System lands based upon suitable habitat, range, or expert taxonomic consensus. If these species are found to occur on the GWNF, they will be re-evaluated. Of the remaining species an additional 82 species were not analyzed further because: a) the species is unaffected by management; b) the Forest is of marginal importance to conservation of the species; c) knowledge of species' ecology is insufficient to support conservation strategy; d) species' taxonomy is too uncertain to develop conservation strategy; or d) species is common and demonstrably secure on the Forest.

The remaining 295 species are addressed in this analysis. Eighty-four of these species have not been found on the Forest, but could possibly be present and nine are only historical records of species that have not been recently found.

3.0 THREATENED AND ENDANGERED SPECIES

This section covers threatened and endangered (T&E) species, which are those species listed by the Department of the Interior, U.S. Fish and Wildlife Service, or the National Oceanic and Atmospheric Administration, National Marine Fisheries Service as threatened or endangered. The U.S. Fish and Wildlife Service (USFWS) is the agency responsible for listing T&E species on lands managed by the GWNF. The Forest Service cooperates with USFWS efforts in conserving T&E species through protection and habitat management. The Forest Service conducts activities and programs to assist in the identification, conservation, and protection of threatened and endangered species and their habitats. Site-specific evaluations are conducted for any proposed activity that may take place within habitat for these species or near known populations. The GWNF program priorities for T&E species include:

(1) Implement Forest Service actions as recommended in recovery plans for federally listed species. In the absence of an approved recovery plan, implement and, if necessary develop interim Forest Service conservation measures. Update interim conservation measures as needed when new science becomes available.
(2) Work with USFWS and other conservation partners to develop recovery plans for federally listed species and candidate conservation agreements for species proposed for listing.
(3) Coordinate with partners to implement measures to resolve conflicts with threatened and endangered species and their habitats.
(4) Monitor trends in population and/or habitat of federally listed species.

3.1 Threatened and Endangered Species List

The GWNF worked cooperatively with the USFWS to develop the list of federally threatened or endangered species to be considered in the ESE process. Ten T&E species were evaluated in the ESE process (Table F-2). These 10 species are further described below.

Table F-2. Federally Listed T&E Species included in Forest Plan Revision Process

Taxa	Species	Status
Mammal	Indiana Bat (*Myotis sodalis*)	Endangered
Mammal	Virginia Big-Eared Bat (*Corynorhinus townsendii virginianus*)	Endangered
Mammal	Virginia northern flying squirrel *(Glaucomys sabrinus fuscus)*	Endangered
Invertebrate - Mussel	James Spinymussel (*Pleurobema collina*)	Endangered
Invertebrate - Arthropod	Madison Cave isopod *(Antrolana lira)*	Threatened
Vascular Plant	Shale Barren Rock Cress (*Arabis serotinai*)	Endangered

Taxa	Species	Status
Vascular Plant	Smooth Cone Flower (*Echinacea laevigata*)	Endangered
Vascular Plant	Virginia Sneezeweed (*Helenium virginicum*)	Threatened
Vascular Plant	Swamp Pink (*Helonius bullata*)	Threatened
Vascular Plant	Northeastern Bulrush (*Scirpus ancistrochaetus*)	Endangered

3.2 Threatened and Endangered Species Descriptions and Needed Plan Components

3.2.1 INDIANA BAT

Background

The Indiana bat is a medium-sized, *Myotis* species. On March 11, 1967, the Indiana bat was listed as a federal endangered species under the Endangered Species Preservation Act (ESPA) of 1966. Species listed under ESPA carried over and became listed by the Endangered Species Act when it became law in 1973. A recovery plan for the species was completed on October 14, 1983. In October 1996, the Indiana Bat Recovery Team released a Technical Draft Indiana Bat Recovery Plan. In October 1997, a preliminary version entitled "Agency Draft of the Indiana Bat Recovery Plan," which incorporated changes from the 1996 Technical Draft, was released. Subsequently, an agency draft entitled "Indiana Bat (*Myotis sodalis*) Revised Recovery Plan" was distributed for comments in March 1999. A final revision has never been completed. The range of the bat has been divided into recovery units. The GWNF falls within the Appalachian Mountains Recovery Unit.

Critical habitat was designated for the species on September 24, 1976 and includes 11 caves and 2 abandoned mines in Illinois, Indiana, Kentucky, Missouri, Tennessee, and Hellhole Cave in Pendleton County, West Virginia. No critical habitat is on or near the Forest and Hellhole Cave is 12.6 miles west of the Forest. The distribution of Indiana bats is generally associated with limestone caves in the eastern U.S. (Menzel et al. 2001). Within this range, the bats occupy two distinct types of habitat. During winter, the Indiana bat hibernates in caves (and occasionally mines) referred to as hibernacula. Bats are often readily found and easily counted at this time. Census of hibernating Indiana bats is the most reliable method of tracking population trends rangewide. As such, the winter distribution of the Indiana bat is well documented. Less is known about the abundance and distribution of the species during the summer maternity season, and even less is known about its migratory habits and associated range. During summer months, maternity colonies of more than 100 adult females roost under sloughing bark of dead and partially dead trees of many species, often in forested settings (Callahan et al. 1997). Reproductive females may require multiple alternate roost trees to fulfill summer habitat needs. Adults forage on winged insects within three miles of the occupied maternity roost. Swarming of both males and females and subsequent mating activity occurs at cave entrances prior to hibernation (MacGregor et al. 1999). During this autumn swarming period, bats roost under sloughing bark and in cracks of dead, partially dead and live trees in proximity to the cave used for hibernation.

Population

Based on winter surveys at Priority 1 & 2 hibernacula, plus data from Priority 3 & 4 hibernacula when available, the U.S. Fish and Wildlife Service reported in 2007 that the total population of Indiana bats was at a recent historic high of approximately 467,947 individuals (this total is still less than half the estimated population in 1960). The 2009 rangewide population estimate was 415,512 individuals, a decline of 52,435 from 2007. Reasons for the decline are unknown, but perhaps the decline was caused by White Nose Syndrome (WNS), which was causing severe bat mortality in some cave hibernating bats in the northeastern and eastern U.S. In January 2012, the January-February 2011 rangewide total was reported at 424,708, an increase of 9,196 bats, and a number comparable to the 2005 count of 425,372 individuals (USFWS 2012).

In 2011, there were 411 hibernacula considered extant, and 62 considered historic or uncertain (USFWS 2012). In 2007, Indiana bats were known to hibernate in approximately 281 hibernacula in 19 states (USFWS 2009). Based on 2011 survey data, Indiana had 52.5% of hibernating individuals, followed by Kentucky 16.6%, Illinois 13.2%, West Virginia 4.8%, New York 3.8%, Missouri 3.2%, Tennessee 3.0%, Ohio 2.3% and the remaining eight states with hibernacula (including Virginia) 0.6% (USFWS 2012). In 2011 the eighteen Priority 1A hibernacula contained 368,597 Indiana bats, or 87% of the total known population, and 36 of 53 hibernacula classified as Priority 2A&B contained 43,328 Indiana bats, or 10% of the total known population. The remaining 340 caves considered extant, Priority 3 or 4 hibernacula contained 12,783 bats, or 3% of the total population. The four hibernacula on or near the Forest – Starr Chapel, Mountain Grove, Clarks, and Hupman's Saltpetre Caves – are considered Priority 3 or 4 hibernacula.

Data on the Indiana bat has been collected in Virginia since the early 1960's, when the state's Indiana bat population was estimated at over 5,000. Dalton (1987) found 2,500 Indiana bats hibernating in eight caves during a 10-year survey of 170 caves in 22 counties. In 1997 the state's population was estimated to be 1,840 bats. Since 2001, the estimated number of bats in Virginia has remained relatively constant, at 700 – 1100. West Virginia, has seen a steady increase in bats during the past decade, from 10,000 to 20,000 bats.

Table F-3. Indiana bat population levels

	2001	2003	2005	2007	2009	2011
Virginia	969	1,158	769	723	730	863
West Virginia	9,714	11,443	13,417	14,745	17,965	20,358

Population estimates of hibernating bats, provided by Rick Reynolds of the Virginia Department of Game and Inland Fisheries, suggest that bat populations in the four hibernacula on associated with the GWNF fluctuate substantially. In general, however, caves with lower numbers of bats seem to maintain low numbers, while caves with higher numbers maintain relative higher numbers of bats (Table F-3a).

Four hibernacula are known to occur on, or within 2 miles, of the Forest. All four caves are gated to control human access. Bat numbers fluctuate from count-to-count, but caves with lower numbers of bats seem to maintain low numbers, while caves with higher numbers maintain relative higher numbers of bats (Table F-3a).

Table F-3a. Indiana Bats in Hibernacula on or Near the GWNF
(Caves with Primary and Secondary Cave Protection Areas on land managed by GWNF)
(Number of Bats Counted per Rick Reynolds - VDGIF)

Winter Survey Year	Starr Chapel Cave	Mt. Grove Cave	Clarks Cave	Hupman's Saltpetre Cave
1960	600			
1962	600			
1970				
1972	35			
1974	30			
1978	2			
1979	1			
1980	0			
1981		0		
1982	16	0		

Winter Survey Year	Starr Chapel Cave	Mt. Grove Cave	Clarks Cave	Hupman's Saltpetre Cave
1983	29			
1984				
1985	30			
1986		0	21	
1987	5		52	
1988			31	0
1989	36			
1990	37	5	22	26
1991	23			0
1992	38	23	0	220
1993	31	0		
1994	42	1	20	300
1995	60			
1996			0	225
1997	54			
1998		2		
1999	55		1	
2000				
2001		2		5
2002				
2003	67		47	4
2004				
2005	57		50	0
2006				
2007	68		49	
2008				
2009	61		48	
2010				
2011	74		64	3
2012	92		63	1

Blank cells = no survey done that winter.

Prior to 2003, there were no documented areas of Indiana bat maternity activity in West Virginia, although a juvenile male was captured during the maternity period in Nicholas County in 1999. This bat was not tracked so no additional information on the potential maternity usage in the area is available. In the summer of 2003, two post-lactating female Indiana bats were captured and tracked to roost trees in Boone County, West Virginia. These captures represented the first confirmed Indiana bat maternity activity in West Virginia. Surveys at this site during 2005 located two primary roost trees and resulted in a maximum emergence count of 73 bats. Maternity activity at this site has consistently been confirmed since then through annual surveys. In the summer of 2004, a second maternity colony of approximately 25 bats was confirmed through the capture and tracking of a lactating female Indiana bat. This colony was located adjacent to the Monongahela National Forest (MNF) in Tucker County and is located within 2 miles (3.2 km) of a known Indiana bat hibernaculum. The roost tree that the bats were eventually tracked to fell down the following summer. Subsequent surveys in the area have not been successful in capturing any reproductively-active females, although a number of male Indiana bats have been caught. The status of this maternity colony is unknown. A third maternity colony was documented as a result of surveys conducted in 2005 near Kanawha State Forest in Boone County. Emergence counts at the two identified primary roost trees documented a maximum count of 49 bats. In the spring of 2010, female bats tracked emerging from a hibernaculum in Pennsylvania were found to have established a roosting area just over the State border in Ohio County, West Virginia. A maximum of 58 bats were found to emerge from a roost tree in this area. In the summer of 2010, a pregnant female was captured in Wetzel County. Radio telemetry was not conducted on this bat, and follow-up surveys were not able to locate any additional Indiana bats, so no additional information on this maternity area is available. In July and August 2012, five female Indiana bats were captured in Brooke and Ohio Counties. Subsequent tracking and emergence counts documented a number of separate roost areas, and up to 26 bats flying out of an individual roost tree. These captures may represent a number of different maternity colonies within the northern panhandle of West Virginia.

In addition to these captures near potential or confirmed maternity colonies, individual male Indiana bats have been captured in numerous locations throughout the State in the following counties: Clay, Fayette, Nicholas, Pendleton, Preston, Pocahontas, Randolph, Raleigh, and Tucker. Three male Indiana bats were captured on another site on the MNF in Pendleton County in 2004. These bats were tracked to a roost tree and subsequent emergence counts on that tree revealed 23 bats. Surveys conducted since that time confirmed this area supports a bachelor male colony roost. In July 2012, a number of male Indiana bats were captured along the Kanawha/Fayette County line in the same area that the juvenile male was captured in 2010. These adult male bats were subsequently tracked to a number of roost trees, as well as to the underside of an Interstate Highway bridge that was later documented to have up to 89 Indiana bats roosting underneath. All the bats that were captured, tracked, or examined were found to be males, providing evidence of an extensive bachelor colony in the area. These captures of both male and female bats confirm that the Indiana bat uses forested habitats throughout the State for summer foraging and roosting. The increase in captures after 2002 may not reflect an actual increase in densities of Indiana bats summering within the State; rather these results may reflect the fact that survey efforts in relation to project review and monitoring have increased in recent years.

Migration

The timing of spring and autumn migration has been generally inferred as the time between when bats leave the hibernacula and when they are found in maternity areas (spring), and vice-versa (autumn). In most portions of the range, this is generally considered to be from 15 April to 15 May in spring, and 15 August to 15 November in autumn, although these dates are sometimes adjusted regionally to accommodate latitudinal differences in season. Essentially all acres within the Forest could serve as potential migratory Forest habitat for the Indiana bat.

Little is known about the habitat used by either sex during migration, although it is generally presumed to include a variety of wooded habitats. The following is an excerpt from the USDI Fish and Wildlife Service (1999) Revised Draft Indiana Bat Recovery Plan: “Although certain migration patterns may be inferred from limited band returns, they should be interpreted with caution. The sparse band recovery records, all of which are from the Midwest, indicate that females and some males migrate north in the spring upon emergence from hibernation (Hall 1962; Barbour and Davis 1969; LaVal and LaVal 1980), although there is also evidence that movements may occur in other directions. However, summer habitats in the eastern and southern United States have not been well investigated; it is possible that both sexes of Indiana bats occur throughout these regions. Very little is known about Indiana bat summer habitat use in the southern and eastern United States, or how many Indiana bats may migrate to form maternity colonies there. Most summer captures of reproductively active Indiana bats (pregnant or lactating females or juveniles) have been made between April 15 and August 15 in areas generally north of the major cave areas. While these observations suggest that many or most female Indiana bats in the Midwest migrate north in the spring and south in the fall, potentially significant numbers also migrate in other directions.” When Indiana bats are captured in spring or autumn, especially when caught near a cave or mine, there is generally no way to determine why the bat was in the area. In West Virginia, a male juvenile caught on August 5, 1999 (Kiser et al. 1999) was likely migrating to a nearby hibernaculum. As noted above, Indiana bats hibernating in mountainous regions of West Virginia may travel to warmer areas in the western part of the state or states to the west to raise their young. Brack et al. (2002) indicated that nursery colonies were less likely in higher elevations and areas of cooler temperatures.

During a survey of coal mining operations in Wise County Virginia, a consulting firm documented use of an abandoned coal mine by a female Indiana bat on April 14, 2001 which may have been a migratory individual. During autumn swarming and spring staging, Indiana bats use the cave hibernacula and nearby wooded habitats. In autumn, use of woodlands decreases over time as bats enter hibernation. The converse is true in spring. Two recent telemetry studies documented use of a variety of habitats within 2 miles of two caves on the Jefferson National Forest. In late September 1999 four Indiana bats (3 males, 1 female) were trapped and fitted with radio transmitters at the entrance of Rocky Hollow Cave in Wise County. From September 23rd to October 13th (21 days) three roost trees were located (all on private land) that were used by two of the bats (one male and one female). The female used two different trees in open woodlands approximately 1.5 miles southwest of the cave near the Lonesome Pine Country Club. One was a shagbark hickory 19" DBH (diameter breast height) and the other was a yellow poplar with peeling bark that was next to a skid-road and had been damaged during a logging operation. The tree occupied by the male bat was used as a roost on multiple days and was a pignut hickory 27.9" DBH located 0.15 miles north of the cave. Other observations made during the course of the study included extensive foraging activity over hayfields and along edges of forests and fields.

McShea and Lessig (2005) conducted a study in April 2005 where thirteen female Indiana bats were fitted with radio transmitters while still in their winter hibernacula in Bath County, VA. They were released and followed closely with both ground and aerial telemetry in an attempt to track them to their unknown summer maternity roost sites. Radio tracking was conducted on a daily basis from the day of their release until their signal disappeared. All bats but one could be followed for up to three weeks and their flight paths were recorded mostly traveling north or south. Four roost trees were found along natural corridors of creeks and ridges and one was still occupied at the end of the study. Several of the bats were observed to travel large distances in a short amount of time. The major directions of travel were generally north and south, with only one bat flying east (into the Shenandoah Valley) and none flying west (over the higher mountain ridges into West Virginia) following release from the winter caves. The bats were located mostly in line with ridges, suggesting that they use these corridors as flyways to follow for easy transportation routes. When they do decide to move the bats can cover large distances in a short amount of time. For example, one bat moved 50-miles south in four days and another moved 25-miles north in two days. The small size of the transmitters necessitated "direct line of sight" to locate the animals, so ground crews were only effective when near the animal or above the animal on a ridge. An aerial crew was a necessity in order to keep track of all individuals when they foraged at night and as the bats dispersed following release. The four roost trees found by McShea and Lessig had similar characteristics. All were large snags and three were along the forest edge (creek or road) where they received significant sunlight during April. All roost sites were within oak-dominated forest types. The three bats that ultimately left their roost trees only stayed in them a few days before moving elsewhere. The overall movement pattern suggests flying to a nearby roost tree, resting for a few days and then flying a long distance before resting again.

A study that started in the spring of 2012 tracked two female Indiana bats from their hibernacula on the Cumberland Plateau in Tennessee south to two locations. One location was on the Talladega National Forest in Alabama, and the other on a wildlife management area in Gilmer County, Georgia. Information is still being gathered, but the tracked bat on the Talladega National Forest is roosting with approximately 25 to 30 other Indiana bats in an old woodpecker cavity in a dead loblolly pine on the Shoal Creek Ranger District. Both bats and associated roost trees are in an area where recent management has occurred, including thinning and prescribed burning.

There is limited data in WV that can make an overall assessment of Indiana bat migration patterns. This is based on numerous returns from bats who were banded in the non-hibernation period (spring, summer, or fall) and then later recovered during hibernation in the same county where they were banded, indicating that many bats will stay in the vicinity of their hibernacula. The following band returns from bats that moved outside the vicinity of their hibernacula into another county for the summer. Some of the bats went north (movement to Greene Co., PA was frequent) both others went south.

Summer Capture Location	Winter Capture Cave/Location
Greene Co., PA	Cliff Cave, Pendleton Co., WV
Greene Co., PA	Big Springs Cave, Tucker Co., WV
Greene Co., PA	Izaak Walton Cave, Randolph Co., WV
Greene Co., PA	Hellhole, Pendleton Co., WV
Somerset Co., PA	Hellhole, Pendleton Co., WV
Nicholas Co., WV	Hellhole, Pendleton Co., WV
Tucker Co., WV	Hellhole, Pendleton Co., WV
Pocahontas Co., WV	Minor Rexrode Cave, Pendleton Co., WV

There are at least four abandoned mines in WV that are being used by Indiana bats in the late fall swarming period, indicating that they are likely being used as hibernacula.

Maternity Colonies

During summer, reproductive females form maternity colonies in trees. Maternity colonies may form hundreds of miles from the hibernacula, and females from a maternity colony may come from more than one hibernaculum. In contrast, males often use wooded areas near the hibernaculum, occasionally visiting the hibernaculum throughout the summer. Males sometime migrate long distances to summer habitat, although they tend to be less migratory than females, and often, though not always, remain geographically close to the hibernacula. During this time, males often roost individually, and likely use trees similar in character to those used near hibernacula in autumn and spring. Wooded lands closer to hibernacula are more likely to support males in summer than areas farther away, but essentially all of the Forest may provide suitable summer habitat.

The core summer range of the Indiana bat is southern Iowa, northern Missouri, northern Illinois, northern Indiana, southern Michigan, and western Ohio. West Virginia is within the eastern maternity range, but not within the core range. Maternity colonies are known to occur in some eastern states, such as Kentucky and North Carolina, but, to date, none have been found in Virginia or neighboring areas in other states.

During a previous study in the summer of 1995, six male Indiana bats were captured in Tucker County, West Virginia. These captures represented the first documented summer use in West Virginia by Indiana bats, and suggest that males in West Virginia use areas near the hibernacula during summer. Until 2004 the best evidence of maternity activity in West Virginia was the discovery of a juvenile male on August 5, 1999. This is outside the defined maternity period and likely represents a juvenile migrating to a nearby hibernaculum. Then during the summer of 2004 surveys found a maternity colony estimated at 25 Indiana bats in Tucker County, West Virginia within two-miles of a known hibernaculum (USFS 2009). That same summer three male Indiana bats were captured on the Monongahela National Forest in Pendleton County and tracked to a roost tree where 23 other bats were subsequently counted (USFS 2009). To date no maternity colonies or reproductive female Indiana bats have been captured in Virginia during the summer reproductive season. In summer 1993, Chris Hobson of the Virginia Division of Natural Heritage surveyed areas of Bath, Bland, Highland, Lee, Tazewell, and Wise counties in proximity to known hibernacula. No female Indiana bats were captured and seven males were captured at five sites. One of the males, captured on July 28, 1993 in Cumberland Gap National Historic Park, Lee County, was a juvenile, suggesting that a maternity colony may be located in the Cumberland Gap area of Virginia, Kentucky, or Tennessee. These captures are the only documented summer Indiana bat occurrences in Virginia and suggest that males, at the least, use areas near the hibernacula during summer in western Virginia (Hobson 1993). Brack and others (2002) analyzed summer netting efforts 1995 to 2000 to identify summer reproductive populations in Virginia, West Virginia, and portions of Pennsylvania considered within the summer range of the Indiana bat. Over 3,000 net nights of effort failed to produce evidence of any maternity colonies.

Summer Foraging

Due to the variability of known roost sites and the lack of knowledge about landscape-scale habitat characteristics, it is difficult to quantify summer roosting habitat for Indiana bat at a range-wide, regional, or local level. Forest management practices that affect occupied roost trees may have local impacts on Indiana bat populations. Across the historic range of the Indiana bat vegetation disturbances are prevalent and the species depends on an ephemeral resource (standing snags; living, dead or dying trees with cavities and/or exfoliating bark). Anecdotal evidence suggests that Indiana bats may benefit from limited disturbance around potential roosting areas (Menzel et al. 2001). Limited disturbance can create potential roost trees and open the canopy around potential roost trees (Gardner et al. 1991; Kurta et al. 1993). Indiana bats may be resilient to minor perturbations on the landscape such as targeted forest management and prescribed fire. General standards that would help ensure adequate roost habitat include retention of snags and suitable roost trees whenever possible, prescribed burning to restore and maintain open midstory foraging conditions (using only cool season backing fires in karst areas), and ensuring a continuous supply of oaks, hickories, and yellow pines as well as other trees with exfoliating bark (Menzel et al. 2001).

Fall Swarming

Indiana bats may use caves and mines during the non-maternity season (autumn through spring) for one of several reasons: 1) winter hibernation; 2) autumn swarming; 3) spring staging; and 4) vagrant or migratory use. Autumn swarming and spring staging typically occur in woodlands near the hibernacula, with use of the hibernacula increasing as autumn progresses towards winter, and decreasing as spring progresses towards summer. Hibernacula tend to have higher use in spring and autumn, and larger winter concentrations typically produce greater spring and autumn use.

During autumn, when Indiana bats swarm and mate at hibernacula, male bats roost in trees nearby during the day and fly to the cave or mine at night. Work in Missouri (Romme et al. 2002) and Kentucky (Kiser and Elliott 1996; Gumbert 1996) have found that Indiana bats range up to 5 miles from hibernacula during autumn and spring swarming activity periods. In Kentucky, Kiser and Elliott (1996) found male Indiana bats roosting primarily in dead trees on upper slopes and ridgetops, within 1.5 mi of their hibernaculum. In West Virginia, some male Indiana bats roosted within 3.5 mi of their cave, in trees near ridgetops, and often switched roost trees from day to day (C. Stihler, West Virginia Division of Natural Resources, pers. observ., October, 1996). One Indiana bat in Michigan roosted 1.4 mi away from the hibernaculum during fall swarming, and another chose trees at a distance of 2.1 mi (Kurta 2000). Gumbert (2001) found an average of 1.2 mi between roost trees and the hibernaculum for 20 radio-tagged Indiana bats. Brack found a range of 0.18 to 0.87 mi between roost trees and a hibernaculum in Virginia, although he did not follow bats if they left the "project area" and the range may actually be greater. Based on terrain and landscape characteristics of these areas (generally rolling without great vertical relief) when compared to the Ridge and Valley terrain of Virginia (mountainous with vertical relief 1,300 to 2,500 feet) it is likely Indiana bat activity in this portion of the Appalachians is confined to the valley in which the hibernaculum occurs and may extend into adjacent valleys via gaps in the surrounding ridges or mountains.

During September and October of 2000 an extensive survey was made of fall swarming activity near Newberry-Bane Cave in Bland County, Virginia as part of the proposed American Electric Power (AEP) 765 kV Wyoming (WV) to Jacksons Ferry (VA) powerline project. This work was conducted by Virgil Brack of Environmental Solutions and Innovations, Cincinnati, Ohio and is documented in the Appendix to the Biological Assessment for the EIS associated with that project. Of 27 Indiana bats captured (24 males and 3 females) at the mouth of Newberry-Bane Cave, 17 (14 males and 3 females) were fitted with transmitters. Radio-tagged bats were monitored between September 9th and October 21st within 2-miles of the cave entrance.

The Brack study found that Indiana bats most frequently foraged over agricultural land (44.7%), intermediate deciduous forests (22.6%), and open deciduous forests (19.0%) habitats types, comprising 86.3% of all habitat types used for foraging during the survey. The bats' activity areas included proportionally more agricultural lands and open forests than was available in the study area. Closed canopy woodlands were not used by foraging bats to the extent they were available. This study concluded that Indiana bats more frequently used rights-of-way, pasture edges, savannah-like woods, and other openings rather than large, continuous tracts of closed canopy forests. These findings are consistent with the interpretation of telemetry data in similar studies. For roosting ecology the study by Brack found a total of 26 roost trees for 8 of 17 bats fitted with transmitters. Of the 26 roost trees, 39% were shagbark hickories (Carya ovata) and 12 % northern red oak (Quercus rubra), for a total of 51%. Other tree species used as roosts included white oak (Quercus alba), red maple (Acer rubrum), sugar maple (Acer saccharum), black oak (Quercus velutina), bitternut hickory (Carya cordiformis), American basswood (Tilia americana), and yellow birch (Betula alleghaniensis). Five (19%) of the roost trees were dead snags. All roost trees were located in close proximity to the cave entrance ranging from 0.16 to 0.86 miles, with an average distance of 3,280 feet (0.6 miles). All roost trees were located near forest canopy openings such as open woodlands of pastures, scattered trees of recently logged areas, old logging roads, utility line corridors, and natural drainages. Five of the eight bats used the same roost tree for two to three consecutive days. Roosts were located in all types of deciduous forests, but exhibited a disproportionately small use of mixed evergreen and deciduous forests. Roost trees were very exposed with little or no canopy shading by other trees. It is likely that in doing so the bats were taking advantage of exposure to solar radiation in order to better regulate body temperature. Many open-canopy areas existed due to recent logging activity that left scattered trees within the harvested areas. Roosts in closed canopy deciduous forests were often in small openings near open corridor flyways.

While much of the activity observed during the study was close to the cave (within approximately 0.6 mile) bats also left the 2-mile study area all together. Males more so than females tended to range further from the cave. Perhaps they would leave to forage where there was less competition for prey (the caves in the area serve as hibernacula for over 8,000 individual bats of at least five different species) and return to the cave area periodically to mate. It's therefore likely roosting and foraging activity also occurred outside this 2-mile area but all documented roost trees and foraging behavior observed were within two miles of the Newberry-Bane cave.

Hibernacula

Indiana bats tend to hibernate in the same cave or mine at which they swarm (LaVal et al. 1976; C. Stihler pers. observation, October 1996), although swarming has been observed at hibernacula other than those in which the bats hibernated (Cope and Humphrey 1977). It is generally accepted that Indiana bats, especially females, are philopatric, that is, they return annually to the same hibernaculum (LaVal and LaVal 1980). Most bats of both sexes enter hibernation by the end of November (mid-October in northern areas–Kurta et al. 1997). Indiana bats hibernate in large, dense clusters, ranging from 300 bats per square foot to 484 bats per square foot (Clawson et al. 1980; Hicks and Novak 2002).

Caves must possess certain characteristics to be suitable as Indiana bat hibernacula. Raesly and Gates (1986) compared microhabitat and microclimate variables between occupied and unoccupied caves and mines. They found that Indiana bat hibernacula tended to have larger openings, more cave passage length, and higher ceilings compared to unoccupied sites. In addition, occupied hibernacula have noticeable airflow (Henshaw 1965). Once Indiana bats enter hibernation, they require specific roost sites in caves or mines that reach appropriate temperatures (Tuttle and Taylor 1994). Indiana bats choose roosts with a low risk of freezing. Stable low temperatures allow the bats to maintain a low metabolic rate and conserve fat reserves until they are ready to emerge in spring; thus, Indiana bats select roosts within hibernacula that best meet their needs for cool temperatures. Indiana bat hibernacula usually host other species of bats. Indiana bats are occasionally observed clustered with or adjacent to other species, including gray bats (*M. grisecens*), Virginia big-eared bats (*Plecotus townsendii virginianus*), little brown bats and northern longeared Myotis (Myers 1964; LaVal and LaVal 1980; Kurta and Teramino 1994).

Threats

Additional recent threats include White Nose Syndrome (WNS) and commercial scale wind power development. WNS is a fungus caused disease that was first seen in New York caves during the winter of 2006-2007. The newly discovered, cold-loving fungus (*Geomyces destructans*) has spread south during the past several years and was first confirmed in Virginia and West Virginia during the winter of 2008-2009 with additional spread and caves now contaminated. To date well over 1-million bats have been killed by this fungus which irritates bats during hibernation causing them to wake and use precious fat reserves. The bats then starve and or freeze when they attempt to fly and leave the cave in search of food during the midst of winter conditions.

Commercial wind power development has rapidly expanded across the Appalachians. Multiple sites have been developed in West Virginia and one site is being constructed in Virginia west of Monterey in Highland County. Bats are often killed during wind tower operations when they fly into the lower pressure area surrounding the trailing edge of spinning blades and suffer extreme barotrauma where decompression causes capillaries in the lungs to explode. Bats are most affected during periods of fall migration when they often follow ridgetops and come into contact with wind towers built along those same ridgetops.

Plan Components

Effects to the federally endangered Indiana bat (*Myotis sodalis*) were considered because there are hibernacula on and near the Forest, plus it is assumed the entire Forest is potential roosting and foraging habitat for this species. Potential effects include direct effects on hibernacula and effects on foraging and roosting habitat. The main management tool used in the Forest Plan to protect and manage habitat for the Indiana bat is the continued use of a management prescription area with an emphasis on the Indiana bat. This management area is located around the four caves known to contain the Indiana bat. This prescription area is established to: 1) protect hibernacula (caves in which the bats spend the winter); 2) maintain and enhance upland and riparian swarming and foraging areas; and 3) identify and protect summer roosting and maternity site habitat.

Management activities can degrade Indiana bat habitat if implemented in an unrestricted manner, therefore all alternatives continues to employ standards that apply to vegetation management across the entire forest to protect roosting and foraging habitat. Alternatives B, C, D, E, F, G, H and I also expand the areas defined as riparian corridors, providing additional protection to vegetation in the riparian corridors which have been reported to be important foraging areas.

Effects on Hibernacula

Steps have been taken by the Forest to protect and maintain these caves as suitable for the Indiana bat. Since 1995, bat gates have been installed on all caves known to be used by endangered bat species on the Forest. Starr Chapel Cave and Mountain Grove Cave on the Warm Springs Ranger District in Bath County are the only caves with entrances on Forest land that serve as hibernacula for Indiana bats. Clarks Cave and Hupman's Saltpeter Cave are on private land, but within 2-miles of National Forest land. The Indiana Bat Primary Cave Protection Area is defined by a radius of no less than one half mile around each hibernaculum, defined by national forest surface ownership and topography. This area is intended to protect the integrity of the cave and the immediate surrounding uplands where bats may swarm and forage in the fall. Commercial timber harvest, road construction, and creation of new wildlife openings are prohibited. Prescribed burning, tree cutting, and road maintenance are evaluated in terms of effects on the Indiana bat before approval. This area is not available for gas leasing and is unsuitable for wind energy development. Two Indiana bats were found to have WNS during an April 21, 2010 cave survey conducted by Rick Reynolds (VDGIF) and Wil Orndorff (VDCR) in Starr Chapel Cave. This represents the first time Indiana bats have been documented with WNS on the Forest. Indiana bats occur in other caves infested with WNS, and where other bat species have been found infected, but individual Indiana bats in those other caves have not shown signs of WNS infection. Caves with significant bat populations on Forest land will continue to be gated and locked year-round. Currently, a Regional Forester closure order is in effect that closes all caves and mines year-round on National Forest lands to human intrusion. If and when access is needed, WNS protocols will be followed that should eliminate contamination from other caves.

Effects on Roosting or Foraging Habitat

The Indiana Bat Secondary Cave Protection Area is defined by a radius of approximately 1 ½ miles around each primary cave protection area, defined by easily recognizable features on the ground. This configuration of the two protection areas provides management direction to protect and enhance the two-mile area around the hibernacula that is most critical to fall swarming. This secondary area is designed to further maintain and enhance swarming, foraging, and roosting habitat. Timber harvest, prescribed burning, wildlife habitat improvement, road construction, trail construction, and special uses may occur following evaluation of the effects on Indiana bats. Vegetation management is allowed to enhance foraging conditions. Timber management activities are suspended during the fall swarming season. The area is unsuitable for wind energy development.

Potential roosting habitat (mature forests with trees having exfoliating bark) exists across the entire Forest and contains tree species of the size and type known to be used by the Indiana bat. The retention of some snags, shagbark hickory, and hollow trees (as available) will allow for potential Indiana bat roost sites. Decreasing canopy closure as occurs with timbering and prescribed fire activities will increase the degree of exposure of some potential maternity roost trees to solar radiation, providing improved thermal conditions for raising young during a wide range of weather conditions. Pond/waterhole construction will increase the number of upland water sources available for Indiana bats. Persistence of early successional habitats and forests with an open understory and patchy overstory would create favorable foraging areas and flight corridors leading to potential roost trees. Harvesting would produce a mosaic of regeneration areas intermixed with mature and late successional forests. Likewise, prescribed fire would also create a mosaic of forest successional stages from early to late resulting from varying fire intensities associated with topographic features, vegetative types, and fuel accumulations. This will indirectly provide feeding areas since bats are known to forage within the canopy openings of upland forests, over clearings with early successional vegetation, and even along the borders of croplands, or wooded strips (fencerows), and over ponds. In contrast, negative impacts to the Indiana bat will be: (a) the slight chance that individuals or small groups of roosting bats (including summer maternity colonies if present) could be unintentionally killed by the felling of trees harboring undetected roosts (e.g. dead limbs with loose bark, or small cavities in the boles), or by the accidental felling of occupied snags, or damaged or hollow trees during timber harvest or other activities; and (b) a short-term reduction in the total amount of foraging habitat available to individual Indiana bats which would be incurred on regeneration cuts immediately after harvest. Although the likelihood is very low, tree cutting activities could result in the inadvertent loss of individual Indiana bats or small groups of Indiana bats via removal of some large-diameter hardwood trees occupied by bats during the period from approximately April 1 to October 15. Occupied and potential roost trees could be directly affected by vegetation management, firewood and salvage sales, routine maintenance/permitting of small clearings including easements, rights-of-way and access to privately-owned lands, and road construction. Plan implementation will result in vegetation disturbance and possible impact to currently occupied and potentially occupied roost trees. There is potential for adverse effects to a maternity roost tree if one occurs on the Forest and in an area where trees are being felled. However, forest-wide standards minimize, if not eliminate, the chance of adverse effects under all alternatives. Any Indiana bat roosts that are discovered would be protected until they were no longer suitable (unless treatments were needed for public or employee safety) under all alternatives.

The National Forest fuelwood program allows the public to purchase and collect wood, often recently downed or standing/leaning dead trees, for personal use. The program is regulated by issuance of an area-specific permit and collection occurs primarily along roadsides and other specified sites with easy access. Vehicles must remain on open roads are not allowed to travel through the forest in order to facilitate finding, cutting, and loading firewood. This, therefore, restricts the distance at which most people are willing to cut and haul firewood and results in firewood being cut within 150 feet (about two tree lengths) of an open road, and is limited almost exclusively to level terrain or the uphill side. Volume of firewood cut on the Forest during 2008 was 4,488 CCF (hundred cubic feet) and during 2009 5,256 CCF, for an average of 4,872 CCF over the two-year period. A 14" DBH tree contains approximately 0.5 CCF of firewood; therefore approximately 9,744 dead trees were cut for firewood each year. The number of standing dead trees on the Forest can be calculated based on analysis of data collected during the 2002-2007 Forest Inventory and Analysis conducted by the Southern Forest Research Station, Asheville, NC and published in 2009. The number of dead standing trees at that time was 14.9 per acre for all trees larger than 5" DBH and 6.1 per acre for trees larger than 9" DBH. Given that the Forest is approximately 1.1 million acres, this equates to at least 6.5 million dead standing trees >9" DBH. All portions of the Forest continue to be infested with gypsy moths and infestations are forest-wide with cycles of defoliation and mortality resulting from population fluctuations of gypsy moths. The result of these infestations is extensive areas of hardwood (especially oak) mortality in the overstory. Therefore, if 10,000 standing dead trees are cut each year for firewood, this equals 0.15% of the total available standing dead trees. Since most of these dead trees are not close to roads or are in Management Prescriptions where firewood cutting is not allowed, the possibility of harming an Indiana bat is extremely remote. In addition, most Indiana bats roost in live trees. Brack and Brown (2002) reported 81% of roost sites used by radio-tagged Indiana bats were live trees and 19% were snags. The odds of encountering a roosting bat are even further reduced since only dead trees are available for cutting as firewood and these dead trees represent perhaps 20% of the trees where they roost. Assuming this trend represented Indiana bat roost selection throughout the Forest; personal use firewood collection could affect 0.0003% of the potential Indiana bat roost trees. Firewood collecting is not allowed in the Primary and Secondary Indiana Bat Cave Protection Management Prescription Areas, ensuring that snags near hibernacula are retained. Although the risk of "take" resulting from firewood cutting cannot be completely eliminated, the risk of direct effects to roosts in the vicinity of hibernacula is further minimized since the collection of firewood in the Primary and Secondary Indiana Bat Cave Protection areas is not allowed by prescription standard. Some minimal risk of taking a bat roosting in a standing dead tree cut for firewood elsewhere on the Forest would continue to exist. However, given the relatively low number of Indiana bats on the Forest when compared to the number of acres, standing trees and snags, the use of any individual dead tree as a roost is likely to be brief, and the likelihood of take from firewood cutting is extremely small under all alternatives.

Most types of timber harvest (salvage, even-aged, uneven-aged, etc.) would require some snag and potential roost tree retention, plus specific retention of leave trees such as shagbark hickories. Forestwide standards in all alternatives require stand regeneration treatments greater than ten acres in size, retaining a minimum average basal area of 15 square feet per acre of live trees, and giving priority to retaining the largest available trees that exhibit characteristics favored by roosting Indiana bats (sloughing bark, cracks and crevices).

To maintain flight and foraging corridors in upland and riparian areas, a Conservation Recommendation in the 1997 Biological Opinion encouraged the Forest to increase its prescribed burning program on lands unsuitable for timber harvest. Over the past 15 years, the Forest has steadily increased its prescribed burn program. Alternative E would have the highest acres with 20,000 acres estimated to be prescribed burned each year. Alternatives B, F, G, H and I have an objective to burn 12,000 to 20,000 acres per year. Prescribed fire is used for ecosystem restoration, wildlife and rare species management, site preparation and oak-pine regeneration. Most prescribed burns occur from March to mid-May, with a few during late May and June. Depending on weather and fuel conditions, a few may occur in late October and November. Control lines consist of existing roads, trails, and streams wherever possible. In areas where control lines need to be constructed, handtools and/or bulldozer will be used to dig a two to five foot wide strip to mineral soil. Some trees will need to be felled during line construction, but in most cases larger trees will be avoided with the line going around and between the largest trees. Some standing trees and snags near the line will be felled because they pose a hazard to personnel, or may burn and fall across the line, potentially spreading the fire into areas not scheduled for burning.

Some of the ridgetops on the GWNF have been identified as having potential for developing wind energy. The total area with a potential rated as fair to superb is about 117,000 acres. Plan Alternatives C and E do not allow for commercial wind power development. Alternatives B, D, F, G, H and I allow for consideration of wind power development. Alternatives B, F, G, H and I assume one development site and assume 15 towers per site, while Alternative D assumes three sites and assumes 45 towers. Currently, there are no proposals for wind power development on the GWNF. Any such proposal will be evaluated with an environmental analysis and impacts to bats will be disclosed at that time.

Cumulatively, with implementation of any alternative, the Forest will maintain a supply of snags, live potential roost trees, upland water sources, and other habitat features across the landscape to allow for the maintenance, and promote the recovery, of Indiana bat populations. At the same time, activities can still continue to meet other multiple-use objectives. For example, timber harvesting can still occur to accomplish sufficient forest regeneration to provide diverse insect productions and provide for the continuation of diverse forest conditions across the Forest. Overall, there will be both potential benefits and potential impacts to the Indiana bat from management activities on the Forest. From a beneficial standpoint, the retention of most snags, all shagbark hickory, and hollow trees in sale areas would allow potential Indiana bat roost sites to be conserved; the reduction of canopy closure in sale areas and along unit margins would increase the degree of exposure of potential roost trees to solar radiation, providing improved thermal conditions for roosting and perhaps raising young; pond/waterhole construction would increase the number of upland water sources available for Indiana bats along with other bat species. Slightly positive benefits for Indiana bat would result as harvested units create insect-rich foraging areas and flight corridors leading to any tree roosts that might be present there. Positive benefits would result from prescribed burning by decreasing understory vegetation density and reducing canopy closure plus favoring oak, yellow pines, and hickory while reducing the in-growth of yellow poplar, red maple, and white pine. Positive benefits will also be realized from the application of prescriptions and associated standards focused on protecting caves and managing vegetation structure and conditions within 2-miles of hibernacula.

Contrastingly, negative impacts to the Indiana bat would be: (a) the slight chance that individuals or small groups of roosting bats (including possible summer maternity colonies) could be unintentionally killed by the intentional felling of trees harboring undetected roosts (e.g. dead limbs with loose bark, or small cavities in the boles), or by the accidental felling of occupied snags, or damaged or hollow trees during timber harvest or other activities; and (b) a short-term reduction in the total amount of foraging habitat available to individual Indiana bats which would be incurred on regeneration cuts. Although these bats will use small forest openings and edges as foraging habitat, they would be unlikely to utilize the central portions of harvested units during the early years of regeneration unless the residual basal area was high enough. It is possible that the increased rate of insect production in the regeneration areas would make up for any loss of foraging habitat acreage, but such a determination would be difficult to make without extensive long-term research on the subject. The level of estimated timber harvest ranges from 1,000 to 5,000 acres depending on Alternative. Specific acreage by type of silvicultural system for each alternative is discussed in the Social/Economic Environment, Timber Management section of the EIS. See specifically Table 3C6-14.

Although the likelihood is very low, implementation of any alternative may result in the inadvertent loss of individual Indiana bats or small groups of Indiana bats, via removal of some large-diameter hardwood trees occupied by bats during the period April 1 through October 15. This risk would be greatest in those alternatives with the highest acres of timber harvest. Alternative D has the highest acres estimated, followed by Alternatives A, B, E, G, H and I, and F in order. Alternative C has no timber harvest allowed.

Under all alternatives, Forest-wide and management prescription standards will provide adequate protection for summering and transitory Indiana bats. These standards and prescriptions provide for maintenance of extensive forest areas that would remain undisturbed. These areas are characterized by disturbance events where net losses and gains of potential roost trees would be dependent on ecological processes including tree mortality due to aging, insect and disease, wildland fires, and weather events.

In addition, all alternatives allocate areas surrounding known Indiana bat hibernacula to Management Prescriptions 8E4a and 8E4b. In the future, any newly discovered hibernacula will be added to this prescription through the Forest Plan amendment process. In the 1997 Biological Opinion for the Forest, and the 2004 BO for the Jefferson NF, the USDI Fish and Wildlife Service determined that the level of anticipated take (4,500 acres not including prescribed burning on the Forest and 16,800 acres including prescribed burning on the JNF) is not likely to result in jeopardy to the Indiana bat or destruction or adverse modification of any critical habitat. Although the loss of a few individuals from time to time during timber harvest is remotely possible, the overall large amount of improvement of roosting and foraging habitat for the Indiana bat, coupled with management activities taking bat life requirements into account, plus an increasing number of upland drinking water sources, and gating of hibernacula, suggests that these potential losses would be offset by overall future net gains in the population.

Long-term effects of WNS are unknown at this time. It's likely that Indiana bats will be further affected by WNS and those cumulative effects may exceed any action Forest Plan implementation will cause.

Cumulative effects of wind power development will be addressed in project level analysis if and when the Forest receives a proposal for construction.

3.2.2 VIRGINIA BIG-EARED BAT

Background

Formerly included in the genus *Plecotus*, the Virginia big-eared bat is a subspecies of the more common and widespread Western (or Townsend's) big-eared bat that occurs throughout the western U.S., southwest Canada, and most of Mexico. The subspecies, *virginianus*, occupies a very limited geographic range in the Central Appalachians that includes portions of four states: West Virginia, Virginia, Kentucky, and North Carolina (Bayless et al. 2011). The species was listed under provisions of the Endangered Species Act as "Endangered" in December 1979. The Recovery Plan was issued on May 8, 1984 and a draft revised recovery plan was submitted for review in 1996, but was never finalized. The first substantive 5-year review of the species was released by the USFWS, West Virginia Field Office, during the summer of 2008. On March 6, 2012, a request was made in the Federal Register by the USFWS for information to initiate a 5-year review of 9 listed species in the northeast, including the Virginia big-eared bat.

Population numbers have shown moderate to strong increases range-wide over the past 20 years. In the late 1970s, when the recovery plan was drafted, the known population of Virginia big-eared bats in maternity colonies was approximately 3,600, and the known hibernating population was approximately 2,585 (U.S. Fish and Wildlife Service 2008). In the late 1980s, the estimated, total population of the subspecies in West Virginia, Virginia, Kentucky, and North Carolina was approximately 10,000 bats (Dalton 1987). By 1997 the range-wide population of *C.t. virginianus* was estimated to have almost doubled to just under 20,000 individuals (Pupek 1997). In West Virginia some cave populations grew as much as 350% from 1983 to 1995 (Pupek 1997). Survey data from 2006-2007 indicate a population of 11,694 hibernating bats and 7,630 maternity colony bats (USFWS 2008). These surveys did not include bachelor colonies or several caves with significant bat use due to access or safety concerns. The 2012 surveys of the 10 summer colonies in West Virginia show that the Virginia big-eared bats continue to do well with the total being the highest count on record with 7,531 bats, up 0.9% from 2011 and up 18.2% since 2008, pre-WNS (WNS was found in WV in 2009). The 2012 count increased in 8 of the 10 caves compared to the 2011 count (Stihler 2012 per comm).

In Virginia, this bat is known from eight caves in six counties in two separate geographic areas. One area is in the upper headwaters of the James River (Cowpasture and Bullpasture Rivers) and the other is in the New River watershed. According to the Virginia Fish and Wildlife Information Service, the Virginia big-eared bat is known from three caves in Tazewell County and one in Highland County during the summer and five caves during the winter in Tazewell, Bland, and Highland Counties. Previous observations of single or a few (<5) individuals in caves found in Rockingham, Bath, and Pulaski Counties are likely transient males and are only seen occasionally in these locations.

In West Virginia, the Virginia big-eared bat is known from at least 30 caves in five counties, with most of the occurrences (20) in Pendleton County. The final rule that placed the Virginia big-eared bat on the endangered species list also designated five caves in West Virginia as Critical Habitat: one cave in Tucker County (Cave Hollow Cave) and four caves in Pendleton County (Cave Mountain Cave, Hellhole Cave, Hoffman School Cave, and Sinnit Cave).

The Virginia big-eared bat occupies caves year-round. These bats are not migratory and their longest recorded movement is approximately 64 kilometers (40 miles; Dalton & Handley 1991). Males and females hibernate singly or in mixed gender, single species clusters in a few caves, and move in the spring to other cave(s), with females forming smaller summer maternity/nursery colonies and males remaining solitary, or forming bachelor groups, during the summer.

Mating begins in late summer/early autumn and continues into early winter. Ovulation and fertilization are delayed until late winter/early spring. Maternity colonies form as early as March or as late as June depending on when the roost site reaches a suitably warm temperature. Gestation lasts 2-3.5 months. Solitary pups are born in late spring/early summer. Young can fly at about 2.5-3 weeks of age, are weaned by 6-8 weeks, and leave the cave to forage on their own by the end of July or August. Most individuals leave the nursery cave by mid to late September. Females are sexually mature their first summer. Males may not be sexually active until their second year. Nearly all adult females breed every year (NatureServe 2011).

The Virginia big-eared bat primarily feeds on moths. Morphological adaptations (long ears and wing shape that results in low wing loadings) facilitate foraging tactics which involve slow-maneuverable flight where prey can be captured in air or from the surface of objects. Foraging techniques consist both of aerial hawking and gleaning. Lacki and Dodd (2011) noted that Lepidopteran prey comprises >80% volume of the diet of all *Corynorhinus* species. Food habits of the maternity colony in Tazewell County, Virginia found that moths formed over 90% of the diet, with beetles a distant second, followed by lesser quantities of other flying insects. The bats typically leave the cave after sunset with the onset of full darkness to begin foraging. Level of flight activity in Virginia big-eared bats is negatively associated with moon phase and wind speed, and directly related to percent relative humidity (Adam et al. 1994). Foraging area averages approximately 280 acres (60 – 650 acres). Maximum flight distance of foraging from caves is 7.0 miles, with 80% of foraging occurring within 3.7 miles (Stihler 2010). Bats have been observed foraging over corn and alfalfa fields as well as mature upland forests, wherever moths occur in abundance (Dalton et al. 1986). An overriding pattern of habit usage in foraging is a preference for abrupt changes in vertical structure, such as along forested and riparian corridors and forest/edge interfaces. The vertical surfaces likely help in capturing stationary moth prey by gleaning. Because most of these same habitats are avoided by families of moths typically eaten by *Corynorhinus*, Lacki and Dodd suggest that foraging habitats are better predicted by structural configuration than by local abundance of preferred moth prey (Lacki and Dodd 2011).

Threats

Limiting factors for the Virginia big-eared bat include caves with suitable temperature regimes (cold in winter and warm in summer). Compared to other bats, Virginia big-eared bats tolerate lower cave temperatures during hibernation, and often occupy areas in caves that receive cold-air flow near entrances. Maternity caves are typically warmer than hibernation caves. Declines appear to be primarily related to human disturbance and loss of cave habitat quality. The Virginia big-eared bat is extremely intolerant of any human disturbance. Former declines in bat populations are likely attributable to human intrusion into caves, which depletes energy reserves of aroused bats and may lead to cave abandonment if disturbance is frequent (NatureServe 2011). The recovery plan (USDI Fish and Wildlife Service 1984) recommends recovery actions focused on cave acquisition and gating of entrances to control human access. The increased population of Virginia big-eared bats over the past 30-years is likely attributable to gating and year-round closure of caves occupied by these bats.

On the Forest there are no caves regularly occupied by the Virginia big-eared bat at any time of the year. All occupied caves in Virginia, during both summer and winter, are on private land. Cave occurrences of the Virginia big-eared bat closest to the Forest are located in Highland County, Virginia, and Pendleton County, West Virginia, where the closest distance from an occupied cave to Forest managed land is approximately 2.5-miles (Arbegast Cave, Highland County). In Pendleton County the closest distance from caves designated as Critical Habitat to Forest land is: Hellhole Cave, 12.6 miles; Cave Mountain Cave, 10.25 miles; Sinnit Cave, 5.0 miles; and Hoffman School Cave, 3.6 miles. It's therefore possible, based on observed flight distances for foraging activity of 2.2 – 5.2 miles, that Virginia big-eared bats may forage over some portions of the North River Ranger District, from the Brandywine area of Pendleton County, WV south to the McDowell area of Highland County, VA.

The greatest threat currently known to Virginia big-eared bats is human disturbance in hibernacula, roosting, and maternity caves. None of these caves occur on the Forest. The Forest has assisted with building and maintaining cave gates, such as the purchase of materials and construction of the gate on Arbegast Cave in 2007. Currently, all the caves on or near the Forest utilized by the endangered Indiana bats are gated and locked year-round, plus a Closure Order, issued by the Regional Forester to lessen spread of WNS and prevent disturbance to bats, continues on all caves and mines.

Negative effects to Virginia big-eared bats from vegetation management are minimal because these bats utilize caves year-round for all roosting and hibernation. Vegetation management such as timber harvest, thinning, and prescribed burning will increase vertical structure in closed canopy forests creating a spatial mosaic of conditions and will therefore provide and enhance foraging habitat.

Plan Components

Under all alternatives, Forest Plan standards relevant to the Virginia big-eared bat and associated cave habitat would protect all caves now known on the Forest, as well as any cave discovered or purchased that may support Virginia big-eared bats. Although no hibernacula, summer roost, or maternity caves have been identified on the Forest, forestwide standards maintain vegetation, and require installation of gates or other protective structures, at entrances of all caves occupied by populations of any threatened or endangered bats. Until a newly discovered cave has been surveyed for bats, it is assumed that federally listed bats are present and the cave and surrounding habitat are maintained for them until surveyed. Potential foraging habitat will be maintained in a mosaic of vegetative conditions, and any changes will result from forest succession and management activities such as timber sales and prescribed burning.

Recent potential and known threats include White Nose Syndrome (WNS) and commercial-scale wind power development.

WNS is a fungus caused disease that was first seen in New York caves during the winter of 2006-2007. The newly discovered, cold-loving fungus (*Geomyces destructans*) has spread south during the past several years and was first confirmed in Virginia and West Virginia during the winter of 2008-2009. Since 2009, the fungus has continued to spread and contaminate caves in and near the Forest. To date, there have been no Virginia big-eared bats found with WNS (Stihler 2012 pers. Comm.). WNS has been documented in caves occupied by Virginia big-eared bats, yet the bats do not show signs of infection, and no mortality attributable to WNS has been documented.

All caves with significant bat populations on Forest land will continue to be gated and locked. Currently, a Regional Forester closure order is in effect that closes all caves and mines on the National Forest to human intrusion. If and when access is needed to any cave, WNS protocols will be followed that are designed to reduce the potential for contamination from caving activity.

Commercial wind power development has rapidly expanded across the Appalachians. Multiple sites have been developed in West Virginia and one site is being constructed in Virginia west of Monterey in Highland County. Bats are often killed by wind towers when they fly into the lower pressure surrounding the trailing edge of spinning blades, and suffer extreme barotrauma because the decompression causes capillaries in their lungs to explode. Bats are most affected during periods of fall migration because they often follow ridgetops and come into contact with wind towers built along those same ridgetops.

Alternatives C, and E do not allow for commercial wind power development. Alternatives B, D, F, G, H and I allow for consideration of wind power development. Alternatives B, F, G, H and I assume one development site and assume 15 towers per site, while Alternative D assumes three sites and assumes 45 towers. Currently there are no proposals for wind power development on the GWNF. Any such proposal will be evaluated with an environmental analysis and impacts to bats will be disclosed at that time.

There are expected to be no cumulative effects to the Virginia big-eared bat resulting from implementation of any alternative. As stated above, the caves where this species occurs are on private land near the Forest. Landowners of these caves are aware of the bats' presence and the caves are either gated or protected to limit human entrance and disturbance. Individual Virginia big-eared bats may forage or fly over National Forest land, but current conditions will be maintained, and habitat enhanced through active management for preferred foraging habitat in all alternatives except Alternative C. Active management will include timber harvest, thinning, and prescribed burning will designed to increase forest openings and decrease canopy closure.

There have been concerns about the effect gypsy moth (*Lymantria dispar*) defoliation and suppression efforts may have on Virginia big-eared bats. Gypsy moths are well established across the Forest. Defoliation, and the subsequent short-term loss of forest cover, may suppress insect populations and thus food sources for the bats. Likewise, pesticides suppress or eliminate insect populations to varying degrees, depending on the type of insecticide used (USDA 1996). Suppression of gypsy moth outbreaks have not been done on the Forest since Spring of 2003 when 1,311 acres in six areas were treated with Btk and none of those areas were within 50-miles of known Virginia big-eared bat occurrences. If necessary in the future decisions on gypsy moth management will be made at that time and further analysis handled at the project level including consultation with the U.S. Fish and Wildlife Service.

Effects of WNS are unknown at this time. If infection occurs in Virginia big-eared bats and they are negatively affected by WNS there is little if anything the Forest can do other than assist with surveys and monitoring, plus keep caves gated and closed on a year-round basis.

Direct and cumulative effects of wind power development will be addressed in project level analysis, including consultation, if and when the Forest receives a proposal for construction.

3.2.3 VIRGINIA NORTHERN FLYING SQUIRREL

Background

The Virginia northern flying squirrel (*Glaucomys sabrinus fuscus*; hereafter abbreviated VNFS) is a nocturnal small mammal endemic to the Alleghany Highlands of West Virginia and Virginia. The species was federally listed as Endangered in 1985, along with another subspecies, the Carolina northern flying squirrel (*Glaucomys sabrinus coloratus*), and is also state listed as endangered under the Virginia Endangered Species Act (Fies and Pagels 1991). VNFS is a relatively short-lived species primarily inhabiting mature spruce forest, as well as the ecotone between spruce and northern hardwood forests (Ford et al. 2004; Ford and Rodrigue 2007; Loeb et al. 2000; Menzel et al. 2004, 2006a; Reynolds et al. 1999; Schuler et al. 2002; Smith 2007; USFWS 1990, 2001, 2006, 2008; Weigl et al. 1999). VNFS will eat a range of seeds, buds, fruits, and insects, but, in the Appalachians, the squirrels rely heavily on hypogeal fungi (truffles) and lichens associated with the root systems of red spruce (Ford et al. 2004; Ford and Rodrigue 2007; Loeb et al. 2000; Maser et al. 1978, 1986; Maser and Maser 1988; Mitchell et al. 2001). While nesting mainly in tree cavities in live hardwoods and snags (yellow birch and American beech are preferred), the VNFS will also utilize leaf or 'drey' nests in conifers such as red spruce and eastern hemlock, and have been observed using multiple den/nest sites in one season (Hackett and Pagels 2003; Menzel 2003; Menzel et al. 2000, 2004; Weigl et al. 1999). Den sites have often been found in trees and snags larger and taller than surrounding tress, and near trails, old logging roads, or railroad grades (Hackett and Pagels 2004; Menzel et al. 2004). VNFS will occupy artificial nest boxes (Reynolds et al. 1999). Individual home range sizes are variable, ranging from 5 to > 100 ha in West Virginia (Urban 1988; Menzel et al. 2006b). Home range size varies by habitat structure quality and seasonal food abundance, with males tending to have larger home ranges than females (Weigle et al. 1999). Optimal habitat is red spruce forest exhibiting mature to old-growth characteristics on north and east-facing slopes, with large trees, numerous snags, high volumes of coarse wood debris, and abundant lichens and hypogeal fungi providing year-round lifecycle needs (Carey 1989, 1991, 1995; Ford et al. 2004; Hackett and Pagels 2003; Odom et al. 2001; Payne et al. 1989; Rosenburg 1990; Shuler et al. 2002; Weigl et al. 1999). However, VNFS can persist in and around remnant patches of red spruce and mixed spruce-northern hardwood forest (Ford et al. 2004; Menzel 2003; Menzel et al. 2004; 2006a, b; Smith 2007).

In a 2006 5 year review and 2008 final rule, the USFWS estimated a range of 242,000 to 600,000 acres of potential suitable habitat for VNFS, generally following the spine of the high Allegheny Plateau in a northeast to southwest alignment (Menzel et al. 2006b; USFWS 2006 and 2008). No critical habitat has been designated for this species. Based on the Menzel habitat suitability model, the majority of 'optimal' (80%) and 'likely' (65%) habitat is found on the Monongahela National Forest in West Virginia (Menzel et al. 2006b; USFWS 2006 and 2008). Approximately 6,268 acres of mixed spruce and northern hardwood habitat occurs in the Laurel Fork area on the Forest, in Highland County, Virginia. This represents approximately 3% of the total estimated habitat for the VNFS rangewide and 25% of an estimated 25,250 acres of 'likely' habitat in Highland County, Virginia, as determined by the Menzel habitat suitability model (Menzel et al. 2006a; USFWS 2006 and 2008). At Laurel Fork, mature red spruce is found mixed within northern hardwood forest types, primarily associated with riparian areas along Buck, Slabcamp, Bearwallow, and Newman Runs, all on the upper east flank of Alleghany Mountain (Fleming and Moorhead 1996). Current estimates of mature red spruce is 219 acres, with an additional 154 acres of mature red spruce in plantations on the upper slopes of Allegheny Mountain, in the vicinity of Buck Knob and Locust Spring Run (Fleming and Moorhead 1996; USFS 2011). In addition, 116 acres of mature red pine plantation is present in the same area. Most of the spruce and red pine is estimated to be 90 years or older. Adjacent to the spruce and pine plantations and intermixed along the tributaries to Laurel Fork and Laurel Fork itself are an estimated 158 acres of open beaver meadow/wetland glades, and herbaceous and shrubby old field habitat (Fleming and Moorhead 1996). In total, 373 acres of mature red spruce and an additional 116 acres of mature red pine are components of the 6,268 acre mixed spruce/northern hardwood forest complex in Laurel Fork. Abundant red spruce regeneration is present throughout the area, both in the understory of spruce/northern hardwood forests and in adjacent old beaver meadows and wetland glades, making the total acreage of the spruce forest component estimated at around 600 acres (Fleming and Moorhead 1996; USFS 2011).

At the time of federal listing in 1985, VNFS was known to occur in four geographic areas, three in West Virginia (Cranberry Glades, Cheat Bridge/Cheat Mountain, Stuart Knob) and one in Virginia (Laurel Fork). The USFWS has documented 109 known sites with VNFS, 107 in West Virginia, and two in Virginia (USFWS 2006 and 2008). The Virginia population is known only from Highland County, Virginia and is considered part of the Spruce Knob/Laurel Fork population cluster (Pocahontas, Randolph, Pendleton Counties, West Virginia, and Highland County, Virginia) (USFWS 2006 and 2008). A population of uncertain genetic status is also located in southwestern Virginia at Mt. Rogers National Recreation Area and adjacent Grayson Highlands State Park (USFWS 2006 and 2008). Several studies have attempted to determine whether this population is the Virginia or Carolina northern flying squirrel subspecies, or an intergrade between the two, with the most recent research indicating a likely genetically distinct population (Arbogast and Schumacher 2010; Fies and Pagels

1991, Reynolds et al. 1999; Sparks 2005). Until the genetic uncertainties are officially resolved, the USFWS recovery plan for Carolina flying squirrel includes this population for conservation and management purposes, and is addressed in the Jefferson National Forest Revised Land Management Plan (USFS 2004; USFWS 2006).

Since 1985, the Laurel Fork area has been monitored for VNFS using a combination of presence/absence surveys with nest box checks and live capture/recapture methods (J. Pagels unpublished data; Reynolds et al. 1999). At the time the first Forest Plan Revision was signed (1993), monitoring efforts estimated fewer than 20 individuals in the Laurel Fork Area (USFS 2011). Despite repeated monitoring efforts for over twenty years, very few VNFS have been captured. During a 10 year mark/recapture study on two sites in Laurel Fork (1986-1996), only one squirrel was captured in 10 years on site one, and 3-6 captured in four of 10 years on site two (Reynolds et al. 1999). Despite a low capture rate throughout the years, VNFS have been shown to persist in the Laurel Fork area with the most recent capture in 2004 (J.Pagels unpublished data). Three sites in Laurel Fork on the Forest have now been documented to have VNFS, as well as two sites on private land in Highland County, one adjacent to Forest land in Laurel Fork (Rick Reynolds, VDGIF and Marek Smith, TNC, pers. comm., 2012). The USFWS acknowledges known inadequacies in current monitoring techniques for VNFS to prove or disprove presence of the VNFS (USFWS 2001, 2006, 2008). The current Recovery Plan for VNFS, as amended, encourages the assumption of presence in suitable habitat, because the squirrels are less likely to use nest boxes or enter traps in good quality habitat due to the abundance of natural den sites and preferred foods in these areas (USFWS 2001).

Threats

A number of natural and human-related threats have been documented for the VNFS in the USFWS recovery plan, USFWS 5 year review, USFWS Final 2008 Rule, and published research.

Loss of suitable habitat and connectivity. Historically, the Allegheny Highlands contained over 500,000 acres of old-growth spruce-dominated forest in the Allegheny Highlands (USFWS 2006 and 2008). Much of this was lost through historical logging and associated wildfires, which led to the replacement forest being more dominated by northern hardwood types, with a reduced spruce/conifer component (Adams and Stephenson 1989; Schuler et al. 2002). This habitat change and resulting fragmentation of suitable habitat had a serious negative impact on the size and distribution of VNFS populations throughout their range (Ford and Rodrigue 2007, USFWS 2006 and 2008). Currently, an estimated 242,000 – 600,000 acres of varying suitability exists for VNFS, based on the consolidation of several habitat suitability models (USFWS 2006 and 2008). In the Laurel Fork area on the Forest, 373 acres of mature red spruce, an additional 116 acres of mature red pine, and an estimated 300 acres of red spruce regeneration are intermixed within 6,268 acres of mixed spruce/northern hardwood forest ecological system. The current Forest Plan Revision (1993) identifies this area as the Laurel Fork Special Management Area and the Laurel Fork Roadless Area (USFS 1993), and management of the area has been in compliance with the guidelines of the VNFS Recovery Plan, as amended.

Disease. Several disease threats to the habitat of the VNFS have been documented at Laurel Fork. The hemlock woolly adelgid (*Adelges tsugae*) has caused serious death and decline of Eastern hemlock forests across the Forest (USFS 2011). Eastern hemlock was identified as a component of the spruce/northern hardwood system in Laurel Fork (Fleming and Moorhead 1996), but not a dominant overstory type in the area of Laurel Fork known to have VNFS populations. Because a predominately montane conifer component is still present, it is not anticipated that hemlock woolly adelgid would pose a serious threat to the habitat quality for VNFS, given the limited role of hemlock in flying squirrel survival (USFWS 2006 and 2008). Beech bark disease results from attack by the beech scale insect, *Cryptococcus fagisuga*; subsequent fungal infestations can either cause serious decline or mortality to mature trees (Cammermeyer 1993). Evidence of beech bark disease is present in Laurel Fork (Fleming and Moorhead 1996), resulting in scattered mortality of mature trees, but the beech component is still present in the spruce/northern hardwood community. Scattered mortality provides potential suitable cavities for VNFS (USFWS 2006 and 2008). Due to the limited amount of beech present in Laurel Fork, Beech bark disease is not considered to be a serious threat to the quality of habitat for VNFS in the life of proposed Forest Plan Revision.

Impacts from southern flying squirrel. The FWS Recovery Plan states VNFS can be threatened by competition for available den sites with the southern flying squirrel (*Glaucomys volans*) and by spread of a parasitic nematode (*Strongyloides*) from the southern to northern flying squirrel (USFWS 2001). Recently, however, the USFWS has documented that while co-occurrence of both species in areas of the VNFS range has been documented, available evidence indicates occurrence and potential severity of impacts due to sympatric existence appears limited (USFWS 2006 and 2008). One possible explanation could be the decline of available beech nuts by the spread of beech bark disease, an important food source for southern flying squirrels. With regards to parasitic infestations, research has hypothesized that the parasitic nematode (*Strongyloides*) is limited by below-freezing temperatures, such as occurs throughout the range of VNFS (Wetzel and Weigel 1994). Twenty years of capture data documenting VNFS with no signs of debilitating effects due to parasitic infestation appear to bolster this hypothesis (USFWS 2006 and 2008). Therefore, the USFWS has concluded the risk of competition with the southern flying squirrel does not threaten the continued existence of the VNFS (USFWS 2006 and 2008).

Acid precipitation and climate change. Since federal listing of VNFS, acid precipitation and climate change have been cited as factors in the decline of the spruce-fir ecosystem throughout the Appalachians. The negative effects of acid deposition on fir species have been well documented, though long-term effects to red spruce have not been as conclusive (USFWS 2006 and 2008). The long-term impacts of a rise of average high temperatures due to climate change could negatively affect the extent and quality of northern hardwood and spruce ecosystems, further reducing available habitat throughout the range of VNFS (Delcourt and Delcourt 1984).

Across the range of the VNFS, the Monongahela National Forest in West Virginia contains the majority of the estimated suitable 242,000 acres of suitable habitat (Menzel 2003; USFWS 2006 and 2008). The Laurel Fork area in the Forest, with an estimated 6,268 acres of suitable habitat, and representing approximately 3% of the available suitable habitat range-wide, borders the Monongahela National Forest, with two Monongahela NF Management Prescription 4.1 (Spruce and Spruce-hardwood Restoration) areas within 3 and 10 miles respectively of the Forest (USFS 2006). The Laurel Fork area is considered part of the larger Spruce Knob/Laurel Fork VNFS Recovery population cluster (Pocahontas, Randolph, Pendleton Counties, West Virginia, and Highland County, Virginia) and affords the best opportunity for connectivity of habitat and long term population gene flow for VNFS (USFWS 2006 and 2008). In Virginia, smaller areas of spruce/northern hardwood on private land adjacent to and in the vicinity of Laurel Fork, and have known VNFS populations, are under Conservation Easement through the Virginia Nature Conservancy (Marek Smith, TNC, pers. Comm. 2012). The current Forest Plan Revision (1993) identifies the Laurel Fork area as the Laurel Fork Special Management Area and the Laurel Fork Roadless Area (USFS 1993). Vegetation desired conditions and management have been performed in compliance with the guidelines of the VNFS Recovery Plan, as amended, (USFS 1993). Current spruce and northern hardwood systems in the Laurel Fork area are mature and will continue to age through the life of the proposed plan revision.

Several studies have attempted to determine whether this population is the Virginia or Carolina northern flying squirrel subspecies, or an intergrade between the two, with the most recent research indicating a likely genetically distinct population (Arbogast and Schumacher 2010; Fies and Pagels 1991; Reynolds et al. 1999; Sparks 2005). Until the genetic uncertainties are officially resolved, the USFWS recovery plan for Carolina flying squirrel includes this population for conservation and management purposes (USFWS The Whitetop and Mount Rogers areas containing northern flying squirrel habitat (approximately 6,000 acres) have been allocated to special areas in the Jefferson National Forest Land Management Plan Revision (management prescriptions 4.K.3. and 4.K.4.) (USFS 2004). Both of these special areas are classified as unsuitable for timber management and management is primarily focused on protecting and restoring the high elevation rare communities and species that inhabit this area (including the spruce-fir and northern hardwood forest and northern flying squirrel), managing forest visitor use, maintaining the outstanding vistas and natural scenery that led to designation of this area as a National Recreation Area. Key spruce-fir and northern hardwoods restoration areas have been identified in the Jefferson NF Revised Forest Plan to provide linkages to connect suitable habitat types for northern flying squirrels.

Habitat on the Forest currently occupied by the northern flying squirrel is protected and habitat and gene flow linkages are being restored through management prescriptions on the adjacent Monongahela National Forest, as well as Conservation Easements on adjacent and nearby private land. The northern flying squirrel population of uncertain genetic status at Mt. Rogers is also being protected through provisions in the Jefferson National Forest Revised Land Management Plan. These actions will provide suitable habitat, connectivity, and opportunities for gene flow over the life of the proposed Plan Revision and into the future. Therefore the cumulative effects of the proposed George Washington Revised Forest Plan will be beneficial to the VNFS.

Plan Components

Alternatives A, B, D, E, G, H and I identify the Laurel Fork Area as a Special Biological Area and as Remote Backcountry. The Laurel Fork Area is also a Potential Wilderness Area. VNFS Recovery Plan Guidelines will continue to be followed in habitat with known populations or the potential to have populations of VNFS. Objectives for the Spruce Forest and Northern Hardwood Ecological Systems are to maintain current acreage. In Alternatives B, D, E, G, H and I there is also an objective to re-establish about 1,300 acres of regenerating spruce across the planning period. Where non-native red pines were planted, red spruce should be restored. Forestwide standards for the Spruce Forest Ecological System are to maintain or restore the forest type.

Current spruce and northern hardwood systems in the Laurel Fork area are mature and will continue to age through the life of the proposed plan revision. Spruce regeneration is also present and will continue through mostly natural means throughout the proposed planning period, although active restoration may also occur. Habitat suitable for VNFS will continue to be available through the foreseeable future.

Alternatives B, D, E, G, H and I have strategies to help mitigate, as much as possible, potential effects of habitat quality and reduction of the spruce and northern hardwood ecosystem.

In Alternatives C and F the Laurel Fork area is recommended for Wilderness designation. Natural processes would continue in the area, but active restoration activities would not occur.

Under all alternatives, the Laurel Fork area is not available for gas leasing so would not be affected by the decision on lands available for leasing.

3.2.4 JAMES SPINYMUSSEL

Background

The James spinymussel was federally listed as endangered in 1988 (USDI Fish and Wildlife Service 1990). Historically, this species was apparently throughout the James River above Richmond, in the Rivanna River, and in ecologically suitable areas in all the major upstream tributaries (Clarke and Neves 1984). The species remained widespread through the mid-1960's, but now appears extirpated from 90% of the historic range. Since 1990, James spinymussel populations have been found in three tributaries to the Dan River in Virginia and North Carolina, which is outside of the species' range known at the time of listing.

This species is found in slow to moderate currents over stable sand and cobble substrates with or without boulders, pebbles, or silt (Clarke and Neves 1984). Hove and Neves (1994) found James spinymussels in 1.5 to 20 m wide second and third order streams at water depths of 0.3 to 2 m. Seven fish hosts, all in the family Cyprinidae, have been identified (Hove 1990): bluehead chub, rosyside dace, blacknose dace, mountain redbelly dace, rosefin shiner, satinfin shiner, and stoneroller. Freshwater mussels are filter feeders taking organic detritus, diatoms, phytoplankton, and zooplankton from the water column. The following excerpt from Hove and Neves (1994) states the current thinking on threats:

> "There are several anthropogenic and natural threats to the James spinymussel's continued existence. Nearly all the riparian lands bordering streams with the James spinymussel are privately owned. With more intensive use of the land, it is probable that water quality and habitat suitability will deteriorate. At

present, the most detrimental activities include road construction, cattle grazing, and feed lots that often introduce excessive silt and nutrients into the stream."

The introduced Asian clam is also considered to be a threat to the James spinymussel and is beginning to invade several sites (Hove and Neves 1994).

Occurrences of the James spinymussel near the Forest include Potts Creek, Craig Creek, Pedlar River, Cowpasture River, Bullpasture River, Mill Creek, and there are historic records from the James and Calfpasture Rivers. In the Craig Creek watershed, the species is stable due to population(s) in Johns, Dicks, and Little Oregon creeks (near the Jefferson National Forest). The species appears to be extirpated in Potts Creek or at such low numbers that detection is extremely difficult. In the Cowpasture River watershed, population status in the Cowpasture and Bullpasture is uncertain with the population in Mill Creek stable (see Table 4, Watson 2010).

Table F-4. Location and Status of James spinymussel populations in the James River Watershed

Watershed	Tributary	County/State	Status
James River	Bullpasture River	Highland/VA	Unknown
James River	Calfpasture River	Rockbridge/VA	Extirpated?
James River	Catawba Creek	Botetourt/VA	Extirpated?
James River	Cowpasture River	Bath & Alleghany/VA	Stable?
James River	Mill Creek	Bath/VA	Stable
James River	Craig Creek	Craig/VA	Declining
James River	Dicks Creek	Craig/VA	Stable to increasing
James River	James River mainstem	Various	Extirpated
James River	Johns Creek	Craig/VA	Stable
James River	Little Oregon Creek	Craig/VA	Stable to increasing
James River	Patterson Creek	Botetourt/VA	Extirpated?
James River	Pedlar River	Amherst/VA	Stable
James River	Potts Creek	Monroe/WV	Stable
James River	Potts Creek	Craig & Alleghany/VA	Extirpated?
James River	Upper Potts Creek	Monroe/WV	Stable?

Despite extensive searches, no occurrences of the spinymussel have been located on the Forest (Watson 2010). The 14 miles of potential habitat modeled for this species in the Ecological Sustainability Analysis assumes all of the river mileage is suitable substrate, which is not probable; in all of the watersheds with spinymussels near the Forest, the occurrences are all on private land. The James spinymussel does occur both upstream and downstream from the Forest. Current Forest management provides for water quantity and quality that contributes to the persistence of mussel populations. The main avenues for the Forest to aid in this species recovery are through land acquisition, assisting in augmentation efforts, and working with landowners to protect streams and streamside habitat. Several isolated reaches of habitat on the Forest could provide sites for augmentation if the substrate were suitable. Working cooperatively with State biologists, university experts, and the US Fish and Wildlife Service, the Forest developed a pro-active conservation plan for federally listed fish and mussels in 2004. The standards and guidelines in the plan are implemented in 6th level HUC watersheds that contain listed fish or mussel species. The following watersheds on the Forest are covered by the Federally Listed Mussel and Fish Conservation Plan.

Table F-5. Sixth Level HUC watersheds on the George Washington National Forest included in the Federally Listed Mussel and Fish Conservation Plan

6th Level HUC	Watershed Name
020802010403	Mill Branch-Potts Creek
020802010404	Cast Steel Run-Potts Creek
020802010405	Hays Creek-Potts Creek
020802010601	Wolfe Draft-Cowpasture River*
020802010602	Shaws Fork*
020802010603	Benson Run-Cowpasture River*
020802010701	Scotchtown Draft-Cowpasture River
020802010702	Dry Run*
020802010703	Thompson Creek-Cowpasture River*
020802010801	Mill Creek-Cowpasture River*
020802010803	Simpson Creek-Cowpasture River
020802011201	Rolands Run Branch-Craig Creek
020802011202	Barbours Creek*
020802011205	Roaring Run-Craig Creek
020802011302	Town Branch-Catawba Creek
020802020104	Hamilton Branch*
020802020105	Fridley Branch-Calfpasture River*
020802020106	Cabin Creek-Mill Creek
020802020108	Guys Run-Calfpasture River*
020802020506	Poague Run-Maury River*
020802030201	Lynchburg Reservoir-Pedlar River
020802030202	Browns Creek-Pedlar River
020802030203	Horsley Creek-Pedlar River

* No spinymussel occurrence in this watershed, but is found in downstream HUC(s)

Threats

The decline and extirpation of most populations of the James spinymussel may be attributed to habitat modification, sedimentation, eutrophication, and other forms of water quality degradation. Restricted movement of host fish may also be a factor in the decline of this species. For populations of the James spinymussel on or near the Forest, potential management influences include sedimentation, altered flow, and blockage of host fish passage associated with roads and crossings. Forestwide and riparian standards will protect the James spinymussel and its habitat from sediment released during management activities.

A cumulative effects analysis should consider incremental impacts of actions when added to past, present, and reasonably foreseeable future actions. Cumulative impacts can result from individually minor but collectively significant actions taking place over time. For this document, cumulative effects were analyzed through a two-part watershed analysis, which included resource assessment and management prescription (Reid 1998).

Throughout the planning process, the Forest evaluated watersheds using information including, but not limited to: Virginia Department of Environmental Quality 303d report for impaired waters; Virginia Department of Environmental Quality and Virginia Department of Conservation and Recreation 305b report on non-point source pollution; Virginia Department of Game and Inland Fisheries collection records; West Virginia Division of Natural Resources collection records and reports; local knowledge of forest recovery from past conditions; local knowledge of current watershed problems; macroinvertebrate, stream habitat, and water chemistry information; and geographic information system layers of land use, point source, road and mine locations. Through this resource assessment, the Forest evaluated cumulative watershed effects associated with land use practices at the 5th Hydrologic Unit Code (HUC) watershed level, and their effect on aquatic fauna and habitat.

Concurrently, the Forest carried out an interdisciplinary analysis looking at interactions between resources with a goal of managing riparian corridors to retain, restore, and /or enhance the inherent ecological processes and functions of the associated aquatic, riparian, and upland components within the corridor, while minimizing effects to aquatic and riparian resources from other activities. This was done through many meetings and discussions, which included not only multi-agency resource professionals, but members of the public as well. From this work, prescriptions, goals, objectives, and standards were developed in order to focus management on riparian, aquatic, and healthy watershed needs. They were designed to not only minimize adverse impacts to aquatic and riparian areas, but to maintain them as healthy, functioning systems.

Resulting from the careful development of prescriptions and standards, there should be beneficial effects on in-stream uses (including federally listed aquatic species) during the implementation of the proposed Forest Plan. These beneficial effects include, but are not limited to: watershed restoration activities, and road and recreation site maintenance, reconstruction, relocation, and/or closure/rehabilitation; control and management of livestock grazing will reduce sediment that is currently entering the stream system. Buffer zone filter strips will limit sediment produced by ground disturbing activities (including road construction, firelines, trails, livestock grazing, wildlife habitat improvements, prescribed and wildland fire, recreation development, and timber harvest) from entering a stream system. Management of streamside areas for riparian purposes and needs will increase large woody debris and shade. Stream crossings of roads and trails will allow the passage of desired aquatic organisms.

Any effects from management activities will be insignificant or discountable; therefore there will be no adverse direct or indirect watershed effects to the James spinymussel. Since it does not occur on the National Forest, the main avenues for the Forest to aid in this species recovery are through educating and working with landowners to protect streams and streamside habitat, and assisting efforts to identify additional suitable habitat and restore these species to historical habitats as appropriate. In some cases, acquisition of lands within the Forest's Proclamation Boundary may also be part of recovery actions.

Plan Components

The expansion of riparian areas in Alternatives B, C, D, E, F, G, H and I will manage all riparian areas in watersheds that support James spinymussel in line with the Forests' Federally Listed Mussel and Fish Conservation Plan. Instream flow needs will be quantified and maintained to protect aquatic organisms when new water use authorizations are proposed. Prior to the stocking of any non-native species, the Forest coordinates with the appropriate State agencies to ensure populations and habitats of native species are maintained.

The Forest will manage and protect extant populations and historical habitats of the James spinymussel. Protection and active management will be implemented where the species is physically on or historically occurred on Forest lands. Protection, monitoring, and augmentation will be the primary recovery objectives. Actions will be taken in order to identify additional suitable habitat and restore fish hosts and mussels to areas on Forest lands. Recovery objectives will include annual or bi-annual monitoring within Virginia of representative populations by qualified biologists for populations trend and habitat quality. Monitoring will include either search indices or transects depending on local conditions and mussel densities. Inventories of additional potential habitat will also be conducted.

3.2.5 MADISON CAVE ISOPOD

Background

The Madison Cave isopod was federally listed as a threatened species in 1982. It is an eyeless, unpigmented, freshwater crustacean, belonging to a family that consists of mostly marine species. It is the only free-swimming stygobitic isopod known in the Appalachians (Holsinger et al. 1994). With a maximum length of 0.7 inches, its body is flattened and bears seven pairs of long walking legs; the first pair are modified as grasping structures (USDI 1996).

The Madison Cave isopod is found in flooded limestone caves beneath the Shenandoah Valley in Virginia and West Virginia where it swims through calcite-saturated waters of deep karst aquifers. It is known from 19 caves and wells, spanning a range 150 miles long and less than 15 miles wide, stretching from Lexington, VA to Charles Town, WV (Hutchins et al. 2010). There are documented population centers in the Waynesboro-Grottoes area (Augusta County, VA), the Harrisonburg area (Rockingham County, VA), and the valley of the main stem of the Shenandoah River (Warren and Clarke counties, VA and Jefferson County, WV) (USDI 2009).

The population size of the Madison Cave isopod is unknown at most sites. Sampling results suggest that the population is dominated by adults. It is thought that the isopod has a lengthy life span and low rate of reproduction; it is unknown how this species reproduces. Feeding habits are unknown, but it is believed to be carnivorous (USDI 2009).

Recent genetic studies of the Madison Cave isopod indicate there are three genetically distinct clades corresponding to three geographic groups of sites. The groups are strongly correlated with the geographic pattern of carbonate rock outcropping in the Shenandoah Valley indicating potential barriers to subterranean hydrologic connectivity (Hutchins et al. 2010).

The Madison Cave isopod is not known from the Forest, the closest occurrence is approximately four miles straight line distance to Forest Service land. To date, all known collections of the Madison Cave isopod have come from caves and wells that tap into the karst aquifer(s) hosted by and formed in Cambro-Ordovician aged carbonate bedrock (limestone and dolostone) of the Great Valley province in Virginia and West Virginia. Orndorff and Hobson (2007) combined Great Valley outcrop areas of the following units from the 1993 Geologic Map of Virginia (VA-DMR, 1993) to create a map of potential habitat for Madison Cave isopods in Virginia: Shady Dolomite, Tomstown Dolomite, Elbrook Formation, Conococheague Formation, Upper Cambrian and Lower Ordovocian Formations (undivided), Beekmantown Group (including Stonehenge, Rockdale Run, and Pinesburg Station Formations), and the Edinburg/Lincolnshire/New Market association. The following additional formations have some minor carbonate units, and have a small potential to host the species: Waynesboro Formation, Pumpkin Valley Shale (including Rome Formation). Carbonate rocks in the base of the Martinsburg Formation, immediately adjacent to the Edinburg/Lincolnshire/New Market association, may also host the species, but are generally confined to an area within a few hundred feet of the contact.

Threats

The Madison Cave isopod appears to be long-lived and have low reproductive potential, suggesting that populations are highly sensitive to disturbance. As a subterranean aquatic obligate, potential threats include the loss and modification of habitat (including the surface environment that is their primary source of water and nutrients), groundwater contamination, and groundwater drawdown (USDI 1996). Agriculture and encroaching industrial and urban development threaten the quality and quantity of groundwater habitat and thus the survival of this species (USDI 2009).

To protect Madison Cave isopod habitat, the USDI Fish and Wildlife Service (2009) recommends avoiding chemical and fertilizer use where it could enter a waterway that supports the Madison Cave isopod, maintaining a buffer of natural vegetation along waterbodies and sinkholes to control erosion and reduce run-off, not disposing of waste or other material into sinkholes, fencing livestock out of streams, properly disposing of household wastes, including used motor oil, and properly maintaining septic tanks. Forest Service activities meet or exceed all of the above recommendations. Based on the limited amount and type of management proposed in the management prescriptions that intersect with potential Madison Cave isopod habitat, there will be no loss or modification of karst aquifer habitat, groundwater contamination, or groundwater drawdown from Forest Service activities; thus no effect to potential habitat.

The strategy on groundwater issues that cross national forest boundaries and are affected by multiple region-wide impacts such as increased agricultural use, growing urban development, is to focus on sustaining and improving watershed areas within national forest control while working cooperatively with other agencies and landowners to improve statewide watershed health.

The high probability potential Madison Cave isopod habitat identified by Orndorff and Hobson (2007) is 352,205 acres; the Forest Service portion of that is 280 acres, or 0.08%. The medium probability potential habitat is 513,215 acres, with the Forest Service owning 428 acres, or 0.08%.

The species range is the Shenandoah Valley in Virginia and West Virginia; it is mostly private land, where agriculture, urban and industrial development dominate the landscape. Because there will be no direct or indirect effects to Madison Cave isopod from Forest Service management activities, and only a fraction (less than a tenth of one percent) of potential habitat is on Forest Service land, any cumulative effects to the quality or quantity of Madison Cave isopod habitat will be from private land.

Plan Components

The potential habitat described above was divided into high, medium, and low probability of Madison Cave isopod occurrence by the Virginia Division of Natural Heritage (Orndorff and Hobson 2007). The high and medium likelihood potential habitat was intersected with Forest Service land boundaries to determine quantity and quality of potential habitat on National Forest. Only about 300 acres on National Forest System lands are in the high probability potential Madison Cave isopod habitat. About 400 acres are in the medium probability potential habitat. With no known populations on the GWNF and the very limited amount of land in potential habitat, none of the alternatives are expected to have any impact on this species.

The high probability potential habitat is within the Remote Backcountry Management Area Prescription (12D) along the western flank of Massanutten Mountain in all alternatives except Alternative C, where it is in Recommended Wilderness. The emphasis for this area is to provide recreation opportunities in large remote, core areas where users can obtain a degree of solitude and the environment can be maintained in a near-natural state. There is little evidence of humans or human activities other than recreation use and nonmotorized trails.

In Alternatives A, B, D, E, G, H and I the majority of the medium probability potential habitat is within the Pastoral Landscapes and Rangelands Management Area Prescription (7G), along the South Fork Shenandoah River; emphasis is on maintaining high quality, generally open landscapes with a pastoral landscape character. These lands are unsuitable for timber production but allow limited recreational facilities, that might include pullouts, small parking areas, trailheads, bulletin boards, interpretive signage, fence stiles, rail, and other fences, and low development trails. In Alternative C the majority of the medium probability potential habitat is in the Eligible Recreation River Corridor Management Area Prescription (2C3).

Based on the limited amount and type of management proposed in the Management Prescriptions of all of the alternatives that intersect with potential Madison Cave isopod habitat, there will be no loss or modification of karst aquifer habitat, groundwater contamination, or groundwater drawdown from Forest Service activities; thus no effect to potential habitat.

3.2.6 SHALE BARREN ROCK CRESS

Background

Unless otherwise noted, the information used in this analysis comes from NatureServe (accessed in 2012).

Shale barren rockcress was listed as endangered under the Endangered Species Act on August 8, 1989. It is an endemic of shale deposits, occurring only on sparsely-vegetated xeric, south or west-facing shale slopes (barrens) at elevations generally ranging from 1300 to 2600 feet. Populations are known from both the shale openings and shale woodlands adjacent to the shale openings. All extant occurrences are on shales of Devonian age (Ludwig pers. comm.); a single occurrence was known from the Martinsburg shale of Ordovician age, but it is no longer extant. This narrow endemic is known only from shale barren regions of Virginia and West Virginia and is one of the most restricted shale barren endemics. According to NatureServe, approximately 56 occurrences are believed extant, 34 in Virginia and 22 in West Virginia, of these, most are made up of fewer than 50 individuals; there are perhaps fewer than 4,000 plants altogether. Most occurrences are on public lands, predominantly National Forests.

Recovery tasks for the Forest identified in the shale barren rockcress Recovery Plan include: Implement and evaluate the monitoring program.

The following is from the Forest's Monitoring and Evaluation Report 2004:

> *"In 1993 there were 17 known occurrences of shale barren rockcress on the Forest. The Forest's focus since this species was listed has been to attempt to locate additional populations and further define its range on the Forest. From 1994 to 1998 agency personnel worked cooperatively with the Virginia Division of Natural Heritage and the USFWS to inventory shale barrens on the Forest (Belden, Ludwig, and Van Alstine 1999). The Virginia Division of Natural Heritage identified 809 potential shale barrens from aerial photographs. Of these, 188 were examined for rare species. The inventory resulted in 27 new occurrences of shale barren rockcress, bringing the total known sites on the Forest (in Virginia) to 42. This number does not include two sites where shale barren rockcress was known to occur recently, but could not be found in 1994. In 2004 the West Virginia Department of Natural Resources discovered a new population of shale barren rockcress at the Little Fork North Shale Barren."*

Currently on the Forest there are 26 Special Biological Areas (SBAs) in Virginia and 8 SBAs in West Virginia that support shale barren rockcress. These SBAs contain all of the known shale barren rockcress populations on the Forest. Within those sites the plants may be in more than one location. Depending on how one counts populations or subpopulations, there are about 75 occurrences of this species on the Forest. The *Arabis serotina* Recovery Task Force and the Shale Barren Protection Strategy Group devised a monitoring plan for shale barren rockcress in 1993. The plan calls for monitoring this species at several sites across its range by the WVDNR between 15 August and 5 September each year, and all other sites every five years. This protocol was followed from 1993 through 2001 in WV. In 2001, it was decided that, to limit the impact of repeatedly crossing the barrens, monitoring would be conducted biennially at the Little Fork and Brandywine shale barrens in Pendleton County, as opposed to every year. In 2011 the VDNH and the USFWS entered into an agreement to resurvey all sites on U.S. Forest Service (USFS) lands in Virginia to determine their persistence and to provide information needed to enable permanent protection measures to be taken by the USFS in cooperation with the Service.

Although adequate moisture is available for most plants within the substrata of the shale layers, adverse surface conditions act to restrict germination and establishment success of plants (Platt 1951). It is primarily the effect of high surface temperatures that limits plant reproductive success in these habitats. Surface soil temperatures are often well above the physiological tolerance of most plant species, reaching maximum temperatures of 63 degrees Celsius (Dix 1990). Such temperatures are high enough to cause direct damage to seedlings. For additional detailed information pertaining to the shale-barren community, see Dix (1990).

Recovery tasks for the Forest identified in the shale barren rock cress Recovery Plan include: implement and evaluate the monitoring program.

Recovery tasks for the Forest identified in the shale barren rockcress Recovery Plan include:

1. Implement and evaluate the monitoring program.

Threats

Threats include:

Construction of roads, railroads, and hiking trails has impacted occurrences in the past; several occurrences are now located adjacent to these corridors where they may be impacted by erosion or maintenance activities.

Flood control measures are a potential threat at some locations (e.g. South Fork Valley of West Virginia) (Bartgis in lit.); one barren has already been destroyed by a stream dam (Dix 1990).

Most extant occurrences are moderately to severely browsed by deer, which is considered by some to be a prime threat to the species (USFWS 1989); quantifying the impact of deer browsing is an area of active research (Ludwig pers. comm.).

Moderately xeric sites may be subject to encroachment of exotic plant species such as *Centauria biebersteinii* and numerous grasses (Dix 1990). Such encroachment is a particular concern for *Arabis serotina* since it does not tolerate competition well; it is generally restricted to the more open portions shale barren communities.

A significant threat to the insect pollinators of *A. serotina* is presented by the spraying of Dimilin and BT insecticides for gypsy moth control. Because of the open habitat, shale barren insects are maximally exposed to pesticides (Dix 1990). Dimilin is a broad-spectrum biocide that persists until leaf fall and up to a few years in the duff and would have a long-term impact of shale-barren slopes. All insect occurrences on shale barrens sprayed with Dimilin should be considered extirpated (Schweitzer in litt). BT is lepidopteran-specific and only persists for roughly one week (Dix 1990). Application during larval development may have devastating impacts on the fauna.

Finally, the very small number of individuals within many occurrences suggests that the long-term persistence of these occurrences is uncertain, especially considering that populations tend to fluctuate dramatically.

The term "shale barren" is a general reference to certain mid-Appalachian slopes that possess the following features: 1) southern exposures, 2) slopes of 20-70 degrees and 3) a covering of lithologically hard and weather-resistant shale or siltstone fragments (Dix 1990). These barrens support sparse, scrubby growth; frequently-observed species include *Quercus ilicifolia, Q. prinus, Q. rubra, Pinus virginiana, Juniperus virginiana, Prunus alleghaniensis, Rhus aromatica, Celtis tenuifolia, Kalmia latifolia, Bouteloua curtipendula, Andropogon scoparius, Phlox subulata var. brittonii, Silene caroliniana ssp. pensylvanica, Sedum telephoides, Antennaria spp., Aster spp*., and *Solidago spp.* (Dix 1990). Local variations in associated flora may be considerable (Braunschweig et al. 1999; Jarrett et al. 1996; Keener 1970; Keener 1983; Wieboldt 1987).

Although adequate moisture is available for most plants within the substrata of the shale layers, adverse surface conditions act to restrict germination and establishment success of plants (Platt 1951). It is primarily the effect of high surface temperatures that limits plant reproductive success in these habitats. Surface soil temperatures are often well above the physiological tolerance of most plant species, reaching maximum temperatures of 63 degrees Celsius (Dix 1990). Such temperatures are high enough to cause direct damage to seedlings. For additional detailed information pertaining to the shale-barren community, see Dix (1990).

Because of the highly stressful nature of shale barren environments, this species is not believed to be capable of tolerating much additional disturbance. Specific threats (NatureServe 2012) include:

1) Construction of roads, railroads, and hiking trails has impacted occurrences in the past; several occurrences are now located adjacent to these corridors where they may be impacted by erosion or maintenance activities.
2) Flood control measures are a potential threat at some locations (e.g. South Fork Valley of West Virginia) (Bartgis in litt.); one barren has already been destroyed by a stream dam (Dix 1990).
3) Most extant occurrences are moderately to severely browsed by deer, which is considered by some to be a prime threat to the species (USFWS 1989); quantifying the impact of deer browsing is an area of active research (Ludwig pers. comm. and WVDNR 2011).
4) Moderately xeric sites may be subject to encroachment of exotic plant species such as *Centauria maculata* and numerous grasses (Dix 1990). Such encroachment is a particular concern for *Arabis serotina* since it does not tolerate competition well; it is generally restricted to the more open portions shale barren communities.
5) A significant threat to the insect pollinators of *A. serotina* is presented by the spraying of Dimilin and BT insecticides for gypsy moth control. Because of the open habitat, shale barren insects are maximally exposed to pesticides (Dix 1990). Dimilin is a broad-spectrum biocide that persists until leaf fall and up to a few years in the duff and would have a long-term impact of shale-barren slopes. All insect occurrences on shale-barrens sprayed with Dimilin should be considered extirpated (Schweitzer in litt). BT is lepidopteran-specific and only persists for roughly one week (Dix 1990). Application during larval development may have devastating impacts on the lepidopteran fauna.
6) The very small number of individuals within many occurrences suggests that the long-term persistence of these occurrences is uncertain, especially considering that populations tend to fluctuate dramatically.
7) Fire suppression is a potential threat. In his draft report on the classification of West Virginia shale barrens, Vanderhorst (in Norris and Sullivan 2002) states:

   "A potential threat to shale barrens is succession, or woody encroachment. Although shale barrens are usually thought to be edaphicly [sic] maintained, it is possible that disturbance such as fire may have some role in maintaining the open physiognomy necessary for survival of shale barren endemics. Fire may be a factor in some shale barren community types and not in others. It is possible that the high cover by deciduous woody species in plots of this community type is due to fire suppression and that the quality of these barrens is declining. Fire is thought to have played a historical role in maintenance of white pine-mixed oak communities near shale barrens on the Greenbrier District of the Monongahela National Forest and in the absence of fire these communities appear to be succeeding towards dominance by more mesophytic species (Abrams et al. 1995). Research into the historical role of fire in maintaining shale barrens is needed to determine appropriate management of this rare community."

Fire

The specific role of fire in relation to shale barren rockcress is uncertain. No in-depth studies have been conducted about the direct or indirect effects of fire on this species; however, an increasing number of studies are showing the historical importance of fire in the Central Appalachians in shaping vegetation communities. Shale barren rockcress habitat is on extremely xeric south to southwest facing slopes in oak forests that are prone to wildfire. It would seem logical that fire would periodically burn through forest communities containing shale barren habitat and there is an increasing body of research that shows, until the early 1900s when fire suppression became universal, that fires occurred regularly on the Central Appalachian landscape. Abrams and others (1995) studied a forest that is transitional between the Ridge and Valley and Appalachian Plateau in Greenbrier County, WV. They concluded that without active management, including the use of prescribed fire, the present white pine-oak forest would transition to a more mesic maple-beech-hemlock forest. Lafon (2010) discusses the role of fire in table mountain pine-pitch pine stands. These pine types are found on dry ridgetops and south to west facing slopes often similar to areas supporting shale barrens. Dendroecological work shows these stands burned frequently in the past, with a regime of frequent surface fires at intervals of 2 to 10 years, and more severe burns at 50 to 100 years intervals. The surface fires maintained open understories needed by shade intolerant herbs and small shrubs. The more severe burns exposed mineral soil and created large canopy gaps enabling shade intolerant pine seedlings to become established. Lafon goes on to discuss the 'fire-oak' hypothesis which posits that many oak forests developed during many centuries of frequent burning. Fire benefits oaks by inhibiting fire sensitive tree species, which do not have oaks' protective bark, ability to compartmentalize fire damaged wood to prevent decay spread, extensive root systems, and strong sprouting ability. Aldrich and others (2010) studied fire chronology from 1704 to 2003 of trees on Mill Mountain in Bath County, VA on the Forest in an area where at least 10 *Arabis serotina* populations occur within 3.5 miles. They found a local fire return interval of about 5 years from the early 1700s until 1930 when fire suppression began. They also found that area-wide fires affecting multiple pine stands were common, recurring approximately every 16 years. The fires were frequent surface fires with occasional severe ones. In the Rough Mountain Wilderness, on the National Forest near the Mill Mountain study site, there were two lightning caused wildfires in 1999 alone (S. Croy pers. comm.). Aldrich and others (2010) conclude that "The greatest impact of industrial society is fire exclusion, which permitted hardwood establishment." There has been a trend since the initiation of widespread fire suppression of pine stands being overtaken by hardwoods in general, and of oak species being replaced by fire intolerant species such as red maple, white pine, tulip poplar, beech, and black gum (Groninger et al. 2005; Harrod and White 1999; Lafon and Grissino-Mayer 2005; Schuler and McLain 2003). It is possible that prescribed burning can halt and perhaps reverse this "mesophication" (Nowacki and Abrams 2008) of the forest.

Most shale barrens have little to no fuel loading so fire intensity, if any, would be expected to be low on the barren itself. Platt (1951) states fires are not a causal agent in shale barren formation. He goes on to say that "Fires in this region are quite rare and localized. Since shale barrens surfaces are bare and tree cover sparse, they usually escape even those fires which completely surround them. Careful examination of tree trunks gave no indication of fire scars." It could well be that Platt's observations are the result of the vigorous program of fire suppression. His comments about the fate of shale barrens in the event of fire are important. The lack of fuel loading would make fire spread nearly impossible in the shale barren environment. However, periodic fire might open and maintain habitat adjacent to the shale barren allowing shale barren rockcress populations to persist or expand. The LANDFIRE Biophysical Setting Model for Appalachian Shale Barrens states that "The absence or sparseness of fuel makes fire relatively unimportant on the barrens themselves, but is likely important in maintaining the adjacent pine and pine-oak dominated woodlands and limiting their encroachment along the barren-woodland edge. Likewise the "shale ridge bald" is maintained by edaphic conditions, but fire is likely important in limiting tree and shrub encroachment" (Croy and Smith 2009). Jarrett and others (1996) conducted an ecological study of shale barren rockcress on property managed by the U.S. Navy in West Virginia. In comparing their vegetation data with data collected ten years earlier they note that "(tree) canopies have closed somewhat at various West Virginia shale barrens, and that some shale barren endemics are no longer there." They suggest that controlled burning or periodic thinning of the canopy may be necessary to set back plant succession (see discussion of mesophication above). This view is echoed by the West Virginia Department of Natural Resources factsheet on shale barren rockcress (accessed online in 2012), "Some observations suggests [sic] that some shale barrens may not always remain barren and dry. Over time, it is possible for conditions there to change, and more trees may eventually grow on them. If more trees grow there, shale barren rockcress may not be able to survive." Several prescribed burns on the Forest in the past included shale barren rockcress habitat and plants.

Fire that burns immediately adjacent to shale barren rockcress plants might have a negative effect depending on the fire's intensity and duration. The higher the intensity and the longer the duration of fire exposure, the greater the effect and an individual plant may be killed. Fire may also have a beneficial effect as noted above. In the past, fire was considered to not be an important factor on shale barrens, especially if they are larger (larger buffer of the interior from fire) and/or steeper (less fuel build up on steep slopes). Since shale barren rockcress plants are usually more abundant in the more open parts of shale barrens, plants growing on smaller shale barrens would be more susceptible to encroachment by woody plants in the absence of fire, although all barrens could be affected to some extent. In addition to potentially enhancing seed germination, plant growth, and flowering and fruiting, fire could open the canopy on the periphery of shale barrens benefitting shale barren rockcress plants. Frequent low intensity fires would have a protective effect by lessening fuel loading in the vicinity of shale barrens and reducing fire intensity and duration. Observations have also shown that deer browse is lessened on rockcress plants when the areas around shale barrens have been burned. This is likely due to increased browse available as the result of coppice growth from top-killed trees and shrubs. This effect lasts for several years as coppicing continues and berry and nut production increases.

There are possible threats to shale barren communities from invasive native and exotic species, deer browsing, and mesophication.

Plan Components

All known locations of shale barren rock cress on the Forest in WV and VA are on land allocated to management prescription 4D, Special Biological Areas. Habitat for this species is stable on the Forest. There are possible threats to shale barren communities from invasive native and exotic species. Populations appear stable, but since they naturally tend to fluctuate greatly from year to year, this is uncertain. Potential habitat is being inventoried and continues to reveal new populations that will be protected. Management activities are having no effect on the habitat that contains the shale barren rock cress and thus are having no effect on the rock cress.

Overall, viability is being maintained through identification and protection of occurrences, however, viability is still of concern due to the naturally limited distribution of this species. Shale barren rock cress populations are expected to remain relatively stable in the near future.

The Forest encompasses several populations of the endemic shale barren rock cress that are in the core of its limited distribution in the Northern Ridge and Valley Section of the mid-Appalachians. This species is inherently rare and not well distributed across the Forest. Current management provides for ecological conditions capable to maintain the shale barren rock cress populations considering its limited distribution and abundance. Overall, ecological conditions are sufficient on the Forest to maintain viability (persistence over time) of populations on national forest land.

3.2.7 SMOOTH CONE FLOWER

Background

Unless otherwise noted, the information used in this analysis comes from NatureServe (accessed in 2010).

Smooth coneflower was listed as endangered under the Endangered Species Act on September 8, 1992. This species is known from about 100 occurrences, a majority of which are of fair to poor viability in several southeastern states. Most historically known populations were destroyed by development and habitat alteration, especially the suppression of fire, and a number of remaining populations are primarily in marginal locations, where they are vulnerable to urbanization, the use of herbicides, repeated mowing, and potentially, collection for the medicinal trade. Small remote populations may suffer from loss of habitat due to succession. The Recovery Plan for smooth coneflower does not have any recovery tasks specific to the Forest.

Formerly a plant of prairie-like habitats or oak-savannas maintained by natural or Native American-set fires as well as large herbivores (such as bison), it now primarily occurs in openings in woods, such as cedar barrens and clear cuts, along roadsides and utility line rights-of-way, and on dry limestone bluffs. It is usually found in areas with magnesium and calcium-rich soils and requires full or partial sun. Associated species include: *Juniperus virginiana* and *Eryngium yuccifolium*. Fire or some other suitable form of disturbance, such as well-timed mowing or the careful clearing of trees, is essential to maintaining the glade remnants upon which this species depends. Without such periodic disturbance, the habitat is overtaken by shrubs and trees [Endangered Spp. Tech. Bull. 17(1-2): 9-10].

Threats

Habitat loss and degradation due to habitat alteration affected 19 of 21 populations known in 1992 (USFWS 1992). Conversion of habitat to agriculture and/or silviculture, residential and industrial development, and highway maintenance (e.g., herbicides) has threatened this species in the past and may continue. Habitat loss and degradation as a result of prolonged fire suppression is also considered a major threat to the species' habitat. Commercial digging was not thought to be a problem as this practice is generally confined to Echinacea populations west of the Mississippi River. However, the Southern Appalachian Species Viability Project (2002) reported that this showy species with medicinal uses is occasionally harvested. Remaining populations appear to be small in numbers which may result in low genetic diversity.

Plan Components

All known locations of smooth coneflower on the Forest are on lands allocated to management prescription 4D, Special Biological Areas. There are currently two known populations of this species on the Forest. Both are in Alleghany County. One is a roadside occurrence that continues to be difficult to manage due to the steepness of the site and encroaching woody vegetation. This population is very small and may not be viable over the long term. The second population is more robust and occurs in an open woodland area. The site needs prescribed fire to maintain the open conditions this species requires.

3.2.8 VIRGINIA SNEEZEWEED

Background

Unless otherwise noted, the information used in this analysis comes from NatureServe (accessed in 2010).

Virginia sneezeweed was listed as threatened under the Endangered Species Act on November 3, 1998. A limited amount of habitat in two Virginia counties and six Missouri counties make up this species' entire global range. There are currently 61 documented occurrences, although 4 or fewer may not be extant, with the majority in Missouri as of 2006. The Virginia occurrences were located during extensive survey work from 1985 to 1995 in over 100 limestone sinkhole ponds along the western edge of the Blue Ridge Mountains, in the Shenandoah Valley of Virginia (USFWS 1998). The Virginia occurrences are restricted to small, discrete areas around sinkholes, and occupying, in total, less than 20 acres (8 ha). Missouri occurrences occupy ca. 11 acres within both discrete and less discrete wetland habitat. Seven Virginia occurrences are currently protected by being on National Forest land. Only 9 Missouri occurrences have some protection although it is not complete. Sites in both states are threatened by drainage and residential development.

The number of Virginia documented occurrences has been revised downward to 17 by using a 1 km separation distance between occurrences (J. Townsend, VA Dept. of Conservation and Recreation 2006 pers. comm.) These 17 occurrences had previously been recognized as 30 occurrences, with an occurrence at that time being equal to the plants within a discrete pond or wet meadow. It is expected that additional survey work will find more occurrences; some of these may be within the more disturbed farm pond type of habitat. In fact, a new, small population was found on the Forest in 2009 by VDNH cooperators (C. Ludwig pers. comm.). Based on what was known at the time the draft Recovery Plan was written in 2000 there were 4 sites where plants had not been seen over several years of surveys (U.S. Fish and Wildlife Service 2000).

The Draft Recovery Plan includes the Forest in the following recovery tasks:

- Seek permanent protection for known populations.
- Identify essential habitat.
- Identify sinkhole habitat adjacent to the National Forest lands, but within the proclamation boundary, to target for future acquisitions by the GWJNF.
- Conduct studies to characterize environmental parameters of the sinkhole ponds.
- Conduct studies to characterize the hydrologic regime at selected sinkhole ponds.
- Alleviate site specific threats as the need and opportunity arise.
- Develop a monitoring plan including standard monitoring methodologies.
- Implement the monitoring plan.
- Conduct surveys for additional populations in Virginia.
- Develop guidelines as to what constitutes a self-sustaining population.
- Maintain seed sources for the species.

On the Forest all known populations of Virginia sneezeweed are located in Augusta County except for a very small population that was located in 2009 between Glasgow and Buena Vista in Rockbridge County.

Threats

In Virginia the long-term viability of existing populations is primarily threatened by human-induced disruptions of hydrologic regimes, particularly by encroaching agriculture, residential land development, and logging (Van Alstine 1991; J. Knox, C. Williams pers. obs.). In addition, a private site and adjacent sites on the George Washington National Forest are sporadically impacted by off road vehicles (e.g., during summer 1991 on the private land; J. Knox, C. Williams, pers. obs.).

Exotic organisms may pose threats to H. virginicum populations in the near future. Purple loosestrife, *Lythrum salicaria*, is slowly spreading through Virginia and may eventually invade some *H. virginicum* sites, especially following disturbances to hydrologic regime and/or substrate. The gypsy moth, *Lymantria dispar*, is currently defoliating large areas of the George Washington National Forest and adjacent lands but it is unclear whether the gypsy moth will negatively impact *H. virginicum* populations. For example, as *H. virginicum* is shade-intolerant, defoliation of trees and shrubs that grow on the periphery of sinkholes may increase light availability and allow *H. virginicum* to expand into areas from which it was formerly excluded.

The following paragraphs are taken, with modifications, from U.S. Fish and Wildlife Service (2000):
The most serious threat to *H. virginicum* appears to be habitat loss, most often arising from changes in the natural hydrological regime of the sinkhole pond habitat. Four of the sites, three of which are grazed by cattle, have had a portion of the wetland deepened to create a permanent pond; prior to being excavated, much of this section once undoubtedly supported *H. virginicum* and so loss of some habitat has occurred. In contrast, actions have been taken at some of the Virginia sites to stop or lessen the periodic inundation. Significant ditches have been dug at two sites, with smaller ditching at three sites. Ditching and plowing occurred at one site in the past, and some evidence of the ditch remains, but does not significantly affect the hydrologic regime. Portions of the sites at 2 sites have been filled in. It is safe to assume that the pressure to control seasonal flooding will only increase, as the area of the Shenandoah Valley where the Virginia populations of *H. virginicum* are found is experiencing rapid growth, particularly in the building and expansion of residential subdivisions.

In addition to obvious hydrological alterations made directly to the sinkhole ponds, off-site actions may affect the hydrology of the ponds. Input from groundwater sources may be decreased by withdrawals for wells for adjacent developments such as subdivisions. Overland surface water flow may be altered by activities such as timber harvesting or road building in upslope areas. Little is known about the relative importance of groundwater vs. surface flow to the hydrological regime of the sinkhole ponds, but preliminary research suggests that the relative importance of these water sources is unique for each pond (E. Knapp, Washington and Lee University pers. comm.).

A variety of site-specific threats to *H. virginicum* from habitat loss have appeared over the last ten years. The Virginia Department of Transportation (VDOT) has proposed to widen to four lanes Route 340, a currently two lane north-south corridor on the east side of the Shenandoah Valley. A portion of one site in Augusta County is immediately east of Route 340. The Virginia Department of Conservation and Recreation's Division of Natural Heritage reviewed the proposal for this project in 1991 and recommended against any road widening to the east in the area of the pond and further recommended that VDOT consult with the U.S. Fish and Wildlife Service before any construction began. While the long range plans still include widening Rt. 340 to 4 lanes in this section, this project is not active; VDOT will coordinate with USFWS whenever the project becomes active (S. Stannard, VDOT pers. comm.)

Another *H. virginicum* population is near the site of silos built in the early 1990s that are used to store septic waste. This waste is eventually dumped on the ground elsewhere on this landowners' ridge-top property and not near the *H. virginicum* site. However, in a 1995 site visit by DCR-DNH a large pile of soil was present on the north side of the shallow basin that supports the *H. virginicum* population. The landowner was considering pushing the soil into the seasonally wet basin to level it out, but was agreeable to not do that. In a 1997 site visit the pile was still present and was larger than in 1995. In 1995 and 1997, it was noted that sediment from the pile had washed into the edge of the pond site, creating different soil conditions in that area and making it more favorable for weedy species (DCR-DNH database).

Mowing occurs in at least 3 of the Virginia sites. Continued mowing may provide beneficial effects to the species; a site that is one of the largest if not the largest and densest population, has been periodically mowed and bush-hogged by the landowner for an extended period of time. Repeated mowing before seed is set and the seed bank is replenished, may lead to local extinction as vegetative plants die out and the seed bank ultimately becomes depleted.

Herbivory does not appear to be a problem; however, the threat to *H. virginicum* from cattle grazing needs evaluation. Large populations of *H. virginicum* co-exist in three sites with cattle grazing. This suggests that the species may respond favorably to limited amounts of disturbance. Knox and others (1999) tested the hypothesis that H. virginicum is unpalatable to generalist herbivores in a common garden study; none of the H. virginicum plants were grazed by either vertebrate or invertebrate herbivores. Knox notes that this is consistent with reports of toxicity in other *Helenium* species associated with the presence of sesquiterpene lactones (Hesker 1982; Anderson et al. 1983; Anderson et al. 1986; Arnason et al. 1987). *Helenium virginicum* has been shown to contain a sesquiterpene lactone, virginolide (Herz and Santhanam 1967). According to J.S. Knox (pers. comm.), the leaves of *H. virginicum* are bitter-tasting; selective grazing by cattle of more palatable associated species therefore may eliminate plant competitors. However, other effects on *H. virginicum* from cattle grazing such as the increased nutrient loads, soil compaction, and trampling of plants are unknown. As the soils of the *H. virginicum* sites have been found to be nutrient-limiting (Knox 1997), long-term nutrient enrichment from cattle could ultimately create more favorable habitat for other plant species.

With federally listed wetland species, the federal permitting process carried out by the US Army Corps of Engineers (USACOE) under authority of the Clean Water Act of 1977, is often the point at which proposed actions can be reviewed in light of their effect on a federally listed species and protection actions can be recommended. The isolated and often small seasonally wet habitat of *Helenium virginicum*, however, does not currently have direct federal protection. United States vs. Wilson 133 F. 3d 251(4th Cir. 1997) ruled that the USACOE has no jurisdiction over isolated water bodies that have no surface connection with any tributary stream that flows into traditional navigable waters or interstate waters. Nationwide Permit 26, under federal wetlands regulations (56 CFR 59134-59147, Part 330-Nationwide Permit Program), which has applied to headwater areas and isolated wetlands, is currently being revised including a lower minimum acreage (1/10 acre); the Norfolk District of the USACOE is proposing a regional minimum threshold of 1/4 acre (E. Gilinsky, DEQ, pers. comm.). These lower minimum acreages, however, will not apply to the *Helenium virginicum* habitat if the ruling in U.S. vs. Wilson stands.

Currently, so-called Tulloch ditching, draining by ditching in which excavation occurs by mechanical means that do not require placing excavated material into a wetland and in which the material is lifted and hauled to an upland disposal site, does not require that USACOE be notified or a permit obtained. Major ditching has been used at three of the *H. virginicum* sites to control the seasonal flooding with more minor ditching used at another three sites.

As most of the populations of *H. virginicum* are on private lands, the current legal protections in place for this species will not be adequate to insure the long-term survival of *H. virginicum*. The effects of future regulation changes are not known.

Extremes in the fluctuating hydroperiod of the sinkhole ponds could, when preceded by low investment in the seed bank, result in the local extinction of populations. Extended drought at a site could make a site more favorable for colonization by other plants previously hampered by the periodic inundation of the site. This would include tree species, which could result in increased shading within the site and so reduce the areas favorable for *H. virginicum*. An extended period of inundation, coupled with development of a floating vegetation mat, such as occurred at one site (Knox 1997), could lead to local extinction if an insufficient seed bank existed to recover from the death of the vegetative plants. Either of these extremes in hydroperiod could result from normal variability in weather patterns or from larger scale climate changes, of either natural or human origin.

If found to hold true for other populations of *H. virginicum*, the self-incompatible breeding system of *H. virginicum* found in one of the populations may eventually lead to local extinction at sites with low population numbers as the chance of successful pollination decreases (Messmore and Knox 1997).

In Missouri threats include grazing and/or trampling of plants in the pasture sites and haying of the plants during the growing season. Herbicide or plant growth hormones used on roadside pose a threat to the roadside populations.

Plan Components

All known locations of Virginia sneezeweed on the Forest are on land allocated to 4D Special Biological Areas. These Special Biological Areas are managed specifically to restore and maintain conditions to benefit the community and/or rare species for which the area was established. There are still threats from illegal ATV use on this species.

3.2.9 SWAMP PINK

Background

Unless otherwise noted, the information used in this analysis comes from NatureServe (accessed in 2010).

Swamp pink was listed as a threatened species under the Endangered Species Act on September 9, 1988. *Helonias bullata* is known from the Coastal Plain of New Jersey, Delaware, Maryland, and Virginia (formerly also Staten Island, NY, where now extirpated), as well as from higher elevations in northern New Jersey, Virginia, North Carolina, South Carolina, and Georgia. Restricted to forested wetlands that are perennially water-saturated with a low frequency of inundation, habitat specificity appears to be a critical factor in this species' rarity. Approximately 225 occurrences are believed extant, over half of which are in New Jersey; 80 additional occurrences are considered historical and 15 are extirpated. The species is locally abundant at several sites in New Jersey, Delaware, Virginia, and North Carolina; some have 10,000+ clumps of plants. In addition to sites known to have been extirpated, significant habitat has been lost throughout the range due to factors such as drainage for agriculture. A number of local population declines have also been documented in the past 20 years. Degradation of this species' sensitive habitat via changes to the hydrologic regime is the primary threat. Such changes can be direct (ditching, damming, draining) or indirect (from development in the watershed); indirect impacts are particularly difficult to address. Other threats include poor water quality, invasive species, trash, all-terrain vehicles, deer herbivory, trampling, and collection. Given this species' very specific hydrological requirements, climate change could also be an issue. *H. bullata* has limited ability to colonize new sites (low incidence of flowering, limited seed dispersal, and poor seedling establishment) and low genetic variation, limiting its ability to adapt to changing conditions and recover when sites are destroyed.

Overall trends of local population declines and extirpations are beginning to emerge (USFWS 2007). The number of occurrences considered historic has increased from 79 to 97 since 1991, a loss of 18 sites (8 in NJ, 8 in DE, and 2 in NC) (USFWS 2007). More than 20 occurrences in New Jersey and Delaware alone have documented declines in population size or condition since the early 1990s (USFWS 2007). In New Jersey, the number of occurrences ranked A or B has decreased by 7 since 1991; comparing occurrence ranks from 1997 and 2004, 6 occurrences were upgraded while 20 were downgraded (USFWS 2007). Of the 27 occurrences discovered in Delaware between 1983 and 1999, 16 showed substantial declines in plant numbers during the most recent site visits (USFWS 2007).

Recovery tasks for Federal agencies in the swamp pink Recovery Plan include:

- Monitor threats to extant sites.
- Develop and maintain site-specific conservation plans.
- Enforce regulations protecting the species and its wetland habitat.
- Investigate population dynamics, using a standard method.
- Identify and, as needed, implement management techniques.

Threats

Habitat degradation is the primary range wide threat. This degradation is difficult to address through either land protection or regulatory mechanisms because it is often brought about by off-site land uses, particularly development. Evidence of detrimental effects of development on *H. bullata* habitat and population quality continues to accumulate; such impacts are anticipated to worsen as development continues (USFWS 2007). A major component of habitat degradation is changes to the hydrologic regime. Such changes can be direct (e.g., ditching, damming, draining) or indirect (i.e., from development in the watershed). Indirect impacts often result from increased impervious surface in the watershed, which reduces infiltration and increases overland flow of stormwater, leading to increased stream erosion, wetland sedimentation, flood volumes and velocities, water level fluctuations, and hydrologic drought (USFWS 2007). Other components of degradation associated with adjacent development include poor water quality, invasive exotic species, trash, all-terrain vehicles, herbivory by overabundant deer populations, trampling, and collection (USFWS 2007). Direct habitat losses have slowed, but historical losses were substantial (USFWS 2007). Because this species requires a very specific hydrology in order to thrive, climate change, which has the potential to either increase or decrease water levels at established sites, is an anticipated threat. For example, increased drought in southern Appalachians mountain bogs may already be having detrimental impacts. Also, about 10% of known occurrences are in areas with increased vulnerability to coastal flooding due to sea level rise (USFWS 2007).

The specific wetland habitat required by this species is easily degraded through both direct and secondary disturbances; among the wetland types it inhabits, some such as sphagnum bogs and Atlantic white cedar swamps are particularly fragile. A low incidence of flowering, limited seed dispersal, and poor seedling establishment combine to make colonization of new sites via reproduction from seed rare for this species (Godt et al. 1995; USFWS 2007). Finally, Godt and others (1995) found low overall genetic diversity both within the species and within populations, even relative to the means found for other endemic and narrowly distributed species. This suggests that *H. bullata* may have limited capacity to adapt to future environmental change.

Habitat specificity appears to be the critical factor in defining *H. bullata* as a rare species (USFWS 2007). Adapted to stable habitats with a number of specialized conditions (e.g., low light, limited nutrients, and saturated soils), this species appears to compete poorly when change in one or more habitat parameters creates an opportunity for the establishment of other species (USFWS 2007). Habitat availability may be a limiting factor across much of the range; Coastal Plain forested headwater wetlands have been significantly reduced by development, and mountain bogs are both historically uncommon and impacted by agricultural conversion (USFWS 2007). Nevertheless, the New Jersey Pine Barrens contain some apparently suitable but unoccupied sites, suggesting that this species' habitat requirements are not fully understood and/or that low dispersal limits colonization of these areas (USFWS 2007). Efforts to create or restore *H. bullata* habitat have had limited success (USFWS 2007).

Plan Components

All known occurrences of swamp pink are on land that will be allocated to 4D, Special Biological Areas, and/or 1A Designated Wilderness. These Special Biological Areas are managed specifically to restore and maintain conditions to benefit the community and/or rare species for which the area was established. Herbivory and shading may continue to be threats. Use of wildland fire may be a tool to reduce shading in some areas.

3.2.10 NORTHEASTERN BULRUSH

Background

Unless otherwise noted, the information used in this analysis comes from NatureServe (accessed in 2010).

Northeastern bulrush (*Scirpus ancistrochaetus*) was listed as endangered under the Endangered Species Act in 1991. Populations are known from MA, MD, NH, NY (presumed extirpated), PA, VA, VT, and WV. The habitat seems to vary geographically, although there are not enough sites to allow generalizations to be made. However, one does observe that in the south, sinkhole ponds are the most common habitat for the plant, and in the north, other kinds of wetlands, including beaver-influenced wetlands, provide suitable habitat. When this species was listed as endangered there were 33 known populations. As of 2007, there were about 113 extant occurrences known in the Appalachians from southern Vermont and New Hampshire to western Virginia, with most occurrences in Pennsylvania.

Most populations are in Pennsylvania (70) and Vermont (22) (USFWS 2008). The other populations are in Massachusetts (1), Maryland (1), New Hampshire (9), Virginia (7), and West Virginia (3) (USFWS 2008). There are about ten historical occurrences: New York (1), Pennsylvania (7), Virginia (1), Quebec (1). The plants are restricted to fairly specific wetland habitats that are infrequent, especially in the southern part of the range.

Various threats are associated with the habitat, including drainage and development, agricultural runoff, and any developments that could alter the local hydrology. Additional, unsurveyed habitat does exist, and more populations of this species may be found in the future if the potential habitats remain intact.

Long-term monitoring of known sites is needed before any conclusions can be drawn about the habitat needs of the plant, or about the stability of its populations in changing environments.

The implementation schedule for the northeastern bulrush recovery plan (USDI Fish and Wildlife Service 1993) includes five items that directly relate to Forest Service management:

Secure permanent protection for known populations;
Resurvey sites thought to have suitable habitat;
Verify, monitor, and protect any additional populations;
Identify potentially suitable habitat for additional surveys; and
Survey potential sites.

Throughout its range, northeastern bulrush is found in open, tall herb-dominated wetlands. Often it grows at the water's edge, or in a few centimeters of water, but it may also be in fairly deep water (0.3-0.9 m) or away from standing water. In the southern part of its range, the most common habitat is sinkhole ponds, usually in sandstone. Water levels in these ponds tend to vary both with the season and from year to year. At least one site (in Massachusetts) is in a sand plain, where water level fluctuates as well. Two sites in Vermont are influenced to some extent by beaver activity as well as other hydrological factors.

With the information available it is difficult to compare sites throughout the plant's range. For example, lists of associated species may represent an entire wetland or the immediate vicinity of the plant, but this is not always possible to determine from available information. Nevertheless, examination of field reports indicates that there is considerable variety in associated species. A few species, however, are common to several of the sites. These are *Dulichium arundinaceum, Scirpus cyperinus sens. lat., Glyceria canadensis*, and *Triadenum virginicum*.

Virginia. There are seven extant northeastern bulrush sites in Virginia, with two ranked as A/AB, two ranked B/BC, and one ranked E. The status of most of these sites is unknown because they have not been surveyed since the 1980s or 1990s. Habitat includes emergent ridgetop shallow ponds, shallow sinkhole depressions and mountainside bench ponds. Four sites are located on private land, three are on public land, and ownership of one site is undetermined. In Virginia, the northeastern bulrush is listed as State endangered; however, no additional protection (e.g., buffers) is afforded to wetlands supporting the species. No upland buffers are regulated or protected around any wetlands in the State. The northeastern bulrush is protected under the Endangered Plant and Insect Species Act of 1979, which prohibits take without a permit, but individual landowners are exempt from these permitting requirements.

West Virginia. There are three northeastern bulrush populations in West Virginia, two of which are ranked B, and one of which is ranked D. According to the U.Ss Fish and Wildlife Service 5-year status review for northeastern bulrush these occurrences were surveyed and last observed in 2005, however, known populations on Forest Service property have been resurveyed (Cipollini and Cipollini 2011) and monitored annually, either by Forest Service personnel or by the West Virginia Department of Natural Resources WVDNR. Habitat includes sinkhole ponds atop a low, flat sandstone ridge, and small seasonal ponds. Two of these sites are located on private lands, and one is located on National Forest land managed by the U.S. Forest Service (USFWS 2008).

The northeastern bulrush has no official status in West Virginia, and this State does not have an endangered species law. No upland buffers are required around any wetlands in the State.

Threats

Among the potential human threats are agricultural runoff, construction of logging and fire roads, development, all-terrain vehicle use, collection, and dredging. In addition to human activity, there may be natural threats to the species as well, although more information about the biology and ecology of the species is needed before these threats can be fully assessed. Among possible natural threats are deer, beaver (one Vermont population has suffered fluctuations, apparently as a result of beaver activity), natural water level fluctuations, fire (this may have damaged a population in Pennsylvania), and succession. Fluctuations in population size have been observed at several localities for the species. It is very likely that botanists visiting the known sites for the species do not identify vegetative plants, and it is possible that, in some cases, the fluctuations are in number of flowering/ fruiting culms rather than actual number of plants.

The 5-year review of northeastern bulrush by the USFWS stated that new information indicates that shading may be a threat, "Therefore, in some cases, it may be helpful to manage the habitat surrounding these sites by selectively removing larger trees to reduce canopy cover to increase light exposure" (USFWS 2008). The 5-year review also noted that alterations of the hydrology of wetlands supporting northeastern bulrush could have negative effects.

Exotic organisms may pose threats to northeastern bulrush populations in the near future. Purple loosestrife, *Lythrum salicaria*, is slowly spreading through Virginia and may eventually invade some northeastern bulrush sites, especially following disturbances to hydrologic regime and/or substrate. The gypsy moth (*Lymantria dispar*) is currently defoliating large areas of the Forest and adjacent lands but it is unclear whether if or how the gypsy moth will negatively impact northeastern bulrush populations.

Plan Components

The known occurrences of this species on the Forest are protected under all alternatives, except A (the 1993 Revised Forest Plan), as management prescription 4D - Special Biological Areas. These Special Biological Areas are managed specifically to restore and maintain conditions to benefit the community and/or rare species for which the area was established. Without regular monitoring and maintenance the cumulative impacts of the OHV trail that passes near the pond on Potts Mountain have the potential to negatively affect the pond and the northeastern bulrush through illegal OHV use (or through maintenance of the OHV road affecting the hydrology of the area. The Pond Run Pond site is very near the intersection of two trails that are used by hikers and horses. In the past there has been evidence of horses in the pond basin, although there has been no apparent negative impact to the Northeastern bulrush. In 2009 the U.S. Forest Service constructed a barbed wire fence that is keeping horses out of the pond. Shading has also been a concern at this site and over the past several years a slow process of girdling trees has been occurring that appears to have increased the number of flowering columns.

3.3 THREATENED AND ENDANGERED SPECIES SUMMARY OF PLAN COMPONENTS

Table F-6. T&E species, associated ecological systems, and plan component

Species	Ecosystem	Forest Plan Component
Indiana bat	Caves and Karstlands	Management Prescription Areas: designation of the primary and secondary Indiana bat cave areas Standards/Guidelines: standards for activities within the primary and secondary Indiana bat cave areas; standards for activities throughout the Forest in regard to leave trees during timber harvest activities Objectives: improvement of habitat through increased open woodlands
Virginia Big-Eared Bat	Caves and Karstlands	Standards: Forestwide cave standards
Virginia Northern Flying Squirrel	Spruce and Northern Hardwoods	Management Prescription Areas: All occupied habitat is in Special Biologic Areas
James Spinymussel	Floodplains, Wetlands and Riparian Areas	Standards: Riparian standards
Madison Cave Isopod	Caves and Karstlands	Not found on the Forest; Standards: Forestwide cave standards
Shale Barrens Rock Cress	Appalachian Shale Barrens	Management Prescription Areas: All known locations are in Special Biologic Areas
Smooth Cone Flower		Management Prescription Areas: All known locations are in Special Biologic Areas
Virginia Sneezeweed	Floodplains, Wetlands and Riparian Areas	Management Prescription Areas: All known locations are in Special Biologic Areas Standards: Riparian standards
Swamp Pink	Floodplains, Wetlands and Riparian Areas	Management Prescription Areas: All known locations are in Special Biologic Areas Standards: Riparian standards
Northeastern Bulrush	Floodplains, Wetlands and Riparian Areas	Management Prescription Areas All known locations are in Special Biologic Areas Standards: Riparian standards

4.0 OTHER SPECIES ADDRESSED

4.1 SPECIES LIST

Criteria for identifying other species to be addressed include the following:

- Species identified as proposed and candidate species under ESA
- Species ranked G-1, G-2 and G-3 on the NatureServe ranking system.
- Subspecific taxa ranked T-1, T-2 and T-3 on the NatureServe ranking system
- Species that have been petitioned for federal listing and for which a positive "90-day finding" has been made
- Species that have been recently delisted, including those delisted within the past five years and other delisted species for which regulatory agency monitoring is still considered necessary
- Species with ranks of S-1, S-2, N-1, or N-2 on the NatureServe ranking system[1]
- State-listed threatened and endangered species that do not meet other criteria
- Species identified as species of conservation concern in state comprehensive wildlife strategies for which habitat on the Forest is important
- Bird species on the U.S. Fish and Wildlife Service Birds of Conservation Concern National Bird Priority List
- Additional species that valid existing information indicates are of regional or local conservation concern due to factors that may include:
  - Significant threats to populations or habitat
  - Declining trends in populations or habitat
  - Rarity
  - Restricted ranges
- Southern Region regional forester's sensitive species
- Species that are hunted or fished
- Other species of public interest
- Invasive species may also be considered

The 282 species remaining for further consideration were screened to determine whether ecosystem diversity plan components fully covered their sustainability needs. If species habitat needs were not met solely through meeting the desired conditions of the ecological systems, additional direction was developed.

4.2 SPECIES GROUPS

The GWNF used species groups as an evaluation and analysis tool to improve planning efficiency and for development of management strategies. Species were grouped according to their habitat needs, limiting factors, threats, and specific habitat elements (snags, den trees, woody debris, etc.). Many species occurred in multiple groups.

Where possible, species groups were associated with ecological systems. Some groups are directly related to specific systems. Other groups may be more closely related to some ecological systems than others, but may be associated with multiple systems. Some groups may occur in any of the systems. The list of species groups and the ecosystem(s) with which they are associated are listed in Table F-7. Where multiple ecological systems are listed, the predominant system is listed first.

[1] The NatureServe ranking system is available at http://www.natureserve.org/.

Table F-7. Species group and Associated Ecological Systems

Species Group	Associated Ecological System(s)
Alkaline Glades and Barrens	Alkaline Glade and Woodlands and Mafic Glades and Barrens
Area Sensitive Grassland and Shrubland and Open Woodlands	Pine Forest and Woodlands, Oak Forests and Woodlands
Area Sensitive Grasslands	Oak Forests and Woodlands Floodplains, Wetlands and Riparian Areas
Area Sensitive Shrubland and Open Woodlands	Pine Forest and Woodlands, Oak Forests and Woodlands
Area Sensitive Late Successional Coniferous, Deciduous and/or Mixed Forests	Spruce Forest, Northern Hardwood Forest, Cove Forest, Oak Forests and Woodlands, Pine Forests and Woodlands, Floodplains Wetlands and Riparian Areas.
Calciphiles	Caves and Karstlands Alkaline Glade and Woodlands and Mafic Glades and Barrens All
Caves	Caves and Karstlands
Cavity Trees, Den Trees and Snags	Oak Forests and Woodlands All
Cliff and Talus and Large Rock Outcrops	Cliff, Talus and Shale Barrens
Cove Forests	Cove Forests
Fire Dependent and Fire Enhanced	Pine Forests and Woodlands, Alkaline Glade and Woodlands and Mafic Glades and Barrens Oak Forests and Woodlands
Grasslands	Oak Forests and Woodlands All
Hard and Soft Mast Dependent	Pine Forests and Woodlands, Oak Forests and Woodlands
High Elevation Coniferous, Deciduous and/or Mixed Forests	Northern Hardwood Forests Cove Forests Spruce Forests Pine Forests and Woodlands Oak Forests and Woodlands
High Elevation Openings, Grassy or Shrubby or Open Woodlands	Oak Forests and Woodlands Northern Hardwood Forests Cove Forests Spruce Forests Pine Forests and Woodlands
Late Successional Hardwood Dominated Forest	Oak Forests and Woodlands Cove Forests Floodplains, Wetlands and Riparian Areas Northern Hardwood Forests
Lepidopterans	Oak Forests and Woodlands All
Mafic Rocks	Alkaline Glade and Woodlands and Mafic Glades and Barrens
Occurrence Protection	Oak Forests and Woodlands All
Open Woodlands	Oak Forests and Woodlands Alkaline Glade and Woodlands and Mafic Glades and Barrens Cliff, Talus and Shale Barrens Pine Forests and Woodlands
Regenerating Forests	Oak Forests and Woodlands All
Riparian	Floodplains, Wetlands and Riparian Areas

Species Group	Associated Ecological System(s)
Ruderal	Any
Sandstone Glades and Barrens	Any
Sensitive to Over-Collection	All
Sensitive to Recreation Traffic	Any
Shale Barrens	Cliff, Talus and Shale Barrens
Shrublands	Oak Forests and Woodlands All
Species in a Special Biologic Area	All

Since species may be associated with many species groups a description of the level of association is included in each of the following tables that list the species in each group. The levels are defined as follows:

Group Weight	Group Weight Description
Very High	All or nearly all of the species' needs are covered by needs of this group
High	A high proportion of the species' needs are covered by the needs of this group
Moderate	A moderate proportion of the species' needs are covered by the needs of this group
Low	A low proportion of the species' needs are covered by the needs of this group

4.2.1 Alkaline Glade and Barren Associates

These species are associated with alkaline glades and barrens. Their habitat needs are tied directly to the Mafic Glade and Barrens and Alkaline Glades and Woodlands ecological system. Maintaining those ecological systems and moving them towards their desired condition will satisfy the needs of the species in this group related to this habitat need.

Species in Alkaline Glad and Barren Associates Group

Species Name	Common Name	Group Weight
Houstonia canadensis	Canada bluets	High
Ruellia purshiana	Pursh's wild petunia	High

4.2.2 Calciphile Associates

These species generally require basic soils (pH greater than seven) in areas underlain by carbonate bedrock. They are often associated with the Cave and Karstland ecological systems, but can be found in other areas where the bedrock geology and soil conditions present the appropriate conditions. Additional measures beyond those identified for the ecological system are needed to assure that the habitat needs for these species are addressed.

Species in Calciphine Associates Group

Species Name	Common Name	Group Weight
Campanula rotundifolia	American harebell	High
Delphinium exaltatum	tall larkspur	High

Species Name	Common Name	Group Weight
Desmodium cuspidatum	toothed tick-trefoil	High
Echinacea laevigata	smooth coneflower	High
Euphorbia purpurea	glade spurge	Moderate
Glyphyalinia raderi	Maryland glyph	High
Helicodiscus diadema	Shaggy coil	High
Helicodiscus triodus	Talus coil	High
Houstonia canadensis	Canada bluets	High
Juniperus communis var depressa	ground juniper	Moderate
Linum lewisii	prairie flax	High
Linum sulcatum	grooved yellow flax	High
Melica nitens	Three-flowered melic grass	High
Nampabius turbator	Cave centipede	High
Oligoneuron rigidum	stiff goldenrod	High
Onosmodium virginianum	Virginia false-gromwell	High
Paronychia virginica	yellow nailwort	High
Paxistima canbyi	Canby's mountain lover	High
Phlox amplifolia	Broadleaf phlox	High
Pseudanophthalmus avernus	Avernus cave beetle	High
Pseudanophthalmus intersectus	Crossroads cave beetle	High
Pseudanophthalmus nelsoni	Nelson's cave beetle	High
Pseudanophthalmus petrunkevitchi	Petrunkevitch's cave beetle	High
Pseudotremia princeps	South Branch Valley cave millipede	High
Pycnanthemum torreyi	Torrey's mountain-mint	High
Pygmarrhopalites carolynae	Cave springtail	High
Pygmarrhopalites sacer	Cave springtail	High
Rosa setigera	prairie rose	Moderate
Ruellia purshiana	Pursh's wild petunia	High
Scutellaria parvula var. parvula	small skullcap	High
Sporobolus neglectus	small dropseed	High
Stygobromus gracilipes	Shenandoah Valley cave amphipod	High
Stygobromus hoffmani	Alleghany County cave amphipod	High
Stygobromus morrisoni	Morrison's cave amphipod	High
Stygobromus mundus	Bath County cave amphipod	High
Stygobromus sp. 7	Sherando spinosid amphipod	High
Stygobromus sp. nov.	Massanutten Spring Amphipod	High
Symphoricarpos albus	snowberry	High
Thuja occidentalis	northern white cedar	High
Zigadenus elegans ssp. glaucus = Anticlea glauca	white camas	Moderate

Species Name	Common Name	Group Weight
Zygonopus weyeriensis	Grand Caverns blind cave millipede	High
Zygonopus whitei	Luray Caverns blind cave millipede	High

4.2.3 Cave Associates

These species live in caves. Temperature, humidity, water flow, water quality and level of human disturbance are all important components of the cave habitat. The habitat needs of the species in this group are tied directly to the Cave and Karstland ecological system. Maintaining these ecological systems and moving them towards their desired condition will satisfy the needs of the species in this group related to this habitat need.

Species in Cave Associates Group

Species Name	Common Name	Group Weight
Apochthonius holsingeri	A cave pseudoscorpion	Very High
Corynorhinus townsendii virginianus	Virginia big-eared bat	Very High
Kleptochthonius anophthalmus	A cave pseudoscorpion	Very High
Miktoniscus racovitzai	Racovitza's terrestrial cave isopod	Very High
Myotis leibii	eastern small-footed bat	Very High
Myotis sodalis	Indiana bat	Very High
Nampabius turbator	Cave centipede	Very High
Neotoma magister	Alleghany woodrat	Moderate
Pseudanophthalmus avernus	Avernus cave beetle	Very High
Pseudanophthalmus intersectus	Crossroads cave beetle	Very High
Pseudanophthalmus nelsoni	Nelson's cave beetle	Very High
Pseudanophthalmus petrunkevitchi	Petrunkevitch's cave beetle	Very High
Pseudognaphalium macounii	Winged cudweed	Very High
Pseudotremia princeps	South Branch Valley cave millipede	Very High
Pygmarrhopalites carolynae	Cave springtail	Very High
Pygmarrhopalites sacer	Cave springtail	Very High
Pygmarrhopalites caedus	A cave springtail	Very High
Stygobromus gracilipes	Shenandoah Valley cave amphipod	Very High
Stygobromus hoffmani	Alleghany County cave amphipod	Very High
Stygobromus morrisoni	Morrison's cave amphipod	Very High
Stygobromus mundus	Bath County cave amphipod	Very High
Stygobromus sp. 7	Sherando spinosid amphipod	Very High
Stygobromus sp. nov.	Massanutten Spring Amphipod	Very High
Zygonopus weyeriensis	Grand Caverns blind cave millipede	Very High
Zygonopus whitei	Luray Caverns blind cave millipede	Very High

4.2.4 Cavity Tree, Den Tree and Snag Associates

Cavity and den trees are live or dead trees with openings or broken out tops that provide habitat for reproduction, shelter, and/or hibernation. Snags are dead trees or live trees with dead limbs or tops that provide sloughing bark, perches, and food sources for a variety of animals. This habitat and these species can be found throughout the GWNF. Additional measures beyond those identified for the ecological systems are needed to assure that the habitat needs for these species are addressed.

Species in Cavity Tree, Den Tree and Snag Associates Group

Species Name	Common Name	Group Weight
Aegolius acadicus	northern saw-whet owl	High
Certhia americana	brown creeper	Very High
Contopus borealis	olive-sided flycatcher	High
Myotis sodalis	Indiana bat	High
Sciurus carolinensis	gray squirrel	High
Sciurus niger	Eastern fox squirrel	High
Sitta canadensis	red-breasted nuthatch	High
Sphyrapicus varius	yellow-bellied sapsucker	High
Thryomanes bewickii altus	Appalachian Bewick's wren	High
Troglodytes troglodytes	winter wren	Moderate
Tyto alba	barn owl	High
Ursus americanus	black bear	High

4.2.5 Cliff, Talus and Large Rock Outcrop Associates

These species are dependent on cliffs, the talus slopes below cliffs, other talus slopes and large rock outcrops. The rock substrate is the key component and type of rock can be important to some species. The habitat needs of the species in this group are tied directly to the Cliff, Talus and Shale Barrens ecological system. Maintaining these ecological systems and moving them towards their desired condition will satisfy the needs of the species in this group related to this habitat need. There are smaller cliffs and talus areas that are not readily recognized and large rock outcrops can be found throughout many other ecological systems. Therefore, additional measures beyond those identified for the ecological systems are needed to assure that the habitat needs for these species are addressed.

Species in Cliff, Talus and Large Rock Outcrop Associates Group

Species Name	Common Name	Group Weight
Aralia hispida	bristly sarsaparilla	High
Betula cordifolia	mountain paper birch	Very High
Campanula rotundifolia	American harebell	High
Cheilanthes eatonii	chestnut lipfern	Very High
Crotalus horridus	Timber rattlesnake	Very High
Cuscuta coryli	hazel dodder	Very High
Cystopteris fragilis	fragile fern	Very High
Falco peregrinus	peregrine falcon	Very High

Species Name	Common Name	Group Weight
Geranium robertianum	herb-robert	High
Helianthemum bicknellii	plains frostweed	High
Linum lewisii	prairie flax	High
Linum sulcatum	grooved yellow flax	High
Minuartia groenlandica	mountain sandwort	Very High
Myotis leibii	eastern small-footed bat	Very High
Neotoma magister	Alleghany woodrat	High
Paronychia virginica	yellow nailwort	High
Paxistima canbyi	Canby's mountain lover	High
Plethodon punctatus	Cow Knob salamander	Moderate
Plethodon virginia	Shenandoah Mt. salamander	Moderate
Scutellaria parvula var. parvula	small skullcap	High
Scutellaria saxatilis	Rock skullcap	Moderate
Sibbaldiopsis tridentata	three-toothed cinquefoil	Very High
Spilogale putorius	Spotted Skunk	High
Sporobolus neglectus	small dropseed	High
Symphoricarpos albus	snowberry	High
Thuja occidentalis	northern white cedar	High
Zigadenus elegans ssp. glaucus = Anticlea glauca	white camas	High

4.2.6 Cove Forest Associates

These species are known to be associated with cove forests. The habitat needs of the species in this group are tied directly to the Cove Forest ecological system. Maintaining these ecological systems and moving them towards their desired condition will satisfy the needs of the species in this group related to this habitat need.

Species in Cove Forest Associates Group

Species Name	Common Name	Group Weight
Leucothoe fontanesiana	highland dog-hobble	High
Panax quinquefolius	Ginseng	High
Panax trifolius	Dwarf ginseng	High

4.2.7 Fire Dependent and Fire Enhanced Associates

These species are generally associated with open woodland conditions that require frequent fires.

These species range from those generally dependent upon fire (weighted very high) to those that are not dependent upon fire, but whose habitat is enhanced through frequent fires. This habitat type is found in the ecological systems where fire is an active component of the disturbance regime. The habitat needs of the species in this group are tied directly to the Pine Forests and Woodlands, Alkaline Glade and Woodlands, Mafic Glades and Barrens, and Oak Forests and Woodlands ecological systems. Maintaining these ecological systems and moving them towards their desired condition will satisfy the needs of the species in this group related to this habitat need.

Species in Fire Dependent and Fire Enhanced Associates Group

Species Name	Common Name	Group Weight
Anaphalis margaritacea	pearly everlasting	High
Arabis serotina	shale barren rockcress	High
Aralia hispida	bristly sarsaparilla	Very High
Arnoglossom muehlenbergii	great Indian-plantain	Moderate
Bartramia longicauda	upland sandpiper	Moderate
Betula cordifolia	mountain paper birch	High
Bonasa umbellus	ruffed grouse	Moderate
Bromus kalmii	wild chess	High
Buckleya distichophylla	Piratebush	Very High
Callophrys irus	Frosted elfin	High
Caprimulgus carolinensis	chuck-will's widow	High
Caprimulgus vociferus	whip-poor-will	Moderate
Carex polymorpha	variable sedge	Very High
Colinus virginianus	northern bobwhite	Moderate
Crataegus pruinosa	prunose hawthorn	Moderate
Delphinium exaltatum	tall larkspur	High
Dendroica discolor	prairie warbler	Moderate
Echinacea laevigata	smooth coneflower	High
Elymus trachycaulus	slender wheatgrass	High
Erynnis martialis	Mottled duskywing	High
Gaylussacia brachycera	box huckleberry	Very High
Liochlorophis vernalis	Smooth green snake	High
Meleagris gallopavo	wild turkey	Moderate
Odocoileus virginianus	white-tailed deer	Moderate
Onosmodium virginianum	Virginia false-gromwell	Moderate
Oporornis philadelphia	mourning warbler	High
Phlox buckleyi	sword-leaved phlox	High
Pituophis melanoleucus	northern pinesnake	High
Prunus alleghaniensis	Alleghany sloe	High
Pyrgus wyandot	Appalachian grizzled skipper	High
Ruellia purshiana	Pursh's wild petunia	Moderate
Sciurus niger	Eastern fox squirrel	Moderate
Vermivora chrysoptera	golden winged warbler	High

4.2.8 Hard and Soft Mast Associates

These species need a mixture of both hard and soft mast as food. The habitat associated with these species can be found in other ecological systems, but is most common in the oak forests and woodlands. Maintaining the Oak Forest and Woodland ecological systems and moving them towards their desired condition will satisfy most of the needs of the species in this group related to this habitat need. The one additional need is to maintain existing shrubland areas.

Species in Hard and Soft Mast Associates Group

Species Name	Common Name	Group Weight
Bonasa umbellus	ruffed grouse	High
Meleagris gallopavo	wild turkey	High
Odocoileus virginianus	white-tailed deer	High
Sciurus carolinensis	gray squirrel	High
Sciurus niger	Eastern fox squirrel	High
Ursus americanus	black bear	High

4.2.9 High Elevation Coniferous, Deciduous and/or Mixed Forest Associates

These species are generally found at high elevation (>3,000 feet) in forested environments. The habitat associated with these species can be found throughout the ecological systems, but is confined to the high elevations. The habitat needs of the species in this group are tied directly to the Spruce Forest and Northern Hardwood ecological systems. Additional measures are needed to assure that the high elevation Oak Forests and Woodlands and the Pine Forests and Woodlands that are at high elevation will also be maintained. Maintaining these ecological systems, implementing additional measures, and moving them towards their desired condition will satisfy the needs of the species in this group related to this habitat need.

Species in High Elevation Coniferous, Deciduous and/or Mixed Forest Associates Group

Species Name	Common Name	Group Weight
Aegolius acadicus	northern saw-whet owl	High
Carpodacus purpureus	purple finch	High
Catharus guttatus	hermit thrush	High
Certhia americana	brown creeper	High
Coccyzus erythropthalmus	black-billed cuckoo	High
Contopus borealis	olive-sided flycatcher	High
Cornus canadensis	bunchberry	High
Dendroica fusca	blackburnian warbler	High
Dendroica magnolia	magnolia warbler	High
Empidonax alnorum	alder flycatcher	High
Glaucomys sabrinus fuscus	Virginia northern flying squirrel	Very High
Gymnocarpium appalachianum	Appalachian oak fern	Very High
Heuchera alba	white alumroot	Very High
Huperzia appalachiana	Appalachian fir clubmoss	High
Hypericum mitchellianum	Blue Ridge St. John's-wort	High
Lepus americanus	snowshoe hare	High
Lonicera canadensis	American fly-honeysuckle	Very High
Loxia curvirostra	red crossbill	Very High
Martes pennanti	fisher	Very High
Microtus chrotorrhinus carolinensis	Southern rock vole	High
Oporornis philadelphia	mourning warbler	High

Species Name	Common Name	Group Weight
Plethodon punctatus	Cow Knob salamander	Very High
Plethodon virginia	Shenandoah Mt. salamander	High
Pyrola elliptica	shinleaf	High
Regulus satrapa	golden-crowned kinglet	Very High
Schizachne purpurascens	purple oat-grass	High
Seiurus noveboracensis	northern waterthrush	High
Sitta canadensis	red-breasted nuthatch	High
Sorex palustris punctulatus	southern water shrew	High
Sphyrapicus varius	yellow-bellied sapsucker	High
Sylvilagus obscurus	Appalachian Cottontail	Very High
Trillium pusillum var. virginianum	mountain least trillium	High
Troglodytes troglodytes	winter wren	Very High

4.2.10 Late Successional Hardwood Dominated Forest Associates

These species are associated with late successional systems usually dominated by hardwoods. These areas have developing or well-developed canopy gap dynamics, large woody material on the ground, and den and cavity trees. The habitat needs of the species in this group are tied directly to the Northern Hardwood, Cove Forest, and Oak Forest and Woodlands ecological systems. Maintaining these ecological systems and moving them towards their desired condition will satisfy the needs of the species in this group related to this habitat need.

Species in Late Successional Hardwood Dominated Forest Associates Group

Species Name	Common Name	Group Weight
Ambystoma tigrinum	Eastern tiger salamander	High
Bonasa umbellus	ruffed grouse	High
Dendroica cerulea	cerulean warbler	High
Glyptemys insculpta	wood turtle	Moderate
Meleagris gallopavo	wild turkey	High
Neotoma magister	Alleghany woodrat	Moderate
Odocoileus virginianus	white-tailed deer	High
Plethodon punctatus	Cow Knob salamander	Moderate
Plethodon virginia	Shenandoah Mt. salamander	Moderate
Sciurus carolinensis	gray squirrel	High
Semionellus placidus	Millipede	High
Spilogale putorius	Spotted Skunk	Moderate
Ursus americanus	black bear	High

4.2.11 Area Sensitive Mature Coniferous, Deciduous, and/or Mixed Forest Associates

These are species requiring large blocks (generally 500 acres or greater) of mature successional forest systems. These areas have developing or well-developed canopy structural dynamics, large woody material on the ground, and den and cavity trees. The habitat needs of the species in this group are tied directly to the Spruce, Northern Hardwood, Pine Forests and Woodlands, Oak Forest and Woodlands, Cover Forest, and Wetlands and Riparian ecological systems. Maintaining these ecological systems and moving them towards their desired condition will satisfy the needs of the species in this group related to this habitat need.

Species in Area Sensitive Mature Coniferous, Deciduous and/or Mixed Forest Associates Group

Species Name	Common Name	Group Weight
Aegolius acadicus	northern saw-whet owl	High
Aquila chrysaetos	golden eagle	Very High
Catharus guttatus	hermit thrush	High
Certhia americana	brown creeper	High
Corynorhinus townsendii virginianus	Virginia big-eared bat	High
Dendroica cerulea	cerulean warbler	High
Dendroica fusca	blackburnian warbler	Moderate
Empidonax virescens	acadian flycatcher	Moderate
Glaucomys sabrinus fuscus	Virginia northern flying squirrel	High
Loxia curvirostra	red crossbill	Moderate
Martes pennanti	fisher	Very High
Myotis sodalis	Indiana bat	Very High
Plethodon punctatus	Cow Knob salamander	High
Plethodon virginia	Shenandoah Mt. salamander	High
Seiurus noveboracensis	northern waterthrush	High
Ursus americanus	black bear	Very High

4.2.12 Lepidopterans

These are lepidopterans that are either sensitive to fire injury (due to their limited distribution) or to treatment of gypsy moths with insecticides like Bt or Dimilin. Many of these species rely on host plants that occur in open conditions, so fire is an important aspect of maintaining their habitat. However, since at least one of their life stages is always present in the area, care must be taken in planning prescribed burns. These species and habitats could be found in many ecological systems. Additional measures beyond those identified for the ecological systems are needed to assure that the habitat needs for these species are addressed.

Species in Lepidopterans Group

Species Name	Common Name	Group Weight
Autochton cellus	Golden-banded skipper	High
Boloria selene	Silver-bordered fritillary	Very High
Callophrys irus	Frosted elfin	Very High
Catocala herodias gerhardi	Herodias underwing	Very High
Catocala marmorata	Marbled underwing	Very High
Colias interior	Pink-edged sulphur	Very High

Species Name	Common Name	Group Weight
Erora laeta	Early hairstreak	Very High
Erynnis martialis	Mottled duskywing	Very High
Erynnis persius	Persius duskywing	Very High
Euchloe olympia	Olympia marble	Very High
Incisalia polia	Hoary elfin	Very High
Phyciodes batesii	Tawny crescent	Very High
Phyciodes cocyta	Northern crescent	Very High
Polygonia progne	Gray comma	Very High
Pyrgus wyandot	Appalachian grizzled skipper	Very High
Satyrium favonius ontario	Northern Hairstreak	Very High
Speyeria atlantis	Atlantis fritillary	Very High
Speyeria diana	Diana fritillary	Very High
Speyeria idalia	Regal fritillary	Very High

4.2.13 Mafic Rock Associates

These species are associated with mafic rock substrates and often with seepage areas. The habitat needs of the species in this group are tied directly to the Mafic Glades and Barrens ecological system. Maintaining these ecological systems and moving them towards their desired condition will satisfy the needs of the species in this group related to this habitat need.

Species in Mafic Rock Associates Group

Species Name	Common Name	Group Weight
Clematis occidentalis	purple clematis	High
Muhlenbergia glomerata	marsh muhly	High
Poa saltuensis	drooping bluegrass	High
Potentilla arguta	tall cinquefoil	Very High
Pycnanthemum torreyi	Torrey's mountain-mint	High
Ruellia purshiana	Pursh's wild petunia	High
Solidago randii = S. simplex var. randii	Rand's goldenrod	Very High

4.2.14 Species Needing Occurrence Protection

Species in this group are rare in occurrence on the GWNF although habitat is widespread. Habitat assessments cannot accurately predict the presence of these species. Most of these species occur in less than 5 populations on the Forest and are sensitive to management actions. Those species which have more than 5 known occurrences represent populations which are critical to the survival of the species and have limited occurrence outside of GWNF. T&E species are not included in this group because they require species-specific protection and have specific guidance described in Section 2. Additional measures beyond those identified for the ecological systems are needed to assure that the habitat needs for these species are addressed.

Species Needing Occurrence Protection Group

Species Name	Common Name	Group Weight
Adlumia fungosa	Climbing fumatory	High
Ammodramus henslowii	Henslow's sparrow	High
Arnoglossom muehlenbergii	great Indian-plantain	High
Bartramia longicauda	upland sandpiper	High
Buckleya distichophylla	Piratebush	High
Callophrys irus	Frosted elfin	High
Carex polymorpha	variable sedge	High
Carex roanensis	Roan Mountain sedge	High
Catocala herodias gerhardi	Herodias underwing	High
Catocala marmorata	Marbled underwing	High
Circus cyaneus	northern harrier	High
Corallorhiza bentleyi	Bentley's coalroot	High
Cornus canadensis	bunchberry	High
Cornus rugosa	roundleaf dogwood	High
Corynorhinus townsendii virginianus	Virginia big-eared bat	High
Crataegus calpodendron	pear hawthorn	Moderate
Crataegus pruinosa	prunose hawthorn	Moderate
Cuscuta coryli	hazel dodder	High
Cuscuta rostrata	beaked dodder	High
Cypripedium reginae	showy lady's-slipper	Moderate
Desmodium cuspidatum	toothed tick-trefoil	High
Erora laeta	Early hairstreak	High
Erynnis martialis	Mottled duskywing	High
Eumeces anthracinus	coal skink	High
Falco peregrinus	peregrine falcon	High
Gaylussacia brachycera	box huckleberry	High
Glyphyalinia raderi	Maryland glyph	Low
Goodyera repens	dwarf rattlesnake plantain	High
Gymnocarpium appalachianum	Appalachian oak fern	High
Haliaeetus leucocephalus	bald eagle	High
Helicodiscus diadema	Shaggy coil	High
Helicodiscus triodus	Talus coil	High
Heuchera alba	white alumroot	High
Hypericum mitchellianum	Blue Ridge St. John's-wort	High
Juglans cinerea	butternut	High
Leucothoe fontanesiana	highland dog-hobble	High
Monotropsis odorata	sweet pinesap	High
Myotis leibii	eastern small-footed bat	High

Species Name	Common Name	Group Weight
Myotis sodalis	Indiana bat	High
Nannaria shenandoah	Shenandoah Mountain xystodesmid	High
Phlox amplifolia	Broadleaf phlox	Moderate
Phlox buckleyi	sword-leaved phlox	High
Phyciodes batesii	Tawny crescent	High
Pituophis melanoleucus	northern pinesnake	Low
Pygmarrhopalites caedus	A cave springtail	High
Pyrola elliptica	shinleaf	High
Satyrium favonius ontario	Northern Hairstreak	High
Semionellus placidus	Millipede	High
Triodopsis picea	Spruce Knob threetooth	High
Triphora trianthophora	nodding pogonia	High

4.2.15 Open Area Associates

Many species require open areas for at least some part of their life history. Openings allow sunlight to reach the ground and that often allows for more herbaceous vegetation and shrubby vegetation to become established. Herbaceous vegetation also allows for development of a richer insect population which can provide food which is often important for the early portion of several species lives. Open areas can take many forms. A stand of trees that is harvested, blown down, or burned creates an opening while the new stand regenerates. The opening for the first ten years is referred to as early successional habitat and is important for many species as a temporary opening. As the stand continues to grow, the dense stand of saplings in the range of 11 to 20 years provides habitat important to ruffed grouse. Openings can be as small as the opening created by a tree falling (canopy gaps) or as large as grasslands greater than 100 acres in size which are desired by Henslow's sparrows. If disturbance of an area occurs on a regular basis, trees will not be reestablished on the site. It may stay as a grassland with very frequent disturbance or as a shrubland with less frequent disturbance. Open woodlands are created when fire is frequent in a mature stand of trees. The few mature trees will maintain an open canopy, but the understory will be open enough for a grassy or herbaceous understory will develop that can be maintained with frequent fire. These openings are sometimes hard to distinguish from each other and they may move from one type to another depending upon the type and frequency of disturbance.

4.2.15.a Area Sensitive Grassland and Shrubland and Open Woodlands Associates

These species require the presence of large blocks (from 40 to 100+ acres) of a combination of grasslands and shrublands and/or open woodlands. It is important to have complexes of all these habitat components. It is important to retain existing sites. While many of these habitats would be found in the Oak Forest and Woodland ecological system, these could be found in other systems as well. Additional measures beyond those identified for the ecological systems are needed to assure that the habitat needs for these species are addressed.

Species in Area Sensitive Grassland and Shrubland and Open Woodlands Associates Group

Species Name	Common Name	Group Weight
Caprimulgus carolinensis	chuck-will's widow	High
Caprimulgus vociferus	whip-poor-will	High
Colinus virginianus	northern bobwhite	High
Dendroica discolor	prairie warbler	High
Sciurus niger	Eastern fox squirrel	High
Vermivora chrysoptera	golden winged warbler	High

4.2.15.b Area Sensitive Grasslands Associates

These species require the presence of large blocks (40 to 100 acres or greater) of open grassland habitat. It is important to retain existing sites and expand them where possible. Most of these species prefer areas at the larger end of this size range. While many of these habitats would be found in the Oak Forest and Woodland ecological system, these could be found in other systems as well. Additional measures beyond those identified for the ecological systems are needed to assure that the habitat needs for these species are addressed.

Species in Area Sensitive Grasslands Associates Group

Species Name	Common Name	Group Weight
Ammodramus henslowii	Henslow's sparrow	Very High
Bartramia longicauda	upland sandpiper	Very High
Circus cyaneus	northern harrier	Very High
Lanius ludovicianus	loggerhead shrike	Very High
Speyeria idalia	Regal fritillary	Very High
Tyto alba	barn owl	High

4.2.15.c Area Sensitive Shrubland and Open Woodland Associates

These species require the presence of large blocks (100 acres or greater) of a mix of open shrubland and open woodland habitat. It is important to retain existing sites and expand them where possible. While many of these habitats would be found in the Oak Forest and Woodland ecological system, these could be found in other systems as well. Additional measures beyond those identified for the ecological systems are needed to assure that the habitat needs for these species are addressed.

Species in Area Sensitive Shrubland and Open Woodlands Associates Group

Species Name	Common Name	Group Weight
Erynnis martialis	Mottled duskywing	High

4.2.15.d Grassland Associates

These species are associated with open areas of any size with grass or forb dominated vegetation. These areas may be permanent openings or temporary openings that will eventually become shrublands or forests. While many of these habitats would be found in the Oak Forest and Woodland ecological system, these could be found in other systems as well. Additional measures beyond those identified for the ecological systems are needed to assure that the habitat needs for these species are addressed.

Species in Grasslands Associates Group

Species Name	Common Name	Group Weight
Anaphalis margaritacea	pearly everlasting	High
Arnoglossom muehlenbergii	great Indian-plantain	Moderate
Bonasa umbellus	ruffed grouse	Moderate
Colinus virginianus	northern bobwhite	High
Erynnis persius	Persius duskywing	High
Glyptemys insculpta	wood turtle	Moderate
Incisalia polia	Hoary elfin	High
Lanius ludovicianus	loggerhead shrike	High
Liochlorophis vernalis	Smooth green snake	High
Meleagris gallopavo	wild turkey	High
Mustela nivalis	least weasel	High
Odocoileus virginianus	white-tailed deer	High
Polygonia progne	Gray comma	Moderate
Scolopax minor	American woodcock	High
Thryomanes bewickii altus	Appalachian Bewick's wren	High
Tyto alba	barn owl	High
Ursus americanus	black bear	High
Vermivora chrysoptera	golden winged warbler	High
Virginia valeriae pulchra	mountain earth snake	High

4.2.15.e High Elevation Opening (Grassy or Shrubby) or Open Woodland Associates

These species are associated with openings or open woodlands at elevations greater than 3,000 feet. The habitat needs of the species in this group are tied directly to the Northern Hardwood, Oak Forest and Woodlands and Pine Forest and Woodlands ecological systems. Additional measures will need to assure that the high elevation grasslands and shrublands are also maintained. Maintaining these ecological systems and these additional measures and moving them towards their desired condition will satisfy the needs of the species in this group related to this habitat need.

Species in High Elevation Opening or Open Woodland Associates Group

Species Name	Common Name	Group Weight
Carpodacus purpureus	purple finch	High
Catharus guttatus	hermit thrush	Moderate
Coccyzus erythropthalmus	black-billed cuckoo	High
Contopus borealis	olive-sided flycatcher	High
Cuscuta rostrata	beaked dodder	Very High
Gnaphalium uliginosum	low cudweed	High
Hypericum mitchellianum	Blue Ridge St. John's-wort	High
Juniperus communis var depressa	ground juniper	High
Lepus americanus	snowshoe hare	Moderate

Species Name	Common Name	Group Weight
Liochlorophis vernalis	Smooth green snake	Very High
Melospiza georgiana	swamp sparrow	High
Oporornis philadelphia	mourning warbler	High
Rubus idaeus ssp. strigosus	American red raspberry	Very High
Sphyrapicus varius	yellow-bellied sapsucker	High
Sylvilagus obscurus	Appalachian Cottontail	Very High
Thryomanes bewickii altus	Appalachian Bewick's wren	High
Vermivora chrysoptera	golden winged warbler	Very High

4.2.15.f Shrubland Associates

These species are associated with shrub dominated vegetation. The habitat needs of the species in this group are tied directly to the Cove Forest, Northern Hardwood, Pine Forest and Woodland, Oak Forest and Woodlands, and Mafic Glade and Barrens and Alkaline Glades and Woodlands ecological systems. Additional measures will need to assure that the existing shrublands are also maintained. Maintaining these ecological systems and these additional measures and moving them towards their desired condition will satisfy the needs of the species in this group related to this habitat need.

Species in Shrubland Associates Group

Species Name	Common Name	Group Weight
Anaphalis margaritacea	pearly everlasting	Moderate
Bonasa umbellus	ruffed grouse	High
Colinus virginianus	northern bobwhite	High
Erynnis persius	Persius duskywing	Moderate
Eumeces anthracinus	coal skink	Low
Glyptemys insculpta	wood turtle	High
Incisalia polia	Hoary elfin	High
Lanius ludovicianus	loggerhead shrike	High
Meleagris gallopavo	wild turkey	High
Mustela nivalis	least weasel	High
Odocoileus virginianus	white-tailed deer	High
Oryzopsis asperifolia	white-grained mtn-ricegrass	High
Polygonia progne	Gray comma	Moderate
Prunus nigra	Canada plum	Moderate
Spilogale putorius	Spotted Skunk	Moderate
Thryomanes bewickii altus	Appalachian Bewick's wren	High
Ursus americanus	black bear	High
Vermivora chrysoptera	golden winged warbler	High
Virginia valeriae pulchra	mountain earth snake	Moderate

4.2.15.g Regenerating Forest Associates

These species utilize regenerating even-aged forests of pole-size timber (typically in the 10-30 year old age class group). The habitat needs of the species in this group are tied directly to the Cove Forest, Pine Forest and Woodland, and Oak Forest and Woodlands ecological systems. Maintaining these ecological systems and moving them towards their desired condition will satisfy the needs of the species in this group related to this habitat need.

Species in Regenerating Forest Associates Group

Species Name	Common Name	Group Weight
Bonasa umbellus	ruffed grouse	High
Caprimulgus carolinensis	chuck-will's widow	High
Caprimulgus vociferus	whip-poor-will	High
Dendroica discolor	prairie warbler	High
Dendroica magnolia	magnolia warbler	High
Lepus americanus	snowshoe hare	Very High
Odocoileus virginianus	white-tailed deer	High
Oporornis philadelphia	mourning warbler	High
Ursus americanus	black bear	High

4.2.15.h Open Woodland Associates

These species are associated with mature stands of trees with open (26-60% open) canopies and well developed grassy or shrubby understories. The habitat needs of the species in this group are tied directly to the Cove Forest, Northern Hardwood, Pine Forest and Woodland, Oak Forest and Woodlands, and Mafic Glade and Barrens and Alkaline Glades and Woodlands ecological systems. Maintaining these ecological systems and moving them towards their desired condition will satisfy the needs of the species in this group related to this habitat need.

Species in Open Woodland Associates Group

Species Name	Common Name	Group Weight
Bonasa umbellus	ruffed grouse	High
Callophrys irus	Frosted elfin	High
Caprimulgus carolinensis	chuck-will's widow	High
Caprimulgus vociferus	whip-poor-will	High
Catocala herodias gerhardi	Herodias underwing	High
Colinus virginianus	northern bobwhite	High
Delphinium exaltatum	tall larkspur	Moderate
Desmodium sessilifolium	sessile-leaf tick-trefoil	Moderate
Echinacea laevigata	smooth coneflower	High
Erysimum capitatum	western wallflower	High
Euchloe olympia	Olympia marble	High
Eumeces anthracinus	coal skink	High
Falco peregrinus	peregrine falcon	High
Glyptemys insculpta	wood turtle	High
Helianthemum bicknellii	plains frostweed	High
Helianthemum propinquum	low frostweed	High

Species Name	Common Name	Group Weight
Linum lewisii	prairie flax	High
Linum sulcatum	grooved yellow flax	High
Liochlorophis vernalis	Smooth green snake	High
Meleagris gallopavo	wild turkey	High
Melica nitens	Three-flowered melic grass	High
Myotis sodalis	Indiana bat	Very High
Odocoileus virginianus	white-tailed deer	High
Oligoneuron rigidum	stiff goldenrod	High
Onosmodium virginianum	Virginia false-gromwell	High
Oryzopsis asperifolia	white-grained mtn-ricegrass	High
Pituophis melanoleucus	northern pinesnake	High
Plethodon sherando	Big levels salamander	High
Poa saltuensis	drooping bluegrass	High
Polygonia progne	Gray comma	Moderate
Prunus alleghaniensis	Alleghany sloe	High
Pycnanthemum torreyi	Torrey's mountain-mint	High
Pyrgus wyandot	Appalachian grizzled skipper	High
Rosa setigera	prairie rose	High
Satyrium favonius ontario	Northern Hairstreak	High
Scutellaria parvula var. parvula	small skullcap	High
Scutellaria saxatilis	Rock skullcap	Moderate
Speyeria diana	Diana fritillary	High
Spiranthes ochroleuca	yellow nodding ladies'-tresses	High
Trichostema setaceum	narrow-leaved blue curls	High
Ursus americanus	black bear	High
Vermivora chrysoptera	golden winged warbler	Very High
Virginia valeriae pulchra	mountain earth snake	High
Zigadenus elegans ssp. glaucus = Anticlea glauca	white camas	High

4.2.16 Riparian Area Associates

Species occurring in this group require wetlands, aquatic systems (streams, lakes, or ponds), springs, seeps or areas adjacent to these systems. The habitat needs of the species in this group are tied directly to the Floodplain, Wetland and Riparian Area ecological system. Maintaining these ecological systems and moving them towards their desired condition will satisfy the needs of the species in this group related to this habitat need. There are also a number of the species in this group that benefit from open canopies. These include wetland plants and many of the birds. Flood events, canopy gaps, edaphic conditions and beaver activity are expected to meet most of the needs of these species.

Species in Riparian Area Associates Group

Species Name	Common Name	Group Weight
Aegolius acadicus	northern saw-whet owl	High
Alnus incana ssp. rugosa	speckled alder	Very High
Ambystoma tigrinum	Eastern tiger salamander	High
Anas rubripes	American black duck	Very High
Arnoglossom muehlenbergii	great Indian-plantain	High
Aster radula	rough-leaved aster	Very High
Autochton cellus	Golden-banded skipper	Very High
Boloria selene	Silver-bordered fritillary	Very High
Boltonia montana	no common name	Very High
Bonasa umbellus	ruffed grouse	High
Bromus ciliatus	fringed brome grass	Very High
Calopogon tuberosus	Grass pink	Very High
Carex aquatilis	water sedge	Very High
Carex arctata	black sedge	Very High
Carex barrattii	Barratt's sedge	Very High
Carex buxbaumii	Buxbaum's sedge	Very High
Carex lasiocarpa var. americana	slender sedge	Very High
Carex schweinitzii	Schweinitz's sedge	High
Carex vesicaria	Inflated sedge	Very High
Castor canadensis	Beaver	Very High
Catocala marmorata	Marbled underwing	High
Certhia americana	brown creeper	High
Cicindela ancocisconensis	a tiger beetle	Very High
Clemmys guttata	spotted turtle	Very High
Coccyzus erythropthalmus	black-billed cuckoo	High
Colias interior	Pink-edged sulphur	Very High
Contopus borealis	olive-sided flycatcher	High
Cyperus dentatus	toothed flatsedge	High
Cypripedium reginae	showy lady's-slipper	Very High
Dendroica cerulea	cerulean warbler	High
Dendroica magnolia	magnolia warbler	High
Desmodium canadense	showy tick-trefoil	High
Desmodium sessilifolium	sessile-leaf tick-trefoil	High
Echinodorus tenellus	dwarf burhead	Very High
Eleocharis compressa	flat-stemmed spikerush	Very High
Eleocharis melanocarpa	black-fruited spikerush	Very High

Species Name	Common Name	Group Weight
Eleocharis robbinsii	Robbins spikerush	Very High
Elymus canadensis	nodding wild rye	High
Empidonax alnorum	alder flycatcher	High
Empidonax virescens	acadian flycatcher	Very High
Epilobium ciliatum	Hair willow-herb	High
Epilobium leptophyllum	linear-leaved willow-herb	Very High
Equisetum sylvaticum	woodland horsetail	Very High
Eriocaulon aquaticum	white buttons	Very High
Erynnis persius	Persius duskywing	High
Eupatorium maculatum	spotted joe-pye weed	High
Euphorbia purpurea	glade spurge	High
Glaucomys sabrinus fuscus	Virginia northern flying squirrel	Moderate
Glyceria acutiflora	sharp-scaled manna-grass	Very High
Glyceria grandis	American manna-grass	Very High
Glyptemys insculpta	wood turtle	High
Gnaphalium uliginosum	low cudweed	High
Goodyera repens	dwarf rattlesnake plantain	Moderate
Haliaeetus leucocephalus	bald eagle	Very High
Hansonoperla appalachia	Appalachian stonefly	Very High
Helenium virginicum	Virginia sneezeweed	Very High
Helonias bullata	swamp-pink	Very High
Huperzia appalachiana	Appalachian fir clubmoss	Very High
Hydraena maureenae	Maureen's shale stream beetle	Very High
Hypericum boreale	northern St. John's-wort	Very High
Iliamna remota	Kankakee globe-mallow	Moderate
Isoetes lacustris	lake quillwort	Very High
Isonychia tusculanensis	a mayfly	Very High
Juncus brachycephalus	small-head rush	Very High
Juncus brevicaudatus	narrow-panicled rush	Very High
Leuctra mitchellensis	Mitchell needlefly	Very High
Leuctra monticola	montane needlefly	Very High
Liparis loeselii	Loesel's twayblade	Very High
Lonicera canadensis	American fly-honeysuckle	High
Lontra canadensis	river otter	Very High
Lycopodiella inundata	northern bog clubmoss	High
Lythrum alatum	winged loosestrife	Very High
Maianthemum stellatum	stary false Solomon's-seal	High

Species Name	Common Name	Group Weight
Megaleuctra flinti	Shenandoah needlefly	Very High
Melospiza georgiana	swamp sparrow	High
Microtus chrotorrhinus carolinensis	Southern rock vole	High
Muhlenbergia glomerata	marsh muhly	High
Myotis sodalis	Indiana bat	High
Nemotaulius hostilis	a limnephilid caddisfly	Very High
Nyctanassa violacea	yellow-crowned night-heron	Very High
Nycticorax nycticorax	black-crowned night-heron	Very High
Osmunda cinnamomea var. glandulosa	glandular cinnamon fern	Very High
Panicum hemitomon	maidencane	Very High
Paragnetina ishusa	widecollar stonefly	Very High
Paraleptophlebia jeanae	a mayfly	Very High
Parnassia grandifolia	Large-leaved grass-of-parnassus	Very High
Peltigera hydrothyria	Waterfan	Very High
Perlesta frisoni	Blue Ridge stonefly	Very High
Platanthera grandiflora	large purple fringed orchid	Very High
Platanthera peramoena	purple fringeless orchid	Very High
Poa paludigena	bog bluegrass	Very High
Poa palustris	fowl bluegrass	Very High
Polanisia dodecandra	common clammy-weed	Very High
Polygonia progne	Gray comma	Moderate
Potamogeton amplifolius	Largeleaf pondweed	Very High
Potamogeton hillii	Hill's pondweed	Very High
Potamogeton oakesianus	Oakes pondweed	Very High
Potamogeton tennesseensis	Tennessee pondweed	Very High
Ribes americanum	wild black currant	Very High
Sabatia campanulata	slender marsh rose-pink	Very High
Sagittaria calycina var calycina	long-lobed arrowhead	Very High
Sagittaria rigida	sessile-fruited arrowhead	Very High
Saxifraga pensylvanica	swamp saxifrage	High
Schizachne purpurascens	purple oat-grass	High
Schoenoplectus subterminalis	water bulrush	Very High
Scirpus ancistrochaetus	northeastern bulrush	Very High
Scirpus torreyi	Torrey's bulrush	Very High
Sciurus carolinensis	gray squirrel	High
Scolopax minor	American woodcock	Very High
Seiurus noveboracensis	northern waterthrush	High

Species Name	Common Name	Group Weight
Sida hermaphrodita	Virginia mallow	Very High
Solidago rupestris	riverbank goldenrod	Very High
Solidago uliginosa	bog goldenrod	Very High
Sorex palustris punctulatus	southern water shrew	High
Sparganium chlorocarpum = S. emersum	narrow-leaf burreed	Very High
Spartina pectinata	freshwater cordgrass	Very High
Speyeria atlantis	Atlantis fritillary	Very High
Sphagnum russowii	Russow's peatmoss	Very High
Sphyrapicus varius	yellow-bellied sapsucker	Very High
Spiranthes lucida	shining ladies'-tresses	Very High
Spiranthes ochroleuca	yellow nodding ladies'-tresses	High
Sylvilagus obscurus	Appalachian Cottontail	Moderate
Triadenum fraseri	Fraser's marsh St. John's-wort	Very High
Triantha racemosa	coastal false-asphodel	Very High
Troglodytes troglodytes	winter wren	High
Vaccinium macrocarpon	large cranberry	Very High
Verbena scabra	sandpaper vervain	Very High
Vermivora chrysoptera	golden winged warbler	Very High
Veronica scutellata	marsh speedwell	Very High
Viburnum lentago	nannyberry	Very High
Vicia americana	American purple vetch	Very High
Vitis rupestris	sand grape	Very High
Woodwardia virginica	Virginia chainfern	Very High

4.2.17 Ruderal Associates

These species are associated with previously disturbed habitats like old fields, old homesites and roadsides. These species are not associated with any particular ecological system so additional measures beyond those identified for the ecological systems are needed to assure that the habitat needs for these species are addressed.

Species in Ruderal Associates Group

Species Name	Common Name	Group Weight
Arnoglossom muehlenbergii	great Indian-plantain	High
Cicindela patruela	Barrens tiger beetle	High
Cirsium altissimum	tall thistle	Very High
Desmodium cuspidatum	toothed tick-trefoil	Moderate
Eumeces anthracinus	coal skink	High
Gnaphalium uliginosum	low cudweed	Moderate
Phlox buckleyi	sword-leaved phlox	Very High

Polygonia progne	Gray comma	High
Prunus nigra	Canada plum	Moderate
Vicia americana	American purple vetch	High

4.2.18 Sandstone Glades and Barrens Associates

These species inhabit sandstone glades and barrens. Additional measures beyond those identified for the ecological systems are needed to assure that the habitat needs for these species are addressed.

Species in Sandstone Glades and Barrens Associates Group

Species Name	Common Name	Group Weight
Cicindela patruela	Barrens tiger beetle	High
Helianthemum bicknellii	plains frostweed	High
Incisalia polia	Hoary elfin	High

4.2.19 Species Sensitive to Over-Collection

Species in this group are sensitive to excessive collection which could lead to sharp population declines. These species are collected commercially and used for a variety of purposes including food, medicinal, decorative, gardening/landscaping, pet trade, and trophy hunting (rattlesnake rattle collection). These species are not associated with any particular ecological system so additional measures beyond those identified for the ecological systems are needed to assure that the habitat needs for these species are addressed.

Species in Sensitive to Over-Collection Group

Species Name	Common Name	Group Weight
Crotalus horridus	Timber rattlesnake	Very High
Cypripedium reginae	showy lady's-slipper	Very High
Glyptemys insculpta	wood turtle	Very High
Panax quinquefolius	Ginseng	Very High
Panax trifolius	Dwarf ginseng	High
Platanthera grandiflora	large purple fringed orchid	Moderate
Platanthera peramoena	purple fringeless orchid	Moderate
Pyrgus wyandot	Appalachian grizzled skipper	High
Speyeria diana	Diana fritillary	High
Speyeria idalia	Regal fritillary	High

4.2.20 Species Sensitive to Recreational Traffic

Species in this group are sensitive to excessive human disturbance such as trampling, harassment, vehicular mortality, and direct mortality. Reptile species are especially sensitive to being harmed, harassed, and killed by humans. This interaction with humans can have long-term negative effects on population sizes and sustainability. Plant species on this list are especially sensitive to trampling by off-road vehicles, heavy equipment, horses, and human traffic. These species are not associated with any particular ecological system so additional measures beyond those identified for the ecological systems are needed to assure that the habitat needs for these species are addressed.

Species in Sensitive to Recreation Traffic Group

Species Name	Common Name	Group Weight
Minuartia groenlandica	mountain sandwort	High
Sibbaldiopsis tridentata	three-toothed cinquefoil	Moderate

4.2.21 Shale Barren Associates

Species occurring in this group require shale barrens. The habitat needs of the species in this group are tied directly to the Cliff, Talus and Shale Barrens ecological system. Maintaining these ecological systems and moving them towards their desired condition will satisfy the needs of the species in this group related to this habitat need.

Species in Shale Barren Associates Group

Species Name	Common Name	Group Weight
Arabis patens	Spreading rockcress	Very High
Arabis serotina	shale barren rockcress	Very High
Astragalus distortus	bent milkvetch	Very High
Bromus kalmii	wild chess	Very High
Cheilanthes eatonii	chestnut lipfern	High
Clematis albicoma	White-haired Leatherflower	Very High
Clematis coactilis	Virginia white-haired leatherflower	Very High
Clematis viticaulis	Millboro leatherflower	Very High
Elymus trachycaulus	slender wheatgrass	Very High
Eriogonum allenii	Yellow Buckwheat	Very High
Erysimum capitatum	western wallflower	High
Euchloe olympia	Olympia marble	High
Liatris helleri	shale -barren blazing star	Very High
Melica nitens	Three-flowered melic grass	Moderate
Oenothera argillicola	Shale-barren evening primrose	Very High
Paronychia argyrocoma	Silver Nail-wort	Very High
Paronychia virginica	yellow nailwort	Very High
Prunus alleghaniensis	Alleghany sloe	Moderate
Pyrgus wyandot	Appalachian grizzled skipper	High
Rosa setigera	prairie rose	Moderate
Solidago arguta var. harrisii	Shale Barren Goldenrod	Very High
Sporobolus neglectus	small dropseed	Moderate
Taenidia montana	Virginia mountain pimpernel	Very High
Trichostema setaceum	narrow-leaved blue curls	High
Trifolium virginicum	Kate's mountain clover	Very High
Viola pedatifida	prairie violet	Very High

4.2.22 Species with Habitat in Special Biologic Areas

These are species that occupy habitat that has been designated as special biologic areas. These areas are established with the goal to manage the area for the particular rare communities or species at the site. These species are not associated with any particular ecological system so additional measures beyond those identified for the ecological systems are needed to assure that the habitat needs for these species are addressed.

Species in Habitat in Special Biologic Areas Group

Species Name	Common Name	Group Weight
Aegolius acadicus	northern saw-whet owl	Moderate
Ambystoma tigrinum	Eastern tiger salamander	Very High
Anaphalis margaritacea	pearly everlasting	Moderate
Arabis serotina	shale barren rockcress	Very High
Aralia hispida	bristly sarsaparilla	Moderate
Betula cordifolia	mountain paper birch	Very High
Boloria selene	Silver-bordered fritillary	Very High
Boltonia montana	no common name	Very High
Bromus kalmii	wild chess	Very High
Campanula rotundifolia	American harebell	Very High
Carex aquatilis	water sedge	High
Carex arctata	black sedge	High
Carex barrattii	Barratt's sedge	Very High
Carex buxbaumii	Buxbaum's sedge	Very High
Carex lasiocarpa var. americana	slender sedge	High
Carex polymorpha	variable sedge	Moderate
Carex roanensis	Roan Mountain sedge	High
Carex vesicaria	Inflated sedge	High
Carpodacus purpureus	purple finch	Very High
Castor canadensis	Beaver	Low
Catharus guttatus	hermit thrush	Moderate
Certhia americana	brown creeper	Moderate
Cheilanthes eatonii	chestnut lipfern	High
Cicindela patruela	Barrens tiger beetle	Moderate
Cirsium altissimum	tall thistle	Very High
Clematis viticaulis	Millboro leatherflower	Very High
Clemmys guttata	spotted turtle	Very High
Colias interior	Pink-edged sulphur	Very High
Contopus borealis	olive-sided flycatcher	Moderate
Cornus canadensis	bunchberry	Very High
Cornus rugosa	roundleaf dogwood	Very High
Crataegus pruinosa	prunose hawthorn	Very High
Cuscuta rostrata	beaked dodder	High

Species Name	Common Name	Group Weight
Cypripedium reginae	showy lady's-slipper	Very High
Cystopteris fragilis	fragile fern	Very High
Dendroica fusca	blackburnian warbler	Moderate
Dendroica magnolia	magnolia warbler	Moderate
Desmodium cuspidatum	toothed tick-trefoil	High
Echinacea laevigata	smooth coneflower	Very High
Echinodorus tenellus	dwarf burhead	Very High
Eleocharis melanocarpa	black-fruited spikerush	High
Eleocharis robbinsii	Robbins spikerush	Very High
Elymus trachycaulus	slender wheatgrass	High
Empidonax alnorum	alder flycatcher	Moderate
Epilobium leptophyllum	linear-leaved willow-herb	Very High
Equisetum sylvaticum	woodland horsetail	Very High
Eriocaulon aquaticum	white buttons	Very High
Erynnis martialis	Mottled duskywing	High
Erysimum capitatum	western wallflower	High
Gaylussacia brachycera	box huckleberry	Very High
Glaucomys sabrinus fuscus	Virginia northern flying squirrel	Very High
Glyceria grandis	American manna-grass	Very High
Gnaphalium uliginosum	low cudweed	Moderate
Gymnocarpium appalachianum	Appalachian oak fern	High
Helenium virginicum	Virginia sneezeweed	Very High
Helianthemum bicknellii	plains frostweed	High
Helonias bullata	swamp-pink	Very High
Heuchera alba	white alumroot	Very High
Houstonia canadensis	Canada bluets	Very High
Hypericum mitchellianum	Blue Ridge St. John's-wort	Moderate
Isoetes lacustris	lake quillwort	Very High
Juncus brachycephalus	small-head rush	High
Juncus brevicaudatus	narrow-panicled rush	High
Juniperus communis var depressa	ground juniper	Very High
Lepus americanus	snowshoe hare	Very High
Leucothoe fontanesiana	highland dog-hobble	Very High
Liparis loeselii	Loesel's twayblade	Very High
Loxia curvirostra	red crossbill	High
Martes pennanti	fisher	High
Minuartia groenlandica	mountain sandwort	Low
Monotropsis odorata	sweet pinesap	Moderate

Species Name	Common Name	Group Weight
Muhlenbergia glomerata	marsh muhly	Very High
Oligoneuron rigidum	stiff goldenrod	Very High
Oryzopsis asperifolia	white-grained mtn-ricegrass	High
Osmunda cinnamomea var. glandulosa	glandular cinnamon fern	Very High
Panicum hemitomon	maidencane	Very High
Phlox buckleyi	sword-leaved phlox	Moderate
Platanthera grandiflora	large purple fringed orchid	Very High
Plethodon punctatus	Cow Knob salamander	Very High
Plethodon sherando	Big levels salamander	Very High
Plethodon virginia	Shenandoah Mt. salamander	Very High
Poa palustris	fowl bluegrass	Very High
Poa saltuensis	drooping bluegrass	Very High
Polygonia progne	Gray comma	Moderate
Potamogeton oakesianus	Oakes pondweed	Very High
Potentilla arguta	tall cinquefoil	Very High
Pyrgus wyandot	Appalachian grizzled skipper	High
Pyrola elliptica	shinleaf	Moderate
Regulus satrapa	golden-crowned kinglet	High
Ribes americanum	wild black currant	High
Rubus idaeus ssp. strigosus	American red raspberry	Very High
Sabatia campanulata	slender marsh rose-pink	Very High
Sagittaria calycina var calycina	long-lobed arrowhead	Very High
Schizachne purpurascens	purple oat-grass	High
Schoenoplectus subterminalis	water bulrush	Very High
Scirpus ancistrochaetus	northeastern bulrush	Very High
Seiurus noveboracensis	northern waterthrush	High
Sibbaldiopsis tridentata	three-toothed cinquefoil	Moderate
Sitta canadensis	red-breasted nuthatch	High
Solidago randii = S. simplex var. randii	Rand's goldenrod	Very High
Solidago rupestris	riverbank goldenrod	High
Solidago uliginosa	bog goldenrod	Very High
Sorex palustris punctulatus	southern water shrew	Moderate
Sparganium chlorocarpum = S. emersum	narrow-leaf burreed	High
Speyeria atlantis	Atlantis fritillary	Very High
Sphagnum russowii	Russow's peatmoss	High
Spiranthes ochroleuca	yellow nodding ladies'-tresses	Moderate
Symphoricarpos albus	snowberry	High
Thuja occidentalis	northern white cedar	High

Species Name	Common Name	Group Weight
Triadenum fraseri	Fraser's marsh St. John's-wort	Very High
Triantha racemosa	coastal false-asphodel	Very High
Trichostema setaceum	narrow-leaved blue curls	High
Trifolium virginicum	Kate's mountain clover	Very High
Trillium pusillum var. virginianum	mountain least trillium	Very High
Triphora trianthophora	nodding pogonia	Moderate
Troglodytes troglodytes	winter wren	High
Vaccinium macrocarpon	large cranberry	Very High
Viola pedatifida	prairie violet	Very High
Vitis rupestris	sand grape	High
Woodwardia virginica	Virginia chainfern	Moderate

A summary of all of the groups with which individual species are associated is in Appendix F2.

5.0 EFFECTS OF ALTERNATIVES ON SPECIES

For species and species groups whose needs are addressed by the condition of the ecological systems, the effects by alternative are described in the Ecological Systems Report.

For the species and species groups that require additional direction, their key attributes and indicators are described as follows.

Attributes and Indicators
The following key attributes were identified for each species group.

Table F-8. Key Attributes and Indicators for Species Groups

Species Group	Key Attribute	Indicator Name
Area Sensitive Grassland and Shrubland and Open Woodlands	Habitat Type Abundance	Total acres of area sensitive grasslands, shrublands or open woodlands
Area Sensitive Grasslands.	Habitat Type Abundance	Area sensitive open Habitat grasslands greater than 100 ac
Area Sensitive Grasslands.	Habitat Type Abundance	Area sensitive open habitat grasslands greater than 40 ac
Area Sensitive Shrubland and Open Woodlands	Habitat Type Abundance	Area sensitive open habitat shrubland and open woodland greater than 100 ac
Grasslands	Existing grasslands	Existing grasslands in open conditions
Grasslands	Habitat Type Abundance	Total grasslands acres
High Elevation Openings, Grassy or Shrubby or Open Woodlands	Habitat Type Abundance	Total High Elevation Grassland acres
High Elevation Openings, Grassy or Shrubby or Open Woodlands	Habitat Type Abundance	Total high elevation shrubland acres

Species Group	Key Attribute	Indicator Name
Shrublands	Habitat Type Abundance	Total shrubland acres
Cavity Trees, Den Trees and Snags	Habitat Element Abundance	Compliance with den/cavity tree and snag guidelines
Lepidopterans - sensitive to fire injury and sensitive to some insecticides (Bt, dimilin)	Fire Regime	Compliance with lepidopteran guidelines
Lepidopterans - sensitive to fire injury and sensitive to some insecticides (Bt, dimilin)	Sensitivity to invasive species treatments	Compliance with guidelines for lepidopterans
Sensitive to Over-Collection	Persistence of Species Occurrences	Compliance with guidelines for over collection
Sensitive to Recreation Traffic	Persistence of Species Occurrences	Compliance with recreation traffic guidelines
Cliff and Talus and Large Rock Outcrops	Habitat Element Abundance	Compliance with cliff, talus and large rock outcrop guidelines
Calciphiles	Habitat Type Abundance	Acres of habitat that supports calciphiles
Calciphiles	Habitat Type Abundance	Total High-Quality Habitat Type Acres
Occurrence Protection	Persistence of Species Occurrences	Compliance with Species Occurrence Guidelines

The following tables display the current condition of each indicator identified for the species groups. It also displays the estimated condition of the indicator after 10 years (Table F-9), or 50 years (Table F-10), of implementation of each alternative. Table F-11 identifies a description (poor, fair, or good) for the indicator based on the indicator values.

The effects by alternative are summarized in the following table:

Table F-9. Current Condition and Expected Condition of Indicators at End of First Decade

Species Group / Indicator	Current Condition	Condition of Indicator at end of 10 years									
		Alt A	Alt A[1]	Alt B	Alt C	Alt D	Alt D*	Alt E	Alt F	Alt G	Alts H and I
Alkaline Glades and Barrens	See Mafic and Alkaline Glades Ecological System										
Area Sensitive Grassland and Shrubland and Open Woodlands											
Total acres of area sensitive grasslands, shrublands or open woodlands	23,247	56,414	74,113	119,587	26,676	85,057	64,414	119,587	119,587	119,587	119,587
Shrublands > 40 acres	398	398	398	398	398	398	398	398	398	398	398
Area Sensitive Grasslands											
Area sensitive open Habitat grasslands greater than 100 ac	224	224	224	224	224	224	224	224	224	224	224
Area Sensitive Grasslands											
Area sensitive open habitat grasslands greater than 40 ac	389	389	389	389	389	389	389	389	389	389	389
Area Sensitive Shrubland and Open Woodlands											
Area sensitive open habitat shrubland and open woodland greater than 100 ac	22,569	55,736	73,435	118,909	25,998	84,379	63,736	118,909	118,909	118,909	118,909
Shrublands > 100 acres	109	109	109	109	109	109	109	109	109	109	109
Area Sensitive Mature Coniferous, Deciduous, and/or Mixed Forest Associates											
Cove, spruce, pine, oak, northern hardwood and riparian ecological systems	898,162	890,272	912,998	884,844	913,891	871,957	871,957	896,272	904,925	885,149	884,849
Calciphiles											
Total High-Quality Habitat Type Acres	6,823	6,823	6,823	6,823	6,823	6,823	6,823	6,823	6,823	6,823	6,823

Species Group / Indicator	Current Condition	Condition of Indicator at end of 10 years									
		Alt A	Alt A[1]	Alt B	Alt C	Alt D	Alt D*	Alt E	Alt F	Alt G	Alts H and I
Caves		See Caves and Karstlands Ecological System									
Cavity Trees, Den Trees and Snags											
Compliance with den/cavity tree and snag guidelines	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Cliff and Talus and large rock outcrops											
Compliance with cliff, talus and large rock outcrop guidelines	No	No	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Cove Forests		See Cove Forests Ecological System									
Fire Dependent and Fire Enhanced											
Acres burned at desired frequency in all systems	26,144	35,855	53,555	99,028	6,118	64,498	43,855	99,028	99,028	99,028	99,028
Grasslands											
Existing grasslands in open conditions	2,773	2,773	2,773	2,773	1,387	2,773	2,773	2,773	2,773	2,773	2,773
Total grasslands acres	2,773	3,886	4,240	5,149	1,904	4,458	4,046	5,149	5,149	5,149	5,149
Hard and Soft Mast Dependent											
Total shrubland acres	31,967	42,447	19,347	48,447	18,447	61,447	61,447	36,447	28,447	48,447	48,447
Regenerating forest, pine + oak	29,232	39,742	17,622	44,242	16,742	56,947	56,947	33,742	24,162	43,442	44,228
Mature Oak	650,442	630,526	651,696	628,526	652,526	613,321	613,321	637,536	649,156	627,836	627,050
Open canopy pine + oak	19,275	50,309	67,648	109,653	16,742	78,058	59,002	109,653	109,653	109,653	109,653
High Elevation Coniferous, Deciduous and/or Mixed Forests											
Total acres of oak, cove or pine ecosystems in mid-late succession at elevations >3000 feet	156,312	156,312	156,312	156,312	156,312	156,312	156,312	156,312	156,312	156,312	156,312

Species Group / Indicator	Current Condition	Condition of Indicator at end of 10 years									
		Alt A	Alt A¹	Alt B	Alt C	Alt D	Alt D*	Alt E	Alt F	Alt G	Alts H and I
High Elevation Openings, grassy or shrubby or open woodlands											
Total High Elevation Grassland acres	411	411	411	411	411	411	411	411	411	411	411
Total high elevation shrubland acres	151	151	151	151	151	151	151	151	151	151	151
Regeneration at high elevation	5,599	7,526	3,278	8,630	3,113	11,021	11,021	6,423	4,952	8,630	8,630
Late Successional Hardwood Dominated Forest											
Mature and late successional oak, cove and northern hardwoods	689,162	679,772	701,548	676,844	702,391	661,457	661,457	686,782	697,425	675,659	675,359
Lepidopterans -											
Compliance with lepidopteran guidelines	No	No	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Mafic Rocks		See Mafic and Alkaline Glades Ecological System									
Occurrence Protection											
Compliance with Species Occurrence Guidelines	No	No	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Open Woodlands											
Open canopy pine, oak, mafic, cliff, riparian, cove, northern hardwood systems	22,460	55,627	73,326	118,800	25,889	84,270	63,627	118,800	118,800	118,800	118,800
Regenerating Forests											
Regenerating forest, pine, oak, cove, northern hardwood systems	30,444	40,924	17,824	46,924	16,924	59,924	59,924	34,924	26,924	46,924	46,924
Riparian		See Riparian Ecological System									
Ruderal											
Compliance with ruderal species guidelines	No	No	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Species Group Indicator	Current Condition	Condition of Indicator at end of 10 years Alt A	Alt A[1]	Alt B	Alt C	Alt D	Alt D*	Alt E	Alt F	Alt G	Alts H and I
Sandstone Glades and Barrens											
Compliance with sandstone glades species guidelines	No	No	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Sensitive to Over-Collection											
Compliance with guidelines for over collection	No	No	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Sensitive to Recreation Traffic											
Compliance with recreation traffic guidelines	No	No	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Shale Barrens		See Cliff, Talus and Shale Barrens Ecological System									
Shrublands											
Total shrubland acres	31,967	42,447	19,347	48,447	18,447	61,447	61,447	36,447	28,447	48,447	48,447
Total maintained Shrubland acres	1,523	1,523	1,523	1,523	1,523	1,523	1,523	1,523	1,523	1,523	1,523
Species in a Special Biologic Area											
Special Biological Area Managed for the habitat needed by the species	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

*This version of Alternative D uses a level of prescribed burning of 5,000 acres per year

Alt A[1] represents the effects of the level of activities accomplished during the past three years (2009 through 2011) under the 1993 Forest Plan.

Table F-10. Current Condition and Expected Condition of Indicators at End of Fifth Decade

Species Group / Indicator	Current Condition	Condition of Indicator at end of 50 years: Alt A	Alt A[1]	Alt B	Alt C	Alt D	Alt D*	Alt E	Alt F	Alt G	Alts H and I
Alkaline glades and barrens	See Mafic and Alkaline Glades Ecological System										
Area Sensitive Grassland and Shrubland and Open Woodlands											
Total acres of area sensitive grasslands, shrublands or open woodlands	23,247	63,278	107,916	191,191	32,777	129,231	87,207	191,191	191,200	191,191	191,191
Shrublands > 40 acres	398	398	398	398	398	398	398	398	398	398	398
Area Sensitive Grasslands.											
Area sensitive open Habitat grasslands greater than 100 ac	224	224	224	224	224	224	224	224	224	224	224
Area Sensitive Grasslands.											
Area sensitive open habitat grasslands greater than 40 ac	389	389	389	389	389	389	389	389	389	389	389
Area Sensitive Shrubland and Open Woodlands											
Area sensitive open habitat shrubland and open woodland greater than 100 ac	22,569	62,600	107,238	190,513	32,099	128,553	86,529	190,513	190,522	190,513	190,513
Shrublands > 100 acres	109	109	109	109	109	109	109	109	109	109	109
Area Sensitive Mature Coniferous, Deciduous, and/or Mixed Forest Associates											
Cove, spruce, pine, oak, northern hardwood and riparian ecological systems	898,162	882,514	993,786	863,259	998,078	788,388	788,388	916,563	965,265	857,706	857,280
Calciphiles											
Total High-Quality Habitat Type Acres	6,823	6,823	6,823	6,823	6,823	6,823	6,823	6,823	6,823	6,823	6,823

Species Group / Indicator	Current Condition	Condition of Indicator at end of 50 years: Alt A	Alt A¹	Alt B	Alt C	Alt D	Alt D*	Alt E	Alt F	Alt G	Alts H and I
Caves	See Caves and Karstlands Ecological System										
Cavity Trees, Den Trees and Snags											
Compliance with den/cavity tree and snag guidelines	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Cliff and Talus and large rock outcrops											
Compliance with cliff, talus and large rock outcrop guidelines	No	No	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Cove Forests	See Cove Forests Ecological System										
Fire Dependent and Fire Enhanced											
Acres burned at desired frequency in all systems	26,144	42,720	87,358	170,641	12,219	108,681	66,657	170,641	170,641	170,641	170,641
Grasslands											
Existing grasslands in open conditions	2,773	2,773	2,773	2,773	1,387	2,773	2,773	2,773	2,773	2,773	2,773
Total grasslands acres	2,773	4,023	4,916	6,581	2,026	5,342	4,501	6,581	6,581	6,581	6,581
Hard and Soft Mast Dependent											
Total shrubland acres	31,967	42,400	19,300	48,392	18,400	61,392	61,392	36,392	28,400	48,392	48,392
Regenerating forest, pine + oak	29,232	39,742	17,622	44,242	16,742	56,947	56,947	33,742	24,162	43,442	44,228
Mature Oak	650,442	611,059	716,909	601,059	721,059	525,034	525,034	646,109	703,959	597,609	593,679
Open canopy pine + oak	19,275	55,389	96,730	175,165	16,742	118,485	79,539	175,165	175,165	175,165	175,165
High Elevation Coniferous, Deciduous and/or Mixed Forests											
Total acres of oak, cove or pine ecosystems in mid-late succession at elevations >3000 feet	156,312	156,312	156,312	156,312	156,312	156,312	156,312	156,312	156,312	156,312	156,312

Species Group / Indicator	Current Condition	Condition of Indicator at end of 50 years: Alt A	Alt A¹	Alt B	Alt C	Alt D	Alt D*	Alt E	Alt F	Alt G	Alts H and I
High Elevation Openings, grassy or shrubby or open woodlands											
Total High Elevation Grassland acres	411	411	411	411	411	411	411	411	411	411	411
Total high elevation shrubland acres	151	151	151	151	151	151	151	151	151	151	151
Regeneration at high elevation	5,599	7,518	3,269	8,620	3,104	11,010	11,010	6,413	4,943	8,620	8,620
Late Successional Hardwood Dominated Forest											
Mature and late successional oak, cove and northern hardwoods	689,162	672,015	782,337	654,418	786,579	577,047	577,047	706,232	757,766	647,375	646,949
Lepidopterans -											
Compliance with lepidopteran guidelines	No	No	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Mafic Rocks		See Mafic and Alkaline Glades Ecological System									
Occurrence Protection											
Compliance with Species Occurrence Guidelines	No	No	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Open Woodlands											
Open canopy pine, oak, mafic, cliff, riparian, cove, northern hardwood systems	22,460	62,491	107,129	190,404	31,990	128,444	86,420	190,404	190,413	190,404	190,404
Regenerating Forests											
Regenerating forest, pine, oak, cove, northern hardwood systems	30,444	40,877	17,777	46,869	16,877	59,869	59,869	34,869	26,877	46,869	46,869
Riparian		See Riparian Ecological System									
Ruderal											
Compliance with ruderal species guidelines	No	No	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Species Group / Indicator	Current Condition	Condition of Indicator at end of 50 years									
		Alt A	Alt A[1]	Alt B	Alt C	Alt D	Alt D*	Alt E	Alt F	Alt G	Alts H and I
Sandstone Glades and Barrens											
Compliance with sandstone glades species guidelines	No	No	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Sensitive to Over-Collection											
Compliance with guidelines for over collection	No	No	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Sensitive to Recreation Traffic											
Compliance with recreation traffic guidelines	No	No	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Shale Barrens		See Cliff, Talus and Shale Barrens Ecological System									
Shrublands											
Total shrubland acres	31,967	42,400	19,300	48,392	18,400	61,392	61,392	36,392	28,400	48,392	48,392
Total maintained Shrubland acres	1,523	1,523	1,523	1,523	1,523	1,523	1,523	1,523	1,523	1,523	1,523
Species in a Special Biologic Area											
Special Biological Area Managed for the habitat needed by the species	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

*This version of Alternative D uses a level of prescribed burning of 5,000 acres per year

Alt A[1] represents the effects of the level of activities accomplished during the past three years (2009 through 2011) under the 1993 Forest Plan.

Table F-11. Description of Indicator Condition

Species Group Indicator	Current Condition	Poor	Fair	Good
Area Sensitive Grassland and Shrubland and Open Woodlands				
Total acres of area sensitive grasslands, shrublands or open woodlands	23,247	<200,637 acres, >751,549 acres	200,637 – 520,927 acres or 631,109 – 751,549 acres	520,927 – 631,109 acres
Shrublands > 40 acres	398	<90% (358 acres) of existing blocks are maintained	90-99% of existing blocks are maintained	100% (398 acres) existing blocks are maintained
Area Sensitive Grasslands				
Area sensitive open Habitat grasslands greater than 100 ac	224	<90% (202 acres) of existing blocks are maintained	90-99 % of existing blocks are maintained	100% (224 acres) existing blocks are maintained
Area Sensitive Grasslands				
Area sensitive open habitat grasslands greater than 40 ac	389	<90% (350 acres) of existing blocks retained	90-99% of existing blocks retained	100% (389 acres) existing blocks are maintained
Area Sensitive Shrubland and Open Woodlands				
Area sensitive open habitat shrubland and open woodland greater than 100 ac	22,569	<199,959 acres, >750,871 acres	199,959 – 520,249 or 630,431 – 750,871	520,249 – 630,431
Shrublands > 100 acres	109	<90% (90 acres) of existing blocks are maintained	90-99% of existing blocks are maintained	100% (109 acres) existing blocks are maintained
Area Sensitive Mature Coniferous, Deciduous, and/or Mixed Forest Associates				
Cove, spruce, pine, oak, northern hardwood and riparian ecological systems	898,162	<404,838 acres, >940,427 acres	404,838 – 524,246 acres or 706,398 – 940,427 acres	524,246 – 706,398 acres
Calciphiles				
Total High-Quality Habitat Type Acres	6,823	0-25% (1,705 acres) of locations in SBA	26-49% of locations in SBA	50% (3,412 acres) of locations in SBA
Cavity Trees, Den Trees and Snags				
Compliance with den/cavity tree and snag guidelines	Yes	No		Yes

Species Group Indicator	Current Condition	Poor	Fair	Good
Cliff and Talus and large rock outcrops				
Compliance with cliff, talus and large rock outcrop guidelines	No	No		Yes
Fire Dependent and Fire Enhanced				
Acres burned at desired frequency in all systems	26,144	<199,850 acres, >750,762 acres	199,850 – 520,140 acres or 630,322 – 750,762 acres	520,140 – 630,322 acres
Grasslands				
Existing grasslands in open conditions	2,773	<80% (2,218 acres) of existing grasslands	80-100% of existing grasslands, many dominated by native grasses	all (2,773 acres) existing grasslands in native grasses
Total grasslands acres	2,773	<1% (7,561 acres) of oak ecosystem acres	1-3% of oak ecosystem acres	3-5% (22,682 - 37,803 acres) of Oak ecosystem acres
High Elevation Coniferous, Deciduous and/or Mixed Forests				
Total acres of oak, cove or pine ecosystems in mid-late succession at elevations >3000 feet	156,312	=<70% (109,418 acres)of current forested area >3000 feet	70-90% of current forested area >3000 feet	>90% (140,680 acres) of current forested area >3000 feet
High Elevation Openings, grassy or shrubby or open woodlands				
Total High Elevation Grassland acres	411	<80% (329 acres) of existing high elevation grasslands maintained	80-100% of existing high elevation grasslands maintained, many dominated by native grasses	all existing (411 acres) high elevation grasslands maintained in native grasses
Total high elevation shrubland acres	151	<80% (121 acres) of existing high elevation shrublands maintained	80-100% of existing high elevation shrublands maintained	all existing (151 acres) high elevation shrublands maintained in native grasses

Species Group Indicator	Current Condition	Poor	Fair	Good
Late Successional Hardwood Dominated Forest				
Mature and late successional oak, cove and northern hardwoods	689,162	<256,617 acres, >733,839 acres	256,617 – 337,114 acres or 507,917 – 733,839 acres	337,114 acres – 507,917 acres
Lepidopterans				
Compliance with lepidopteran guidelines	No	No		Yes
Occurrence Protection				
Compliance with Species Occurrence Guidelines	No	No		Yes
Open Woodlands				
Open canopy pine, oak, mafic, cliff, riparian, cove, northern hardwood systems	22,460	<199,850 acres, >750,762 acres	199,850 – 520,140 acres or 630,322 – 750,762 acres	520,140 – 630,322 acres
Regenerating Forests				
Regenerating forest, pine, oak, cove, northern hardwood systems	30,444	<29,777 acres, >295,766 acres	29,777 - 58,543 acres or 92,992 – 295,766 acre	58,543 – 92,992 acres
Ruderal				
Compliance with ruderal species guidelines	No	No		Yes
Sandstone Glades and Barrens				
Compliance with sandstone glades species guidelines	No	No		Yes
Sensitive to Over-Collection				
Compliance with guidelines for over collection	No	No		Yes
Sensitive to Recreation Traffic				
Compliance with recreation traffic guidelines	No	No		Yes
Shrublands				
Total shrubland acres	31,967	<31,569 acres, >300,659 acres	31,569 – 79,238 acres or 125,434 – 300,659 acres	79,238 - 125,434 acres
Total maintained Shrubland acres	1,523	<762 acres		1,523 acres
Species in a Special Biologic Area				
Special Biological Area Managed for the habitat needed by the species	Yes	No		Yes

The complete summary of stresses and threats for each species and how it is addressed in the Forest Plan is in Appendix F3.

6.0 PLAN COMPONENTS NEEDED FOR SPECIES DIVERSITY

6.1 INTRODUCTION

A wide array of species occurs on the GWNF, with many species sharing common habitat requirements that are associated with particular ecological systems. Plan components developed for ecosystem diversity are fundamental to providing appropriate ecological conditions for sustaining species diversity. Most species' requirements would be met in whole through ecosystem diversity plan components, meaning that provisions to restore, maintain, and protect ecological systems are sufficient to sustain plant and animal species on the forest. The first portion of this section describes how species with similar habitat needs are grouped and addressed through plan components for ecosystem diversity.

Although most species on NFS lands would be conserved through the management of healthy and productive ecosystems, even under the best conditions some species require additional attention. In the second portion of this section, those species that require further plan components are grouped by similar species needs and additional recommended plan components (typically standards) are identified for each species group. With the addition of these plan components, sustainability needs for all species would be addressed.

6.2 SPECIES GROUPS COVERED BY ECOSYSTEM DIVERSITY PLAN COMPONENTS

Those species groups whose habitat needs would be met in whole, or in part, through achieving the desired conditions for the ecological systems are identified in the following table.

Table F-12. Relationship of Species Groups to Ecological Systems

Species Group	Associated Ecological System(s)	Needs Met in Whole
Alkaline Glades and Barrens	Alkaline Glade and Woodlands and Mafic Glades and Barrens	X
Area Sensitive Late Successional Coniferous, Deciduous and/or Mixed Forests	Spruce Forest, Northern Hardwood Forest, Cove Forest, Oak Forests and Woodlands, Pine Forests and Woodlands, Floodplains Wetlands and Riparian Areas.	X
Calciphiles	Caves and Karstlands	
Caves	Caves and Karstlands	X
Cliff and Talus and Large Rock Outcrops	Cliff, Talus and Shale Barrens	
Cove Forests	Cove Forests	X
Fire Dependent and Fire Enhanced	Pine Forests and Woodlands, Alkaline Glade and Woodlands and Mafic Glades and Barrens Oak Forests and Woodlands	X
Hard and Soft Mast Dependent	Oak Forests and Woodlands	
High Elevation Coniferous, Deciduous and/or Mixed Forests	Northern Hardwood Forests Spruce Forests Pine Forests and Woodlands Oak Forests and Woodlands	
Late Successional Hardwood Dominated Forest	Oak Forests and Woodlands Cove Forests Northern Hardwood Forests	X
Mafic Rocks	Alkaline Glade and Woodlands and Mafic Glades and Barrens	X

Species Group	Associated Ecological System(s)	Needs Met in Whole
High Elevation Openings, Grassy or Shrubby or Open Woodlands	Oak Forests and Woodlands Northern Hardwood Forests Pine Forests and Woodlands	X
Shale Barrens	Cliff, Talus and Shale Barrens	
Regenerating Forests	Oak Forests and Woodlands Cove Forest Pine Forests and Woodlands	X
Shrublands	Oak Forests and Woodlands Cove Forest Pine Forests and Woodlands Alkaline Glade and Woodlands and Mafic Glades and Barrens Northern Hardwood Forests	
Open Woodlands	Oak Forests and Woodlands Cove Forest Pine Forests and Woodlands Alkaline Glade and Woodlands and Mafic Glades and Barrens Northern Hardwood Forests	X
Shale Barrens	Cliff, Talus and Shale Barrens	X
Riparian	Floodplains, Wetlands and Riparian Areas	X

6.3 SPECIES GROUPS REQUIRING ADDITIONAL PLAN COMPONENTS

This section provides details on groups of species that will require further plan components in addition to those already provided by ecological diversity. Management strategies and appropriate plan components are recommended for each group. These groups represent small spatial scales and groups of species associated with localized conditions and features that cross ecosystem boundaries.

6.3.1 Calciphile Associates

Plan Components

Ecosystem diversity plan components include desired conditions and objectives for the Cave and Karstland Ecological System and standards for caves and karstlands. Special Biological Areas should be established for the most representative calciphile sites.

Management Strategies

The communities that are most representative of the calciphile associates should be established as Special Biological Areas. These include all the areas recommended by the Virginia Natural Heritage Program. As additional significant areas are identified they should be added as special biological areas.

6.3.2 Cavity Tree, Den Tree and Snag Associates

Plan Components

Ecosystem diversity plan components include desired conditions for managed forest to provide habitat for denning and cavity nesting species. Rock falls, caves, uprooted trees, and cavity trees of all sizes serve as suitable nesting and denning sites.

The following make up the den/cavity tree and snag guidelines. Compliance with these guidelines should be met through use of standards that will address the needs of the cavity and den tree associates like:

FW: Favor the retention of large (>20" d.b.h.) standing snags and den trees when implementing silvicultural treatments. Active bear den trees are retained in harvest areas along with an unharvested buffer of at least 100 feet wide on all sides of the den.

FW: When applying herbicide, protect non-target vegetation, especially threatened, endangered, proposed, or sensitive plants by employing a physical barrier between them and the area being treated. The physical barrier must be sufficient to protect the non-target vegetation from herbicide drift and flow.

7C: Favor the retention of large (>20" d.b.h.[2]) standing snags and den trees when implementing silvicultural treatments.

Desired Condition for Management Prescription 13: Rockfalls, caves, road culverts, uprooted trees, and trees larger than 22 inches in diameter serve as potential dens. Known den trees are retained in harvest areas and future den trees will be recruited over the long term on the many acres in older age classes.

Indiana-bat standards

FW: In order to promote potential summer roost trees and maternity sites for the Indiana bat throughout the Forest, planned silvicultural practices in hardwood-dominated forest types will leave all shagbark hickory trees greater than 6 inches d.b.h. and larger, except when they pose a safety hazard. In addition:

- Clearcut openings 10 to 25 acres in size will also retain a minimum average of 6 snags or cavity trees per acre, 9 inches d.b.h. or larger, scattered or clumped.
- Group selection openings and clearcuts less than 10 acres in size have no provision for retention of a minimum number of snags, cavity trees, or residual basal area due the small opening size and safety concerns.
- All other harvesting methods (and clearcut openings 26-40 acres in size) will retain a minimum residual 15 square feet of basal area per acre (including 6 snags or cavity trees) scattered or clumped. Residual trees are greater than 6 inches d.b.h. with priority given to the largest available trees, which exhibit characteristics favored as roost trees by Indiana bats.

8E4: In order to promote fall foraging and swarming areas, timber activities will leave all shagbark hickory trees and retain a minimum average of 6 snags or cavity trees (greater than or equal to 9 inches d.b.h.) per acre as potential roost sites (except where they pose a safety hazard). For group selection harvest method, all shagbark hickories are maintained (except where they pose a safety hazard) with no provision for minimum number of snags or cavity trees due to the small opening size.

Management Strategies

Cavity and den trees are generally not limiting and with the increasing age of most of the trees in most of the ecological systems, cavity and den trees will become even more common. The key characteristics for this group are recruitment of new den/cavity trees and retention of existing trees, particularly in areas where management activities are planned. This should be done through the use of den/cavity tree and snag guidelines.

6.3.3 Cliff, Talus and Rock Outcrop Associates

Plan Components

Ecosystem diversity plan components include desired conditions and objectives for the Cliff and Talus and Shale Barrens ecological systems. In addition is the Cliff, Talus and Large Rock Outcrop guideline, described in the following standard:

When land disturbing projects are proposed in these areas:

identified species associated with this group will be searched for; and

effects of the proposed project on the species will be evaluated

Management Strategies

Manage these areas to enhance habitat for TESLR species that may occur there. Follow the Cliff, Talus and Large Rock Outcrop guidelines for managing these areas.

6.3.4 Hard and Soft Mast Associates

Plan Components

Ecosystem diversity plan components include desired conditions and objectives for open canopy, regenerating forests and mature trees (oak) in the Oak and Pine Forest and Woodlands ecological systems. In addition, an objective is needed to maintain existing shrubland areas on the GWNF.

Management Strategies

Manage to restore and maintain the open woodlands, regenerating forests and existing shrublands that produce a mixture of hard and soft mast.

6.3.5 High Elevation Coniferous, Deciduous and/or Mixed Forest Associates

Plan Components

Desired conditions and objectives that maintain the Spruce, Northern Hardwood Forest, Cove Forest, Oak Forest and Woodland, and Pine Forest and Woodland ecological systems will support this group.

Management Strategies

Manage to maintain the forested environment at high elevations (>3,000 feet). This would include all successional stages of the forests. Spruce restoration may include planting red spruce seedlings, removing exotic tree plantations, and releasing red spruce from hardwood overstory.

6.3.6 Lepidopterans

Plan Components

Lepidopteran guidelines should be incorporated with the following standard:

When projects are proposed in areas where these species occur:

- the area where the species occurs and adjacent habitat will not be treated with Dimilin, BT or other insecticides that kill lepidopterans other than gypsy moth; and
- the entire area where the species occurs will not be part of a single prescribed burn; burning will be done only in patches of the occupied habitat.

Management Strategies

Species in this group are especially sensitive to the direct effects of fire, and care should be taken whenever fire is used in areas where they are known to occur. There are no direct key characteristics for this group; however, project monitoring can determine if damage is occurring to species. These species are limited in occurrence on the GWNF, therefore implementation of special provisions at the project level are unlikely to interfere with completion of work.

When developing burn plans, the following should be considered at a minimum for all species in this group:

- Is any species from this group present or have potential to be present in project area?
- Is species habitat present in project area?
- What are the negative effects of fire to species?

What mitigation can be performed to reduce impacts to species, i.e. burning during specific part of life-cycle (hibernation, non-breeding, dormancy, etc.); protecting individuals from direct effects of fire; protecting duff layer in mesic areas; etc.?
Are there sufficient populations of this species adjacent to the project area to re-populate after the project?
Are there any additional techniques that can be used to reduce impacts?

Consideration of and mitigation for these questions should provide for species in this group.

6.3.7 Species Needing Occurrence Protection

Plan Components

Because these species are low in occurrence across the GWNF and cannot be accurately predicted by availability of habitat, ecosystem and species diversity plan components should provide some protection for these species, but additional provisions are needed due to their rarity and sensitivity to management. The following standard should be created to implement the Species Occurrence Guidelines:
When projects are proposed in areas where species in this group are likely to occur (known county, proximity to known populations, suitable habitat):
identified species associated with this group will be searched for; and
effects of the proposed project on the species will be evaluated

Management Strategies

These species are rare in occurrence across the forest and known populations should be protected. Implement the Species Occurrence Guidelines to protect these species.

6.3.8 Open Area Associates

Plan Components

Because these openings blend into one another, the objectives to meet the needs for these species groups could include:
Maintain and enhance old fields, short/medium/tall grasslands at old farm tracts.
Maintain grassland habitat. Maintain all current areas that are greater than 40 acres in size in patches at least that size, or greater. Maintain all current areas that are greater than 100 acres in size in patches at least that size.
Maintain shrubland habitat.
Areas of forest will be in the 0-10 year age class from regeneration harvest.
Restore and maintain areas in open woodland conditions through the use of fire on an annual basis.
Create or maintain grasslands, shrublands or regenerating forests on high elevation (>3,000 feet) land.
Maintain or create old fields or clusters of maintained openings (1-5 acres in size) on sites greater than 2,000 feet elevation.

Management Strategies

All of these types of opening are important. Manage to maintain existing grasslands and shrublands of all sizes. For some species it is important to maintain openings of a given size (greater than 40 acres or greater than 100 acres). Moving towards the desired open woodland component of the Oak Forest and Woodland and Pine Forest and Woodland ecological systems will produce open woodlands of a variety of sizes, including those greater than 100 acres in size. Meeting the regenerating forest objectives of the ecological systems is also important for this group. Objectives for openings at high elevations also need to be included.

It is important that these open conditions be incorporated within a forested environment. Many species need a combination of closed canopy and open canopy conditions during various parts of their life cycle. This is particularly important for many bird species.

6.3.9 Ruderal Associates

Plan Components

Add a standard to manage the old home sites, roadsides, old fields where members of the ruderal species group are found in conditions that maintain their open character.

Management Strategies

Manage the old home sites, roadsides, old fields where these species are found in conditions that maintain their open character.

6.3.10 Sandstone Glades and Barrens Associates

Plan Components

Establish Special Biological Areas for areas that represent high quality examples of this habitat.

Management Strategies

Sandstone glades and barrens may transition with other systems like cliff, talus and shale barrens. Where good examples of the sandstone glade and barren habitat are present, they are identified as Special Biological Areas. As more are identified they will be added as Special Biological Areas.

6.3.11 Species Sensitive to Over-Collection

Plan Components

Plan components include species diversity desired conditions and the following standards to limit collection of species occurring within rare communities to approved scientific purposes only:

Limit permission to collect these species;
Limit sharing of location information of these species;
Avoid improving access to these locations;
Evaluate seasonal closure of access to these locations;
Evaluate relocation of access to these locations.

Management Strategies

The strategy for these species is to continue to educate the public on species needs, restrict access to known populations, and limit approval of collections of these species to scientific purposes only.

6.3.12 Species Sensitive to Recreational Traffic

Plan Components

The following standard applies to this species group:

Provide education regarding the recreational impacts to these species;
Alert recreation users of the concerns in the area;
Avoid improving access to these locations;
Evaluate seasonal closure of access to these locations;
Evaluate relocation of access to these locations.

Management Strategies

All species on this list occur outside of rare and wetland communities. There are no ecosystem diversity plan components which cover these species. The strategy for these species is to continue to educate the public on species needs, restrict access to rare or sensitive populations, increase road ecopassage, and implement standards to protect these species where they occur during projects that involve heavy equipment or ground disturbance. New roads and trails should be located to avoid populations of these species and existing roads and trails should be evaluated for closure if they are causing declines to populations. Many roads on the Forest are not under our control, so partnerships and collaborative efforts may be required to help sustain species in this group.

6.3.13 Species with Habitat in Special Biologic Areas

These species are addressed in the Ecological Diversity Report.

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APPENDIX F1. SPECIES NOT CARRIED FORWARD INTO THE ECOLOGICAL SUSTAINABILITY ANALYSIS

Taxon	Scientific Name	Common Name	Rationale
Amphibian	*Plethodon shenandoah*	Shenandoah salamander	1
Amphibian	*Pseudacris brachyphona*	Mountain chorus frog	5
Arachnid	*Anthrobia mammouthia*	Mammoth cave spider	4a
Arachnid	*Apochthonius coecus*	A cave pseudoscorpion	4a
Arachnid	*Chitrella superba*	A cave pseudoscorpion	4a
Arachnid	*Mundochthonius holsingeri*	A cave pseudoscorpion	1
Bird	*Dendroica caerulescens*	black-throated blue warbler	5
Bird	*Ixobrychus exilis exilis*	least bittern	1
Bird	*Melanerpes erythrocephalus*	red-headed woodpecker	3
Bird	*Oporornis formosus*	Kentucky warbler	3
Bird	*Rallus elegans*	King rail	1
Insect	*Euphyes bimacula*	Two-spotted skipper	4a
Insect	*Properigea costa*	A noctuid moth	4a
Insect	*Pseudanophthalmus fuscus*	A cave beetle	1
Insect	*Pseudanophthalmus hubbardi*	Hubbard's cave beetle	1
Insect	*Pseudanophthalmus hypertrichosis*	A cave beetle	1
Insect	*Pseudanophthalmus pontis*	Natural Bridge cave beetle	1
Insect	*Pseudanophthalmus potomaca*	South Branch Valley cave beetle	4a
Insect	*Pseudanopthalmus parvicollis*	Thin-necked cave beetle	4a
Insect	*Pseudosinella granda*	A cave springtail	4a
Insect	*Pygmarrhopalites lacuna*	A cave springtail	1
Insect	*Pygmarrhopalites pavo*	A cave springtail	1
Insect	*Pygmarrhopalites silvus*	A cave springtail	1
Insect	*Remenus kirchneri*	Blue Ridge springfly	1
Insect	*Schaefferia hubbardi*	A cave springtail	4a
Insect	*Strophopteryx limata*	Newfound willowfly	1
Insect	*Sweltsa voshelli*	Virginia sallfly	1
Invertebrate	*Amaurobius borealis*	Spider	4a
Invertebrate	*Anaplectoides brunneomedia*	Brown-lined dart moth	4a
Invertebrate	*Antrolana lira*	Madison Cave isopod	1
Invertebrate	*Caecidotea bowmani*	Natural Bridge cave isopod	4a
Invertebrate	*Caecidotea vandeli*	Vandel's cave isopod	4a
Invertebrate	*Cleidogona fidelitor*	Faithful millipede	4a
Invertebrate	*Clubiona spiralis*	Two-clawed hunting spider	4a
Invertebrate	*Euchlaena milnei*	Looper moth	4a

Taxon	Scientific Name	Common Name	Rationale
Invertebrate	*Lytrosis permagnaria*	Geometrid moth	4a
Invertebrate	*Melanoplus acrophilus acrophilus*	Short-winged melanoplus	1
Invertebrate	*Melanoplus cherokee*	Cherokee melanoplus	1
Invertebrate	*Melanoplus divergens*	Divergent melanoplus	1
Invertebrate	*Melanoplus serrulatus*	Serrulate melanoplus	1
Invertebrate	*Paravitrea reesei*	Round supercoil	1
Invertebrate	*Procotyla typhlops*	A groundwater planarian	1
Invertebrate	*Pseudanophthalmus limicola*	Mud-dwelling cave beetle	1
Invertebrate	*Pseudotremia alecto*	Millipede	4a
Invertebrate	*Scudderia septentrionalis*	Northern bush katydid	1
Invertebrate	*Sphaeroderus schaumii*	Schaum's ground beetle	4a
Invertebrate	*Sphalloplana virginiana*	Rockbridge County cave planarian	1
Invertebrate	*Stygobromus baroodyi*	Rockbridge County cave amphipod	4a
Invertebrate	*Stygobromus biggersi*	Bigger's cave amphipod	1
Invertebrate	*Stygobromus estesi*	Craig County cave amphipod	1
Invertebrate	*Stygobromus fergusoni*	Montgomery County cave amphipod	1
Invertebrate	*Stygobromus pseudospinosus*	Luray Caverns amphipod	4a
Invertebrate	*Stygobromus spinosus*	Blue Ridge spring amphipod	4a
Invertebrate	*Stylodrilus beattiei*	A cave lumbriculid worm	4a
Invertebrate	*Synanthedon castaneae*	Chestnut clearwing moth	1
Invertebrate	*Trimerotropis saxatalis*	Rock-loving grasshopper	1
Mammal	*Juncus articulatus*	jointed rush	4a
Mammal	*Stygobromus stegerorum*	Madison Cave amphipod	4a
Nonvascular Plant	*Anastrophyllum saxicola*	Liverwort	1
Nonvascular Plant	*Anzia americana*	Foliose lichen	1
Nonvascular Plant	*Brachydontium trichodes*	Peak moss	1
Nonvascular Plant	*Bryoerythrophyllum ferruginascens*	Moss	1
Nonvascular Plant	*Buxbaumia minakatae*	Bug-on-a-stick moss	4a
Nonvascular Plant	*Cephaloziella massalongi*	Liverwort	1
Nonvascular Plant	*Cephaloziella spinicaulis*	Liverwort	1
Nonvascular Plant	*Diplophyllum obtusatum*	Liverwort	1
Nonvascular Plant	*Drepanolejeunea appalachiana*	Liverwort	1
Nonvascular Plant	*Entodon sullivantii*	Sullivant's entodon	1
Nonvascular Plant	*Ephebe solida*	Fructicose lichen	1
Nonvascular Plant	*Fissidens appalachensis*	Appalachian pocket moss	1
Nonvascular Plant	*Heterodermia appalachensis*	Foliose lichen	1
Nonvascular Plant	*Homaliadelphus sharpii*	Sharp's homaliadelphus	1

Taxon	Scientific Name	Common Name	Rationale
Nonvascular Plant	*Hygrohypnum closteri*	Closter's brook-hypnum	1
Nonvascular Plant	*Hypotrachyna virginica*	Foliose Lichen	1
Nonvascular Plant	*Lejeunea blomquistii*	Liverwort	1
Nonvascular Plant	*Leptodontium excelsum*	Grandfather Mountain excelsum	1
Nonvascular Plant	*Lophocolea appalachiana*	Liverwort	1
Nonvascular Plant	*Macrocoma sullivantii*	Sullivant's manned-moss	1
Nonvascular Plant	*Melanelia stygia*	Foliose lichen	1
Nonvascular Plant	*Metzgeria fruticulosa (=M. temperata)*	Liverwort	1
Nonvascular Plant	*Metzgeria uncigera*	Liverwort	1
Nonvascular Plant	*Palamocladium leskeoides*	Palamocladium	1
Nonvascular Plant	*Pannaria conoplea*	Foliose lichen	1
Nonvascular Plant	*Pellia appalachiana (= Pelia X appalachiana)*	Liverwort	1
Nonvascular Plant	*Physcia pseudospeciosa*	Rosette lichen	1
Nonvascular Plant	*Plagiochila austinii*	Liverwort	1
Nonvascular Plant	*Plagiochila caduciloba*	Liverwort	1
Nonvascular Plant	*Plagiochila sullivantii var. sullivantii*	Sullivant's leafy liverwort	1
Nonvascular Plant	*Plagiochila virginica var virginica*	Liverwort	1
Nonvascular Plant	*Polytrichum appalachianum*	Appalachian haircap moss	1
Nonvascular Plant	*Riccardia jugata*	Liverwort	1
Nonvascular Plant	*Sphagnum fallax*	Pretty peatmoss	3
Nonvascular Plant	*Sphagnum flavicomans*	Peatmoss	1
Nonvascular Plant	*Sphagnum girgensohnii*	Girgensohn's peatmoss	1
Nonvascular Plant	*Sphagnum quinquefarium*	Five-rowed peatmoss	1
Nonvascular Plant	*Tetrodontium brownianum*	Little Georgia moss	1
Nonvascular Plant	*Tortula ammonsiana = Syntrichia ammonsiana*	Ammon's tortula	1
Nonvascular Plant	*Xanthoparmelia monticola*	Xanthoparmelia lichen	1
Reptile	*Terrapene carolina*	eastern box turtle	5
Snail	*Fontigens tartarea*	Organ cavesnail	4a
Snail	*Glyphyalinia picea*	Rust glyph	4a
Snail	*Helicodiscus lirellus*	Rubble coil	4a
Vascular Plant	*Aconitum reclinatum*	white monkshood	1
Vascular Plant	*Agastache scrophulariifolia*	Giant purple hyssop	5
Vascular Plant	*Allium oxyphilum*	Nodding onion	1
Vascular Plant	*Anemone canadensis*	Canada anemone	1
Vascular Plant	*Arabis hirsuta var. adpressipilis*	hairy rockcress	1
Vascular Plant	*Arethusa bulbosa*	Dragon's mouth	1
Vascular Plant	*Aster laevis var. concinnus*	Smooth purple aster	5
Vascular Plant	*Baptisia australis*	blue wild-indigo	5

Taxon	Scientific Name	Common Name	Rationale
Vascular Plant	*Berberis canadensis*	American barberry	1
Vascular Plant	*Botrychium matricariifolium = Sceptridium oneidense*	Chamomile grape fern	4a
Vascular Plant	*Botrychium oneidense*	Blunt-lobed grape fern	4b
Vascular Plant	*Bouteloua curtipendula*	Side-oats grama	5
Vascular Plant	*Calamagrostis canadensis*	Canada reedgrass	5
Vascular Plant	*Camassia scilloides*	wild hyacinth	1
Vascular Plant	*Campanula aparinoides*	Marsh bellflower	5
Vascular Plant	*Carex conoidea*	field sedge	1
Vascular Plant	*Carex cristatella*	crested sedge	1
Vascular Plant	*Carex hitchcockiana*	Hitchcock's sedge	5
Vascular Plant	*Carex interior*	inland sedge	1
Vascular Plant	*Carex ormostachya*	necklace spike sedge	1
Vascular Plant	*Carex pedunculata*	longstalk sedge	1
Vascular Plant	*Carex plantaginea*	Plantain-leaved sedge	3
Vascular Plant	*Carex tetanica*	rigid sedge	5
Vascular Plant	*Carex trisperma*	Three-seeded sedge	5
Vascular Plant	*Carex verrucosa*	Warty sedge	1
Vascular Plant	*Chenopodium simplex*	Giant-seed goosefoot	3
Vascular Plant	*Cymophyllus fraserianus*	Fraser's sedge	5
Vascular Plant	*Diarrhena americana*	Eastern beakgrass	5
Vascular Plant	*Dicentra eximia*	Bleeding heart	5
Vascular Plant	*Dirca palustris*	Leatherwood	3
Vascular Plant	*Eriophorum virginicum*	Tawny cotton-grass	3
Vascular Plant	*Eupatorium godfreyanum*	Godfrey's thoroughwort	5
Vascular Plant	*Geum aleppicum*	yellow avens	1
Vascular Plant	*Hasteola suaveolens*	False Indian-plantain	1
Vascular Plant	*Helianthus atrorubens*	Savanna hairy sunflower	5
Vascular Plant	*Helianthus laevigatus*	smooth sunflower	5
Vascular Plant	*Heuchera parviflora*	Little-leaved alumroot	1
Vascular Plant	*Hexalectris spicata*	crested coralroot	5
Vascular Plant	*Hydrocotyle americana*	American pennywort	3
Vascular Plant	*Hypericum ellipticum*	pale St. John's-wort	1
Vascular Plant	*Isoetes virginica*	Virginia quillwort	1
Vascular Plant	*Isotria medeoloides*	small whorled pogonia	1
Vascular Plant	*Juncus subcaudatus*	Woods rush	5
Vascular Plant	*Lachnanthes caroliniana*	Carolina redroot	1
Vascular Plant	*Listera smallii*	Kidney-leaf twayblade	5

Taxon	Scientific Name	Common Name	Rationale
Vascular Plant	*Lithospermum latifolium*	American gromwell	5
Vascular Plant	*Lycopodiella margueritae*	Marguerite's clubmoss	1
Vascular Plant	*Lycopodium annotinum*	Stiff clubmoss	5
Vascular Plant	*Lysimachia radicans*	trailing loosestrife	1
Vascular Plant	*Malaxis bayardii*	Appalachian adder's-mouth	1
Vascular Plant	*Milium effusum*	Millet grass	5
Vascular Plant	*Monarda didyma*	Oswego Tea	5
Vascular Plant	*Orontium aquaticum*	Golden club	3
Vascular Plant	*Penstemon hirsutus*	hairy beardtoungue	5
Vascular Plant	*Platanthera flava var. herbiola*	Turbercled rein-orchid	5
Vascular Plant	*Polygonum arifolium = arifolia*	Halberdleaf tearthumb	5
Vascular Plant	*Polygonum cilinode = Fallopia cilinodis*	Fringed black bindweed	4b
Vascular Plant	*Pycnanthemum virginianum*	Virginia mountain mint	5
Vascular Plant	*Ranunculus trichophyllus*	white water crowfoot	1
Vascular Plant	*Ribes lacustre*	bristly black currant	4b
Vascular Plant	*Robinia hispida var kelseyi*	Kelsey's locust	4b
Vascular Plant	*Robinia viscosa*	Clammy locust	4b
Vascular Plant	*Sanicula trifoliata*	Large-fruited snakeroot	5
Vascular Plant	*Saxifraga careyana*	Golden-eye saxifrage	1
Vascular Plant	*Saxifraga caroliniana*	Carolina saxifrage	1
Vascular Plant	*Solidago squarrosa*	Squarrose goldenrod	5
Vascular Plant	*Sphenopholis pensylvanica*	Swamp wedgescale	3
Vascular Plant	*Stellaria longifolia*	Longleaf stitchwort	5
Vascular Plant	*Talinum teretifolium*	Roundleaf flame-flower	1
Vascular Plant	*Taxus canadensis*	Canada yew	5
Vascular Plant	*Thermopsis mollis (= T. m. var. mollis)*	Appalachian golden-banner	1
Vascular Plant	*Torreyochloa pallida*	Pale mannagrass	5
Vascular Plant	*Triosteum aurantiacum*	Horse gentian	5
Vascular Plant	*Vaccinium hirsutum*	Hairy blueberry	1
Vascular Plant	*Viola appalachiensis*	Appalachian blue violet	1
Vascular Plant	*Viola conspersa*	American dog violet	5
Vascular Plant	*Woodwardia areolata*	Netted chain fern	5

Key to Rationale

1 - No occurrences or habitat known on the Unit
2 - Species is unaffected by Management
3 - Unit is of marginal importance to conservation of the species
4a - Knowledge of species' ecology is insufficient to support conservation strategy
4b - Species' taxonomy is too uncertain to develop conservation strategy
5 - Species is common and demonstrably secure on the Unit
O - Other (describe in comments)

APPENDIX F2. SPECIES GROUPS BY INDIVIDUAL SPECIES

Species Scientific Name	Common Name	Species Group Name	Species Group Name	Species Group Name	Species Group Name	Species Group Name	Species Group Name	Species Group Name
Adlumia fungosa	Climbing fumatory	Occurrence Protection						
Aegolius acadicus	northern saw-whet owl	Area Sensitive Mature Coniferous, Deciduous, and/or Mixed Forest Associates	High Elevation Coniferous, Deciduous and/or Mixed Forests	Cavity Trees, Den Trees and Snags	Riparian	Species in a Special Biologic Area		
Alnus incana ssp. rugosa	speckled alder	Riparian						
Ambystoma tigrinum	Eastern tiger salamander	Late Successional Hardwood Dominated Forest	Riparian	Species in a Special Biologic Area				
Ammodramus henslowii	Henslow's sparrow	Area Sensitive Grasslands.	Occurrence Protection					
Anaphalis margaritacea	pearly everlasting	Fire Dependent and Fire Enhanced	Grasslands	Shrublands	Species in a Special Biologic Area			
Anas rubripes	American black duck	Riparian						
Apochthonius holsingeri	A cave pseudoscorpion	Caves						
Aquila chrysaetos	golden eagle	Area Sensitive Mature Coniferous, Deciduous, and/or Mixed Forest Associates						

Species Scientific Name	Common Name	Species Group Name	Species Group Name	Species Group Name	Species Group Name	Species Group Name	Species Group Name	Species Group Name
Arabis patens	Spreading rockcress	Shale barrens						
Arabis serotina	shale barren rockcress	Fire Dependent and Fire Enhanced	Shale barrens	Species in a Special Biologic Area				
Aralia hispida	bristly sarsaparilla	Cliff and Talus and large rock outcrops	Fire Dependent and Fire Enhanced	Species in a Special Biologic Area				
Arnoglossom muehlenbergii	great Indian-plantain	Fire Dependent and Fire Enhanced	Grasslands	Occurrence Protection	Riparian	Ruderal		
Aster radula	rough-leaved aster	Riparian						
Astragalus distortus	bent milkvetch	Shale barrens						
Autochton cellus	Golden-banded skipper	Lepidopterans	Riparian					
Bartramia longicauda	upland sandpiper	Area Sensitive Grasslands.	Fire Dependent and Fire Enhanced	Occurrence Protection				
Betula cordifolia	mountain paper birch	Cliff and Talus and large rock outcrops	Fire Dependent and Fire Enhanced	Species in a Special Biologic Area				
Boloria selene	Silver-bordered fritillary	Lepidopterans	Riparian	Species in a Special Biologic Area				
Boltonia montana	no common name	Riparian	Species in a Special Biologic Area					

Species Scientific Name	Common Name	Species Group Name	Species Group Name	Species Group Name	Species Group Name	Species Group Name	Species Group Name	Species Group Name
Bonasa umbellus	ruffed grouse	Fire Dependent and Fire Enhanced	Grasslands	Hard and Soft Mast Dependent	Late Successional Hardwood Dominated Forest	Riparian	Open Woodlands	Regenerating Forests & Shrublands
Bromus ciliatus	fringed brome grass	Riparian						
Bromus kalmii	wild chess	Fire Dependent and Fire Enhanced	Shale barrens	Species in a Special Biologic Area				
Buckleya distichophylla	Piratebush	Fire Dependent and Fire Enhanced	Occurrence Protection					
Callophrys irus	Frosted elfin	Fire Dependent and Fire Enhanced	Lepidopterans	Occurrence Protection	Open Woodlands			
Calopogon tuberosus	Grass pink	Riparian						
Campanula rotundifolia	American harebell	Calciphiles	Cliff and Talus and large rock outcrops	Species in a Special Biologic Area				
Caprimulgus carolinensis	chuck-will's widow	Area Sensitive Grassland and Shrubland and Open Woodlands	Fire Dependent and Fire Enhanced	Open Woodlands	Regenerating Forests			
Caprimulgus vociferus	whip-poor-will	Area Sensitive Grassland and Shrubland and Open Woodlands	Fire Dependent and Fire Enhanced	Open Woodlands	Regenerating Forests			

Species Scientific Name	Common Name	Species Group Name	Species Group Name	Species Group Name	Species Group Name	Species Group Name	Species Group Name	Species Group Name
Carex aquatilis	water sedge	Riparian	Species in a Special Biologic Area					
Carex arctata	black sedge	Riparian	Species in a Special Biologic Area					
Carex barrattii	Barratt's sedge	Riparian	Species in a Special Biologic Area					
Carex buxbaumii	Buxbaum's sedge	Riparian	Species in a Special Biologic Area					
Carex lasiocarpa var. americana	slender sedge	Riparian	Species in a Special Biologic Area					
Carex polymorpha	variable sedge	Fire Dependent and Fire Enhanced	Occurrence Protection	Species in a Special Biologic Area				
Carex roanensis	Roan Mountain sedge	Occurrence Protection	Species in a Special Biologic Area					
Carex schweinitzii	Schweinitz's sedge	Riparian						
Carex vesicaria		Riparian	Species in a Special Biologic Area					
Carpodacus purpureus	purple finch	High Elevation Openings, grassy or shrubby or open woodlands	High Elevation Coniferous, Deciduous and/or Mixed Forests	Species in a Special Biologic Area				

Species Scientific Name	Common Name	Species Group Name	Species Group Name	Species Group Name	Species Group Name	Species Group Name	Species Group Name	Species Group Name
Castor canadensis	Beaver	Riparian	Species in a Special Biologic Area					
Catharus guttatus	hermit thrush	Area Sensitive Mature Coniferous, Deciduous, and/or Mixed Forest Associates	High Elevation Coniferous, Deciduous and/or Mixed Forests	High Elevation Openings, grassy or shrubby or open woodlands	Species in a Special Biologic Area			
Catocala herodias gerhardi	Herodias underwing	Lepidopterans	Occurrence Protection	Open Woodlands				
Catocala marmorata	Marbled underwing	Lepidopterans	Occurrence Protection	Riparian				
Certhia americana	brown creeper	Area Sensitive Mature Coniferous, Deciduous, and/or Mixed Forest Associates	High Elevation Coniferous, Deciduous and/or Mixed Forests	Cavity Trees, Den Trees and Snags	Riparian	Species in a Special Biologic Area		
Cheilanthes eatonii	chestnut lipfern	Cliff and Talus and large rock outcrops	Shale barrens	Species in a Special Biologic Area				
Cicindela ancocisconensis	a tiger beetle	Riparian						
Cicindela patruela	Barrens tiger beetle	Ruderal	Sandstone glades and barrens	Species in a Special Biologic Area				
Circus cyaneus	northern harrier	Area Sensitive Grasslands.	Occurrence Protection					

Species Scientific Name	Common Name	Species Group Name	Species Group Name	Species Group Name	Species Group Name	Species Group Name	Species Group Name	Species Group Name
Cirsium altissimum	tall thistle	Ruderal	Species in a Special Biologic Area					
Clematis albicoma	White-haired Leatherflower	Shale barrens						
Clematis coactilis	Virginia white-haired leatherflower	Shale barrens						
Clematis occidentalis	purple clematis	Mafic rocks						
Clematis viticaulis	Millboro leatherflower	Shale barrens	Species in a Special Biologic Area					
Clemmys guttata	spotted turtle	Riparian	Species in a Special Biologic Area					
Coccyzus erythropthalmus	black-billed cuckoo	High Elevation Coniferous, Deciduous and/or Mixed Forests	High Elevation Openings, grassy or shrubby or open woodlands	Riparian				
Colias interior	Pink-edged sulphur	Lepidopterans	Riparian	Species in a Special Biologic Area				
Colinus virginianus	northern bobwhite	Area Sensitive Grassland and Shrubland and Open Woodlands	Fire Dependent and Fire Enhanced	Grasslands	Open Woodlands	Shrublands		
Contopus borealis	olive-sided flycatcher	High Elevation Coniferous, Deciduous and/or Mixed Forests	High Elevation Openings, grassy or shrubby or open woodlands	Riparian	Species in a Special Biologic Area	Cavity Trees, Den Trees and Snags		

Species Scientific Name	Common Name	Species Group Name	Species Group Name	Species Group Name	Species Group Name	Species Group Name	Species Group Name	Species Group Name
Corallorhiza bentleyi	Bentley's coalroot	Occurrence Protection						
Cornus canadensis	bunchberry	High Elevation Coniferous, Deciduous and/or Mixed Forests	Occurrence Protection	Species in a Special Biologic Area				
Cornus rugosa	roundleaf dogwood	Occurrence Protection	Species in a Special Biologic Area					
Corynorhinus townsendii virginianus	Virginia big-eared bat	Area Sensitive Mature Coniferous, Deciduous, and/or Mixed Forest Associates	Caves	Occurrence Protection				
Crataegus calpodendron	pear hawthorn	Occurrence Protection						
Crataegus pruinosa	prunose hawthorn	Fire Dependent and Fire Enhanced	Occurrence Protection	Species in a Special Biologic Area				
Crotalus horridus	Timber rattlesnake	Cliff and Talus and large rock outcrops	Sensitive to Over-Collection					
Cuscuta coryli	hazel dodder	Cliff and Talus and large rock outcrops	Occurrence Protection					
Cuscuta rostrata	beaked dodder	High Elevation Openings, grassy or shrubby or open woodlands	Occurrence Protection	Species in a Special Biologic Area				
Cyperus dentatus	toothed flatsedge	Riparian						

Species Scientific Name	Common Name	Species Group Name	Species Group Name	Species Group Name	Species Group Name	Species Group Name	Species Group Name	Species Group Name
Cypripedium reginae	showy lady's-slipper	Occurrence Protection	Riparian	Sensitive to Over-Collection	Species in a Special Biologic Area			
Cystopteris fragilis	fragile fern	Cliff and Talus and large rock outcrops	Species in a Special Biologic Area					
Delphinium exaltatum	tall larkspur	Calciphiles	Fire Dependent and Fire Enhanced	Open Woodlands				
Dendroica cerulea	cerulean warbler	Area Sensitive Mature Coniferous, Deciduous, and/or Mixed Forest Associates	Late Successional Hardwood Dominated Forest	Riparian				
Dendroica discolor	prairie warbler	Area Sensitive Grassland and Shrubland and Open Woodlands	Fire Dependent and Fire Enhanced	Regenerating Forests				
Dendroica fusca	blackburnian warbler	Area Sensitive Mature Coniferous, Deciduous, and/or Mixed Forest Associates	High Elevation Coniferous, Deciduous and/or Mixed Forests	Species in a Special Biologic Area				
Dendroica magnolia	magnolia warbler	High Elevation Coniferous, Deciduous and/or Mixed Forests	Regenerating Forests	Species in a Special Biologic Area	Riparian			
Desmodium canadense	showy tick-trefoil	Riparian						

Species Scientific Name	Common Name	Species Group Name	Species Group Name	Species Group Name	Species Group Name	Species Group Name	Species Group Name	Species Group Name
Desmodium cuspidatum	toothed tick-trefoil	Calciphiles	Occurrence Protection	Ruderal	Species in a Special Biologic Area			
Desmodium sessilifolium	sessile-leaf tick-trefoil	Open Woodlands	Riparian					
Echinacea laevigata	smooth coneflower	Calciphiles	Fire Dependent and Fire Enhanced	Open Woodlands	Species in a Special Biologic Area			
Echinodorus tenellus	dwarf burhead	Riparian	Species in a Special Biologic Area	Riparian				
Eleocharis compressa	flat-stemmed spikerush	Riparian						
Eleocharis melanocarpa	black-fruited spikerush	Riparian	Species in a Special Biologic Area					
Eleocharis robbinsii	Robbins spikerush	Riparian	Species in a Special Biologic Area					
Elymus canadensis	nodding wild rye	Riparian						
Elymus trachycaulus	slender wheatgrass	Fire Dependent and Fire Enhanced	Shale barrens	Species in a Special Biologic Area				
Empidonax alnorum	alder flycatcher	High Elevation Coniferous, Deciduous and/or Mixed Forests	Riparian	Species in a Special Biologic Area	Riparian			
Empidonax virescens	acadian flycatcher	Area Sensitive Mature Coniferous, Deciduous, and/or Mixed	Riparian					

Species Scientific Name	Common Name	Species Group Name	Species Group Name	Species Group Name	Species Group Name	Species Group Name	Species Group Name	Species Group Name
		Forest Associates						
Epilobium ciliatum	Hair willow-herb	Riparian						
Epilobium leptophyllum	linear-leaved willow-herb	Riparian	Species in a Special Biologic Area					
Equisetum sylvaticum	woodland horsetail	Species in a Special Biologic Area	Riparian					
Eriocaulon aquaticum	white buttons	Riparian	Species in a Special Biologic Area					
Eriogonum allenii	Yellow Buckwheat	Shale barrens						
Erora laeta	Early hairstreak	Lepidopterans	Occurrence Protection					
Erynnis martialis	Mottled duskywing	Area Sensitive Shrubland and Open Woodlands	Fire Dependent and Fire Enhanced	Lepidopterans	Occurrence Protection	Species in a Special Biologic Area		
Erynnis persius	Persius duskywing	Grasslands	Lepidopterans	Riparian	Shrublands			
Erysimum capitatum	western wallflower	Open Woodlands	Shale barrens	Species in a Special Biologic Area				
Euchloe olympia	Olympia marble	Lepidopterans	Open Woodlands	Shale barrens				
Eumeces anthracinus	coal skink	Occurrence Protection	Open Woodlands	Ruderal	Shrublands			

Species Scientific Name	Common Name	Species Group Name	Species Group Name	Species Group Name	Species Group Name	Species Group Name	Species Group Name	Species Group Name
Eupatorium maculatum	spotted joe-pye weed	Riparian						
Euphorbia purpurea	glade spurge	Calciphiles	Riparian					
Falco peregrinus	peregrine falcon	Cliff and Talus and large rock outcrops	Occurrence Protection	Open Woodlands				
Gaylussacia brachycera	box huckleberry	Fire Dependent and Fire Enhanced	Occurrence Protection	Species in a Special Biologic Area				
Geranium robertianum	herb-robert	Cliff and Talus and large rock outcrops						
Glaucomys sabrinus fuscus	Virginia northern flying squirrel	Area Sensitive Mature Coniferous, Deciduous, and/or Mixed Forest Associates	High Elevation Coniferous, Deciduous and/or Mixed Forests	Riparian	Species in a Special Biologic Area			
Glyceria acutiflora	sharp-scaled manna-grass	Riparian						
Glyceria grandis	American manna-grass	Riparian	Species in a Special Biologic Area					
Glyphyalinia raderi	Maryland glyph	Calciphiles	Occurrence Protection					
Glyptemys insculpta	wood turtle	Late Successional Hardwood Dominated Forest	Riparian	Open Woodlands	Sensitive to Over-Collection	Shrublands	Grasslands	

Species Scientific Name	Common Name	Species Group Name	Species Group Name	Species Group Name	Species Group Name	Species Group Name	Species Group Name	Species Group Name
Gnaphalium uliginosum	low cudweed	High Elevation Openings, grassy or shrubby or open woodlands	Riparian	Ruderal	Species in a Special Biologic Area			
Goodyera repens	dwarf rattlesnake plantain	Occurrence Protection	Riparian					
Gymnocarpium appalachianum	Appalachian oak fern	High Elevation Coniferous, Deciduous and/or Mixed Forests	Occurrence Protection	Species in a Special Biologic Area				
Haliaeetus leucocephalus	bald eagle	Occurrence Protection	Riparian					
Hansonoperla appalachia	Appalachian stonefly	Riparian						
Helenium virginicum	Virginia sneezeweed	Riparian	Species in a Special Biologic Area					
Helianthemum bicknellii	plains frostweed	Cliff and Talus and large rock outcrops	Open Woodlands	Sandstone glades and barrens	Species in a Special Biologic Area			
Helianthemum propinquum	low frostweed	Open Woodlands						
Helicodiscus diadema	Shaggy coil	Calciphiles	Occurrence Protection					
Helicodiscus triodus	Talus coil	Calciphiles	Occurrence Protection					
Helonias bullata	swamp-pink	Species in a Special Biologic Area	Riparian					

Species Scientific Name	Common Name	Species Group Name	Species Group Name	Species Group Name	Species Group Name	Species Group Name	Species Group Name	Species Group Name
Heuchera alba	white alumroot	High Elevation Coniferous, Deciduous and/or Mixed Forests	Occurrence Protection	Species in a Special Biologic Area				
Houstonia canadensis	Canada bluets	Alkaline glades and barrens	Calciphiles	Species in a Special Biologic Area				
Huperzia appalachiana	Appalachian fir clubmoss	High Elevation Coniferous, Deciduous and/or Mixed Forests	Riparian					
Hydraena maureenae	Maureen's shale stream beetle	Riparian						
Hypericum boreale	northern St. John's-wort	Riparian						
Hypericum mitchellianum	Blue Ridge St. John's-wort	High Elevation Coniferous, Deciduous and/or Mixed Forests	High Elevation Openings, grassy or shrubby or open woodlands	Occurrence Protection	Species in a Special Biologic Area			
Iliamna remota	Kankakee globe-mallow	Riparian						
Incisalia polia	Hoary elfin	Grasslands	Lepidopterans	Sandstone glades and barrens	Shrublands			
Isoetes lacustris	lake quillwort	Riparian	Species in a Special Biologic Area					
Isonychia tusculanensis	a mayfly	Riparian						
Juglans cinerea	butternut	Occurrence Protection						

Species Scientific Name	Common Name	Species Group Name	Species Group Name	Species Group Name	Species Group Name	Species Group Name	Species Group Name	Species Group Name
Juncus brachycephalus	small-head rush	Species in a Special Biologic Area	Riparian					
Juncus brevicaudatus	narrow-panicled rush	Species in a Special Biologic Area	Riparian					
Juniperus communis var depressa	ground juniper	High Elevation Openings, grassy or shrubby or open woodlands	Species in a Special Biologic Area	Calciphiles				
Kleptochthonius anophthalmus	A cave pseudoscorpion	Caves						
Lanius ludovicianus	loggerhead shrike	Area Sensitive Grasslands.	Grasslands	Shrublands				
Lepus americanus	snowshoe hare	High Elevation Coniferous, Deciduous and/or Mixed Forests	High Elevation Openings, grassy or shrubby or open woodlands	Regenerating Forests	Species in a Special Biologic Area			
Leucothoe fontanesiana	highland dog-hobble	Cove forests	Occurrence Protection	Species in a Special Biologic Area				
Leuctra mitchellensis	Mitchell needlefly	Riparian						
Leuctra monticola	montane needlefly	Riparian						
Liatris helleri	shale -barren blazing star	Shale barrens						
Linum lewisii	prairie flax	Calciphiles	Cliff and Talus and large rock outcrops	Open Woodlands				

Species Scientific Name	Common Name	Species Group Name	Species Group Name	Species Group Name	Species Group Name	Species Group Name	Species Group Name	Species Group Name
Linum sulcatum	grooved yellow flax	Calciphiles	Cliff and Talus and large rock outcrops	Open Woodlands				
Liochlorophis vernalis	Smooth green snake	Fire Dependent and Fire Enhanced						
Liochlorophis vernalis	Smooth green snake	High Elevation Openings, grassy or shrubby or open woodlands	Open Woodlands	Grasslands				
Liparis loeselii	Loesel's twayblade	Riparian	Species in a Special Biologic Area					
Lonicera canadensis	American fly-honeysuckle	High Elevation Coniferous, Deciduous and/or Mixed Forests	Riparian					
Loxia curvirostra	red crossbill	Area Sensitive Mature Coniferous, Deciduous, and/or Mixed Forest Associates	High Elevation Coniferous, Deciduous and/or Mixed Forests	Species in a Special Biologic Area				
Lycopodiella inundata	northern bog clubmoss	Riparian						
Lythrum alatum	winged loosestrife	Riparian						
Maianthemum stellatum	stary false Solomon's-seal	Riparian						

Species Scientific Name	Common Name	Species Group Name	Species Group Name	Species Group Name	Species Group Name	Species Group Name	Species Group Name	Species Group Name
Martes pennanti	fisher	Area Sensitive Mature Coniferous, Deciduous, and/or Mixed Forest Associates	High Elevation Coniferous, Deciduous and/or Mixed Forests	Species in a Special Biologic Area				
Megaleuctra flinti	Shenandoah needlefly	Riparian						
Meleagris gallopavo	wild turkey	Fire Dependent and Fire Enhanced	Grasslands	Hard and Soft Mast Dependent	Late Successional Hardwood Dominated Forest	Open Woodlands	Shrublands	
Melica nitens	Three-flowered melic grass	Calciphiles	Open Woodlands	Shale barrens				
Melospiza georgiana	swamp sparrow	High Elevation Openings, grassy or shrubby or open woodlands	Riparian					
Microtus chrotorrhinus carolinensis	Southern rock vole	High Elevation Coniferous, Deciduous and/or Mixed Forests	Riparian					
Miktoniscus racovitzai	Racovitza's terrestrial cave isopod	Caves						
Minuartia groenlandica	mountain sandwort	Cliff and Talus and large rock outcrops	Sensitive to Recreation Traffic	Species in a Special Biologic Area				
Monotropsis odorata	sweet pinesap	Occurrence Protection	Species in a Special Biologic Area					

Species Scientific Name	Common Name	Species Group Name	Species Group Name	Species Group Name	Species Group Name	Species Group Name	Species Group Name	Species Group Name
Muhlenbergia glomerata	marsh muhly	Mafic rocks	Species in a Special Biologic Area	Riparian				
Mustela nivalis	least weasel	Grasslands	Shrublands					
Myotis leibii	eastern small-footed bat	Caves	Cliff and Talus and large rock outcrops	Occurrence Protection				
Myotis sodalis	Indiana bat	Area Sensitive Mature Coniferous, Deciduous, and/or Mixed Forest Associates	Caves	Cavity Trees, Den Trees and Snags	Occurrence Protection	Open Woodlands	Riparian	
Nampabius turbator	Cave centipede	Calciphiles	Caves					
Nannaria shenandoah	Shenandoah Mountain xystodesmid	Occurrence Protection						
Nemotaulius hostilis	a limnephilid caddisfly	Riparian						
Neotoma magister	Alleghany woodrat	Caves	Cliff and Talus and large rock outcrops	Late Successional Hardwood Dominated Forest				
Nyctanassa violacea	yellow-crowned night-heron	Riparian						
Nycticorax nycticorax	black-crowned night-heron	Riparian						

Species Scientific Name	Common Name	Species Group Name	Species Group Name	Species Group Name	Species Group Name	Species Group Name	Species Group Name	Species Group Name
Odocoileus virginianus	white-tailed deer	Fire Dependent and Fire Enhanced	Grasslands	Hard and Soft Mast Dependent	Late Successional Hardwood Dominated Forest	Open Woodlands	Regenerating Forests	Shrublands
Oenothera argillicola	Shale-barren evening primrose	Shale barrens						
Oligoneuron rigidum	stiff goldenrod	Calciphiles	Open Woodlands	Species in a Special Biologic Area				
Onosmodium virginianum	Virginia false-gromwell	Fire Dependent and Fire Enhanced	Open Woodlands	Calciphiles				
Oporornis philadelphia	mourning warbler	High Elevation Coniferous, Deciduous and/or Mixed Forests	High Elevation Openings, grassy or shrubby or open woodlands	Regenerating Forests	Fire Dependent and Fire Enhanced			
Oryzopsis asperifolia	white-grained mtn-ricegrass	Open Woodlands	Shrublands	Species in a Special Biologic Area				
Osmunda cinnamomea var. glandulosa	glandular cinnamon fern	Species in a Special Biologic Area	Riparian					
Panax quinquefolius	Ginseng	Cove forests	Sensitive to Over-Collection					
Panax trifolius	Dwarf ginseng	Cove forests	Sensitive to Over-Collection					
Panicum hemitomon	maidencane	Riparian	Species in a Special Biologic Area					

Species Scientific Name	Common Name	Species Group Name	Species Group Name	Species Group Name	Species Group Name	Species Group Name	Species Group Name	Species Group Name
Paragnetina ishusa	widecollar stonefly	Riparian						
Paraleptophlebia jeanae	a mayfly	Riparian						
Parnassia grandifolia	Large-leaved grass-of-parnassus	Riparian						
Paronychia argyrocoma	Silver Nail-wort	Shale barrens						
Paronychia virginica	yellow nailwort	Calciphiles	Cliff and Talus and large rock outcrops	Shale barrens				
Paxistima canbyi	Canby's mountain lover	Calciphiles	Cliff and Talus and large rock outcrops					
Peltigera hydrothyria	Waterfan	Riparian						
Perlesta frisoni	Blue Ridge stonefly	Riparian						
Phlox amplifolia	Broadleaf phlox	Calciphiles	Occurrence Protection					
Phlox buckleyi	sword-leaved phlox	Fire Dependent and Fire Enhanced	Occurrence Protection	Ruderal	Species in a Special Biologic Area			
Phyciodes batesii	Tawny crescent	Lepidopterans	Occurrence Protection					
Phyciodes cocyta	Northern crescent	Lepidopterans						
Pituophis melanoleucus	northern pinesnake	Fire Dependent and Fire Enhanced	Occurrence Protection	Open Woodlands				

Species Scientific Name	Common Name	Species Group Name	Species Group Name	Species Group Name	Species Group Name	Species Group Name	Species Group Name	Species Group Name
Platanthera grandiflora	large purple fringed orchid	Riparian	Sensitive to Over-Collection	Species in a Special Biologic Area				
Platanthera peramoena	purple fringeless orchid	Riparian	Sensitive to Over-Collection					
Plethodon punctatus	Cow Knob salamander	Area Sensitive Mature Coniferous, Deciduous, and/or Mixed Forest Associates	High Elevation Coniferous, Deciduous and/or Mixed Forests	Late Successional Hardwood Dominated Forest	Species in a Special Biologic Area	Cliff and Talus and large rock outcrops		
Plethodon sherando	Big levels salamander	Open Woodlands	Species in a Special Biologic Area					
Plethodon virginia	Shenandoah Mt. salamander	Area Sensitive Mature Coniferous, Deciduous, and/or Mixed Forest Associates	High Elevation Coniferous, Deciduous and/or Mixed Forests	Late Successional Hardwood Dominated Forest	Species in a Special Biologic Area	Cliff and Talus and large rock outcrops		
Poa paludigena	bog bluegrass	Riparian						
Poa palustris	fowl bluegrass	Riparian	Species in a Special Biologic Area					
Poa saltuensis	drooping bluegrass	Mafic rocks	Open Woodlands	Species in a Special Biologic Area				
Polanisia dodecandra	common clammy-weed	Riparian						

Species Scientific Name	Common Name	Species Group Name	Species Group Name	Species Group Name	Species Group Name	Species Group Name	Species Group Name	Species Group Name
Polygonia progne	Gray comma	Grasslands	Lepidopterans	Riparian	Open Woodlands	Ruderal	Shrublands	Species in a Special Biologic Area
Potamogeton amplifolius		Riparian						
Potamogeton hillii	Hill's pondweed	Riparian						
Potamogeton oakesianus	Oakes pondweed	Riparian	Species in a Special Biologic Area					
Potamogeton tennesseensis	Tennessee pondweed	Riparian						
Potentilla arguta	tall cinquefoil	Mafic rocks	Species in a Special Biologic Area					
Prunus alleghaniensis	Alleghany sloe	Fire Dependent and Fire Enhanced	Open Woodlands	Shale barrens				
Prunus nigra	Canada plum	Ruderal	Shrublands					
Pseudanophthalmus avernus	Avernus cave beetle	Calciphiles	Caves					
Pseudanophthalmus intersectus	Crossroads cave beetle	Calciphiles	Caves					
Pseudanophthalmus nelsoni	Nelson's cave beetle	Calciphiles	Caves					
Pseudanophthalmus petrunkevitchi	Petrunkevitch's cave beetle	Calciphiles	Caves					
Pseudognaphalium macounii	Winged cudweed	Caves						

Species Scientific Name	Common Name	Species Group Name	Species Group Name	Species Group Name	Species Group Name	Species Group Name	Species Group Name	Species Group Name
Pseudotremia princeps	South Branch Valley cave millipede	Calciphiles	Caves					
Pycnanthemum torreyi	Torrey's mountain-mint	Calciphiles	Mafic rocks	Open Woodlands				
Pygmarrhopalites carolynae	Cave springtail	Calciphiles	Caves					
Pygmarrhopalites sacer	Cave springtail	Calciphiles	Caves					
Pygmarrhopalites caedus	A cave springtail	Caves	Occurrence Protection					
Pyrgus wyandot	Appalachian grizzled skipper	Fire Dependent and Fire Enhanced	Lepidopterans	Open Woodlands	Sensitive to Over-Collection	Shale barrens	Species in a Special Biologic Area	
Pyrola elliptica	shinleaf	High Elevation Coniferous, Deciduous and/or Mixed Forests	Occurrence Protection	Species in a Special Biologic Area				
Regulus satrapa	golden-crowned kinglet	High Elevation Coniferous, Deciduous and/or Mixed Forests	Species in a Special Biologic Area					
Ribes americanum	wild black currant	Species in a Special Biologic Area	Riparian					
Rosa setigera	prairie rose	Calciphiles	Open Woodlands	Shale barrens				
Rubus idaeus ssp. strigosus	American red raspberry	High Elevation Openings, grassy or shrubby or open woodlands	Species in a Special Biologic Area					

Species Scientific Name	Common Name	Species Group Name	Species Group Name	Species Group Name	Species Group Name	Species Group Name	Species Group Name	Species Group Name
Ruellia purshiana	Pursh's wild petunia	Alkaline glades and barrens	Calciphiles	Fire Dependent and Fire Enhanced	Mafic rocks			
Sabatia campanulata	slender marsh rose-pink	Species in a Special Biologic Area	Riparian					
Sagittaria calycina var calycina	long-lobed arrowhead	Species in a Special Biologic Area	Riparian					
Sagittaria rigida	sessile-fruited arrowhead	Riparian						
Satyrium favonius ontario	Northern Hairstreak	Lepidopterans	Occurrence Protection	Open Woodlands				
Saxifraga pensylvanica	swamp saxifrage	Riparian						
Schizachne purpurascens	purple oat-grass	High Elevation Coniferous, Deciduous and/or Mixed Forests	Species in a Special Biologic Area	Riparian				
Schoenoplectus subterminalis	water bulrush	Riparian	Species in a Special Biologic Area					
Scirpus ancistrochaetus	northeastern bulrush	Riparian	Species in a Special Biologic Area					
Scirpus torreyi		Riparian						
Sciurus carolinensis	gray squirrel	Late Successional Hardwood Dominated Forest	Hard and Soft Mast Dependent	Cavity Trees, Den Trees and Snags	Riparian			

Species Scientific Name	Common Name	Species Group Name	Species Group Name	Species Group Name	Species Group Name	Species Group Name	Species Group Name	Species Group Name
Sciurus niger	Eastern fox squirrel	Area Sensitive Grassland and Shrubland and Open Woodlands	Cavity Trees, Den Trees and Snags	Fire Dependent and Fire Enhanced	Hard and Soft Mast Dependent			
Scolopax minor	American woodcock	Grasslands	Riparian					
Scutellaria parvula var. parvula	small skullcap	Calciphiles	Cliff and Talus and large rock outcrops	Open Woodlands				
Scutellaria saxatilis	Rock skullcap	Cliff and Talus and large rock outcrops	Open Woodlands					
Seiurus noveboracensis	northern waterthrush	Area Sensitive Mature Coniferous, Deciduous, and/or Mixed Forest Associates	High Elevation Coniferous, Deciduous and/or Mixed Forests	Species in a Special Biologic Area	Riparian			
Semionellus placidus	Millipede	Late Successional Hardwood Dominated Forest	Occurrence Protection					
Sibbaldiopsis tridentata	three-toothed cinquefoil	Cliff and Talus and large rock outcrops	Sensitive to Recreation Traffic	Species in a Special Biologic Area				
Sida hermaphrodita	Virginia mallow	Riparian						
Sitta canadensis	red-breasted nuthatch	Cavity Trees, Den Trees and Snags	High Elevation Coniferous, Deciduous and/or Mixed Forests	Species in a Special Biologic Area				

Species Scientific Name	Common Name	Species Group Name	Species Group Name	Species Group Name	Species Group Name	Species Group Name	Species Group Name	Species Group Name
Solidago arguta var. harrisii	Shale Barren Goldenrod	Shale barrens						
Solidago randii = S. simplex var. randii	Rand's goldenrod	Species in a Special Biologic Area	Mafic rocks					
Solidago rupestris	riverbank goldenrod	Species in a Special Biologic Area	Riparian					
Solidago uliginosa	bog goldenrod	Species in a Special Biologic Area	Riparian					
Sorex palustris punctulatus	southern water shrew	High Elevation Coniferous, Deciduous and/or Mixed Forests	Riparian	Species in a Special Biologic Area				
Sparganium chlorocarpum = S. emersum	narrow-leaf burreed	Species in a Special Biologic Area	Riparian					
Spartina pectinata	freshwater cordgrass	Riparian						
Speyeria atlantis	Atlantis fritillary	Lepidopterans	Species in a Special Biologic Area	Riparian				
Speyeria diana	Diana fritillary	Lepidopterans	Open Woodlands	Sensitive to Over-Collection				
Speyeria idalia	Regal fritillary	Area Sensitive Grasslands.	Lepidopterans	Sensitive to Over-Collection				
Sphagnum russowii	Russow's peatmoss	Species in a Special Biologic Area	Riparian					

Species Scientific Name	Common Name	Species Group Name	Species Group Name	Species Group Name	Species Group Name	Species Group Name	Species Group Name	Species Group Name
Sphyrapicus varius	yellow-bellied sapsucker	High Elevation Coniferous, Deciduous and/or Mixed Forests	High Elevation Openings, grassy or shrubby or open woodlands	Riparian	Cavity Trees, Den Trees and Snags			
Spilogale putorius	Spotted Skunk	Late Successional Hardwood Dominated Forest	Shrublands	Cliff and Talus and large rock outcrops				
Spiranthes lucida	shining ladies'-tresses	Riparian						
Spiranthes ochroleuca	yellow nodding ladies'-tresses	Riparian	Open Woodlands	Species in a Special Biologic Area				
Sporobolus neglectus	small dropseed	Cliff and Talus and large rock outcrops	Shale barrens	Calciphiles				
Stygobromus gracilipes	Shenandoah Valley cave amphipod	Calciphiles	Caves					
Stygobromus hoffmani	Alleghany County cave amphipod	Calciphiles	Caves					
Stygobromus morrisoni	Morrison's cave amphipod	Calciphiles	Caves					
Stygobromus mundus	Bath County cave amphipod	Calciphiles	Caves					
Stygobromus sp. 7	Sherando spinosid amphipod	Calciphiles	Caves					

Species Scientific Name	Common Name	Species Group Name	Species Group Name	Species Group Name	Species Group Name	Species Group Name	Species Group Name	Species Group Name
Stygobromus sp. nov.	Massanutten Spring Amphipod	Calciphiles	Caves					
Sylvilagus obscurus	Appalachian Cottontail	High Elevation Coniferous, Deciduous and/or Mixed Forests	High Elevation Openings, grassy or shrubby or open woodlands					
Sylvilagus obscurus	Appalachian Cottontail	Riparian						
Symphoricarpos albus	snowberry	Calciphiles	Cliff and Talus and large rock outcrops	Species in a Special Biologic Area				
Taenidia montana	Virginia mountain pimpernel	Shale barrens						
Thryomanes bewickii altus	Appalachian Bewick's wren	High Elevation Openings, grassy or shrubby or open woodlands	Cavity Trees, Den Trees and Snags	Grasslands	Shrublands			
Thuja occidentalis	Northern white cedar	Cliff and Talus and large rock outcrops	Species in a Special Biologic Area	Calciphiles				
Triadenum fraseri	Fraser's marsh St. John's-wort	Riparian	Species in a Special Biologic Area					
Triantha racemosa	coastal false-asphodel	Riparian	Species in a Special Biologic Area					
Trichostema setaceum	narrow-leaved blue curls	Open Woodlands	Shale barrens	Species in a Special Biologic Area				

Species Scientific Name	Common Name	Species Group Name	Species Group Name	Species Group Name	Species Group Name	Species Group Name	Species Group Name	Species Group Name
Trifolium virginicum	Kate's mountain clover	Species in a Special Biologic Area	Shale barrens					
Trillium pusillum var. virginianum	mountain least trillium	High Elevation Coniferous, Deciduous and/or Mixed Forests	Species in a Special Biologic Area					
Triodopsis picea	Spruce Knob threetooth	Occurrence Protection						
Triphora trianthophora	nodding pogonia	Species in a Special Biologic Area	Occurrence Protection					
Troglodytes troglodytes	winter wren	High Elevation Coniferous, Deciduous and/or Mixed Forests	Species in a Special Biologic Area	Riparian	Cavity Trees, Den Trees and Snags			
Tyto alba	barn owl	Area Sensitive Grasslands.	Cavity Trees, Den Trees and Snags	Grasslands				
Ursus americanus	black bear	Area Sensitive Mature Coniferous, Deciduous, and/or Mixed Forest Associates	Late Successional Hardwood Dominated Forest	Cavity Trees, Den Trees and Snags	Grasslands	Hard and Soft Mast Dependent	Open Woodlands	Regenerating Forests & Shrublands
Vaccinium macrocarpon	large cranberry	Species in a Special Biologic Area	Riparian					
Verbena scabra	sandpaper vervain	Riparian						
Vermivora chrysoptera	golden winged warbler	Area Sensitive Grassland and Shrubland and Open Woodlands	High Elevation Openings, grassy or shrubby or open woodlands	Fire Dependent and Fire Enhanced	Grasslands	Riparian	Open Woodlands	Shrublands

Species Scientific Name	Common Name	Species Group Name	Species Group Name	Species Group Name	Species Group Name	Species Group Name	Species Group Name	Species Group Name
Veronica scutellata	marsh speedwell	Riparian						
Viburnum lentago	nannyberry	Riparian						
Vicia americana	American purple vetch	Riparian	Ruderal					
Viola pedatifida	prairie violet	Species in a Special Biologic Area	Shale barrens					
Virginia valeriae pulchra	mountain earth snake	Grasslands	Open Woodlands	Shrublands				
Vitis rupestris	sand grape	Species in a Special Biologic Area	Riparian					
Woodwardia virginica	Virginia chainfern	Species in a Special Biologic Area	Riparian					
Zigadenus elegans ssp. glaucus = Anticlea glauca	white camas	Cliff and Talus and large rock outcrops	Open Woodlands	Calciphiles				
Zygonopus weyeriensis	Grand Caverns blind cave millipede	Calciphiles	Caves					
Zygonopus whitei	Luray Caverns blind cave millipede	Calciphiles	Caves					

APPENDIX F3. SPECIES STRESSES AND THREATS AND FOREST PLAN STRATEGIES

Species Name	Stress	Threat	Management Strategies
Adlumia fungosa	0 None or Unknown	0 None or Unknown	
Aegolius acadicus	1 Terrestrial System/Habitat Stresses	8.1 Non-native invasive species	Establish Invasive Species Control Guidelines
Aegolius acadicus	1 Terrestrial System/Habitat Stresses	9.5.1 Acid deposition	Continue air resource management activities to reduce impacts of acid deposition
Aegolius acadicus	1.3.1 Limited existing distribution of system/habitat	11 Climate Change and Weather	Establish management strategy for climate change incl land allocation, obj and desired conditions
Aegolius acadicus	1.3.1 Limited existing distribution of system/habitat	11 Climate Change and Weather	Utilize Jefferson riparian standards
Aegolius acadicus	2 Aquatic System/Habitat Stresses	11 Climate Change and Weather	Establish management strategy for climate change incl land allocation, obj and desired conditions
Aegolius acadicus	2 Aquatic System/Habitat Stresses	11 Climate Change and Weather	Utilize Jefferson riparian standards
Aegolius acadicus	2 Aquatic System/Habitat Stresses	7.33 Lack of disturbance; succession	Utilize Jefferson riparian standards
Alnus incana ssp. rugosa	2.5 Aquatic/Riparian system modification	8.1 Non-native invasive species	Utilize Jefferson riparian standards
Ambystoma tigrinum	1.2 Modification of vegetation	7 Modification of natural systems	Protect and maintain occurrences of rare communities in SBAs in addition to those in 1993 Plan
Ammodramus henslowii	1.1 Conversion and fragmentation	7 Modification of natural systems	Establish objective for grasslands of various sizes
Ammodramus henslowii	2 Aquatic System/Habitat Stresses	7.33 Lack of disturbance; succession	Utilize Jefferson riparian standards
Anaphalis margaritacea	1.2.1 Modification of vegetation structure	7.1 Fire and fire suppression	Establish fire objective of 12,000 to 20,000 acres per year
Apochthonius holsingeri	0.3 Unknown	0.2 Unknown	
Aquila chrysaetos	1.1 Conversion and fragmentation	A Highly modified land uses	
Aquila chrysaetos	3.1.1 Accidental mortality	A Highly modified land uses	
Aquila chrysaetos	3.1.2 Persecution mortality	5.1.1 Hunting and/or poaching of terrestrial animals	Enforce laws on off road use, illegal hunting
Arabis patens	1.2.1 Modification of vegetation structure	7.33 Lack of disturbance; succession	Establish fire objective of 12,000 to 20,000 acres per year

Species Name	Stress	Threat	Management Strategies
Arabis patens	1.2.2 Modification of vegetation composition	8.1 Non-native invasive species	Utilize timber harvest to create early successional habitat, annual harvest of 1,800 - 3,000 acres
Arabis patens	1.3 Limited distribution of the system/habitat	8.2 Problematic native species	
Arabis serotina	1.2.1 Modification of vegetation structure	7.1 Fire and fire suppression	
Arabis serotina	1.2.1 Modification of vegetation structure	7.33 Lack of disturbance; succession	Establish fire objective of 12,000 to 20,000 acres per year
Arabis serotina	3.3.2 Predation	8.2 Problematic native species	
Aralia hispida	1.2.1 Modification of vegetation structure	7.33 Lack of disturbance; succession	Establish fire objective of 12,000 to 20,000 acres per year
Arnoglossom muehlenbergii	1.2.1 Modification of vegetation structure	7.1 Fire and fire suppression	Establish fire objective of 12,000 to 20,000 acres per year
Aster radula	2.5 Aquatic/Riparian system modification	7 Modification of natural systems	Utilize Jefferson riparian standards
Astragalus distortus	1.2.1 Modification of vegetation structure	7.1 Fire and fire suppression	Establish fire objective of 12,000 to 20,000 acres per year
Autochton cellus	1 Terrestrial System/Habitat Stresses	7 Modification of natural systems	Establish Lepidopteran guidelines
Autochton cellus	3.1.2 Persecution mortality	5.1.2 Collection of terrestrial animals	Establish guidelines for overcollection
Bartramia longicauda	1.1 Conversion and fragmentation	7.33 Lack of disturbance; succession	Establish fire objective of 12,000 to 20,000 acres per year
Bartramia longicauda	1.1 Conversion and fragmentation	7.33 Lack of disturbance; succession	Utilize timber harvest to create early successional habitat, annual harvest of 1,800 - 3,000 acres
Bartramia longicauda	1.2 Modification of vegetation	7.1 Fire and fire suppression	Establish fire objective of 12,000 to 20,000 acres per year
Betula cordifolia	1.2.1 Modification of vegetation structure	7.1 Fire and fire suppression	Establish fire objective of 12,000 to 20,000 acres per year
Boloria selene	1.1 Conversion and fragmentation	7.33 Lack of disturbance; succession	Establish desired condition for riparian areas
Boloria selene	1.1 Conversion and fragmentation	7.34 Loss of beaver activity	Establish desired condition for riparian areas
Boloria selene	3.1.2 Persecution mortality	5.1.2 Collection of terrestrial animals	Establish guidelines for overcollection
Boltonia montana	2.5 Aquatic/Riparian system modification	7 Modification of natural systems	Utilize Jefferson riparian standards
Bonasa umbellus	1.2.1 Modification of vegetation structure	7.1 Fire and fire suppression	Establish fire objective of 12,000 to 20,000 acres per year
Bonasa umbellus	1.2.1 Modification of vegetation structure	7.33 Lack of disturbance; succession	Establish fire objective of 12,000 to 20,000 acres per year

Species Name	Stress	Threat	Management Strategies
Bonasa umbellus	1.2.1 Modification of vegetation structure	7.33 Lack of disturbance; succession	Utilize timber harvest to create early successional habitat, annual harvest of 1,800 - 3,000 acres
Bromus ciliatus	2.5 Aquatic/Riparian system modification	7 Modification of natural systems	Utilize Jefferson riparian standards
Bromus kalmii	1.2.1 Modification of vegetation structure	7.1 Fire and fire suppression	Establish fire objective of 12,000 to 20,000 acres per year
Buckleya distichophylla	1.2.1 Modification of vegetation structure	7.1 Fire and fire suppression	Establish fire objective of 12,000 to 20,000 acres per year
Callophrys irus	1 Terrestrial System/Habitat Stresses	7.33 Lack of disturbance; succession	Establish fire objective of 12,000 to 20,000 acres per year
Callophrys irus	1 Terrestrial System/Habitat Stresses	7.33 Lack of disturbance; succession	Utilize timber harvest to create early successional habitat, annual harvest of 1,800 - 3,000 acres
Callophrys irus	1.2 Modification of vegetation	7.1 Fire and fire suppression	Establish fire objective of 12,000 to 20,000 acres per year
Callophrys irus	1.2.2 Modification of vegetation composition	7 Modification of natural systems	Establish fire objective of 12,000 to 20,000 acres per year
Callophrys irus	1.2.2 Modification of vegetation composition	7 Modification of natural systems	Establish Lepidopteran guidelines
Callophrys irus	3.1.2 Persecution mortality	5.1.2 Collection of terrestrial animals	Establish guidelines for overcollection
Calopogon tuberosus	2.5 Aquatic/Riparian system modification	7 Modification of natural systems	Utilize Jefferson riparian standards
Campanula rotundifolia	1.3 Limited distribution of the system/habitat	7 Modification of natural systems	Protect and maintain occurrences of rare communities in SBAs in addition to those in 1993 Plan
Caprimulgus carolinensis	1.2.1 Modification of vegetation structure	7.1 Fire and fire suppression	Establish fire objective of 12,000 to 20,000 acres per year
Caprimulgus carolinensis	1.2.2 Modification of vegetation composition	7.33 Lack of disturbance; succession	Establish fire objective of 12,000 to 20,000 acres per year
Caprimulgus carolinensis	1.2.2 Modification of vegetation composition	7.33 Lack of disturbance; succession	Utilize timber harvest to create early successional habitat, annual harvest of 1,800 - 3,000 acres
Caprimulgus vociferus	1.2.1 Modification of vegetation structure	7.1 Fire and fire suppression	Establish fire objective of 12,000 to 20,000 acres per year
Caprimulgus vociferus	1.2.2 Modification of vegetation composition	7.33 Lack of disturbance; succession	Establish fire objective of 12,000 to 20,000 acres per year
Caprimulgus vociferus	1.2.2 Modification of vegetation composition	7.33 Lack of disturbance; succession	Utilize timber harvest to create early successional habitat, annual harvest of 1,800 - 3,000 acres
Carex aquatilis	2.5 Aquatic/Riparian system modification	7 Modification of natural systems	Utilize Jefferson riparian standards

Species Name	Stress	Threat	Management Strategies
Carex arctata	0 None or Unknown	0 None or Unknown	
Carex barrattii	2.5 Aquatic/Riparian system modification	7 Modification of natural systems	Utilize Jefferson riparian standards
Carex buxbaumii	2.5 Aquatic/Riparian system modification	7 Modification of natural systems	Utilize Jefferson riparian standards
Carex lasiocarpa var. americana	2.5 Aquatic/Riparian system modification	7 Modification of natural systems	Utilize Jefferson riparian standards
Carex polymorpha	1.2 Modification of vegetation	7.1 Fire and fire suppression	Establish fire objective of 12,000 to 20,000 acres per year
Carex polymorpha	1.2.1 Modification of vegetation structure	7.1 Fire and fire suppression	
Carex roanensis	1.2 Modification of vegetation	7 Modification of natural systems	Establish guidelines for species occurrence
Carex schweinitzii	2.5 Aquatic/Riparian system modification	7 Modification of natural systems	Utilize Jefferson riparian standards
Carex vesicaria	2.5 Aquatic/Riparian system modification	7 Modification of natural systems	Utilize Jefferson riparian standards
Carpodacus purpureus	1.2.2 Modification of vegetation composition	9.5.1 Acid deposition	Continue air resource management activities to reduce impacts of acid deposition
Carpodacus purpureus	1.3.1 Limited existing distribution of system/habitat	11 Climate Change and Weather	Establish management strategy for climate change incl land allocation, obj and desired conditions
Carpodacus purpureus	1.3.1 Limited existing distribution of system/habitat	7.33 Lack of disturbance; succession	Establish fire objective of 12,000 to 20,000 acres per year
Carpodacus purpureus	1.3.1 Limited existing distribution of system/habitat	7.33 Lack of disturbance; succession	Utilize timber harvest to create early successional habitat, annual harvest of 1,800 - 3,000 acres
Carpodacus purpureus	2.5 Aquatic/Riparian system modification	7.33 Lack of disturbance; succession	Utilize Jefferson riparian standards
Castor canadensis	1.3.1 Limited existing distribution of system/habitat	5.1.1 Hunting and/or poaching of terrestrial animals	Establish desired condition for riparian areas
Castor canadensis	3.1.2 Persecution mortality	6 Human intrusions and disturbance	Establish desired condition for riparian areas
Catharus guttatus	1.2 Modification of vegetation	11 Climate Change and Weather	Establish management strategy for climate change incl land allocation, obj and desired conditions
Catocala herodias gerhardi	1 Terrestrial System/Habitat Stresses	7.1 Fire and fire suppression	Establish Lepidopteran guidelines
Catocala herodias gerhardi	1 Terrestrial System/Habitat Stresses	8.1 Non-native invasive species	Establish Lepidopteran guidelines
Catocala marmorata	0.3 Unknown	0.2 Unknown	
Certhia americana	1 Terrestrial System/Habitat Stresses	9.5.1 Acid deposition	Continue air resource management activities to reduce impacts of acid deposition

Species Name	Stress	Threat	Management Strategies
Certhia americana	1.3 Limited distribution of the system/habitat	11 Climate Change and Weather	Establish management strategy for climate change incl land allocation, obj and desired conditions
Certhia americana	1.3 Limited distribution of the system/habitat	7.33 Lack of disturbance; succession	Establish fire objective of 12,000 to 20,000 acres per year
Certhia americana	1.3 Limited distribution of the system/habitat	7.33 Lack of disturbance; succession	Utilize timber harvest to create early successional habitat, annual harvest of 1,800 - 3,000 acres
Certhia americana	2 Aquatic System/Habitat Stresses	9.5.1 Acid deposition	Utilize Jefferson riparian standards
Cheilanthes eatonii	1 Terrestrial System/Habitat Stresses	6 Human intrusions and disturbance	Protect and maintain occurrences of rare communities in SBAs in addition to those in 1993 Plan
Cicindela ancocisconensis	2 Aquatic System/Habitat Stresses	7.2 Dams and water management	Utilize Jefferson riparian standards
Cicindela ancocisconensis	2 Aquatic System/Habitat Stresses	7.32 Off Road Vehicles	Enforce laws on off road use, illegal hunting
Cicindela ancocisconensis	2 Aquatic System/Habitat Stresses	A.3.2 Mining and quarrying	
Cicindela patruela	1 Terrestrial System/Habitat Stresses	6 Human intrusions and disturbance	Protect and maintain occurrences of rare communities in SBAs in addition to those in 1993 Plan
Cicindela patruela	1 Terrestrial System/Habitat Stresses	7.1 Fire and fire suppression	Establish fire objective of 12,000 to 20,000 acres per year
Cicindela patruela	1 Terrestrial System/Habitat Stresses	7.32 Off Road Vehicles	Enforce laws on off road use, illegal hunting
Cirsium altissimum	1.2.1 Modification of vegetation structure	7.1 Fire and fire suppression	Establish fire objective of 12,000 to 20,000 acres per year
Clematis albicoma	1.2 Modification of vegetation	7.33 Lack of disturbance; succession	
Clematis occidentalis	1.3 Limited distribution of the system/habitat	7 Modification of natural systems	Protect and maintain occurrences of rare communities in SBAs in addition to those in 1993 Plan
Clematis occidentalis	1.3 Limited distribution of the system/habitat	7 Modification of natural systems	Utilize Jefferson riparian standards
Clematis viticaulis	1.2.1 Modification of vegetation structure	7.1 Fire and fire suppression	Establish fire objective of 12,000 to 20,000 acres per year
Clemmys guttata	2.5 Aquatic/Riparian system modification	7 Modification of natural systems	Utilize Jefferson riparian standards
Coccyzus erythropthalmus	1.2 Modification of vegetation	11 Climate Change and Weather	Establish management strategy for climate change incl land allocation, obj and desired conditions
Colias interior	1 Terrestrial System/Habitat Stresses	7 Modification of natural systems	Establish Lepidopteran guidelines

Species Name	Stress	Threat	Management Strategies
Colias interior	3.1.2 Persecution mortality	5.1.2 Collection of terrestrial animals	Establish guidelines for overcollection
Contopus borealis	1.2 Modification of vegetation	11 Climate Change and Weather	Establish management strategy for climate change incl land allocation, obj and desired conditions
Corallorhiza bentleyi	0.2 Lack of knowledge	0 None or Unknown	
Corallorhiza bentleyi	0.2 Lack of knowledge	0.2 Unknown	
Cornus canadensis	1 Terrestrial System/Habitat Stresses	7 Modification of natural systems	Establish guidelines for species occurrence
Cornus canadensis	1.2 Modification of vegetation	11 Climate Change and Weather	Establish management strategy for climate change incl land allocation, obj and desired conditions
Cornus rugosa	1.3 Limited distribution of the system/habitat	7 Modification of natural systems	Protect and maintain occurrences of rare communities in SBAs in addition to those in 1993 Plan
Corynorhinus townsendii virginianus	3.2 Disrupted activity/energy budgets	6 Human intrusions and disturbance	Establish guidelines for caves and karstlands
Corynorhinus townsendii virginianus	3.3.5 Disease	8.1 Non-native invasive species	Establish guidelines for caves and karstlands
Crataegus calpodendron	3.5 Limited population size	7 Modification of natural systems	Establish guidelines for species occurrence
Crataegus pruinosa	1.2.1 Modification of vegetation structure	7.1 Fire and fire suppression	Establish fire objective of 12,000 to 20,000 acres per year
Crotalus horridus	1.2.1 Modification of vegetation structure	7.1 Fire and fire suppression	Establish fire objective of 12,000 to 20,000 acres per year
Crotalus horridus	3.1.2 Persecution mortality	5.1.1 Hunting and/or poaching of terrestrial animals	Enforce laws on off road use, illegal hunting
Cuscuta coryli	0.3 Unknown	0.2 Unknown	
Cuscuta rostrata	0.3 Unknown	0.2 Unknown	
Cyperus dentatus	2.5 Aquatic/Riparian system modification	7 Modification of natural systems	Utilize Jefferson riparian standards
Cypripedium reginae	1.2.1 Modification of vegetation structure	7 Modification of natural systems	Establish guidelines for species occurrence
Cypripedium reginae	3.1.2 Persecution mortality	5.2 Collection of plants	Establish guidelines for overcollection
Cypripedium reginae	3.3.2 Predation	8.2 Problematic native species	
Cystopteris fragilis	1.3 Limited distribution of the system/habitat	7 Modification of natural systems	Protect and maintain occurrences of rare communities in SBAs in addition to those in 1993 Plan
Delphinium exaltatum	1.2.1 Modification of vegetation structure	7.1 Fire and fire suppression	Establish fire objective of 12,000 to 20,000 acres per year

Species Name	Stress	Threat	Management Strategies
Dendroica fusca	1.2 Modification of vegetation	11 Climate Change and Weather	Establish management strategy for climate change incl land allocation, obj and desired conditions
Dendroica magnolia	1.2 Modification of vegetation	11 Climate Change and Weather	Establish management strategy for climate change incl land allocation, obj and desired conditions
Desmodium canadense	0.3 Unknown	0.2 Unknown	
Desmodium cuspidatum	0.3 Unknown	0.2 Unknown	
Desmodium sessilifolium	0.3 Unknown	0.2 Unknown	
Echinacea laevigata	1.2.1 Modification of vegetation structure	7.1 Fire and fire suppression	Establish fire objective of 12,000 to 20,000 acres per year
Echinodorus tenellus	2.5 Aquatic/Riparian system modification	7 Modification of natural systems	Utilize Jefferson riparian standards
Eleocharis compressa	1.3 Limited distribution of the system/habitat	7 Modification of natural systems	Protect and maintain occurrences of rare communities in SBAs in addition to those in 1993 Plan
Eleocharis melanocarpa	2.5 Aquatic/Riparian system modification	7 Modification of natural systems	Utilize Jefferson riparian standards
Eleocharis robbinsii	2.5 Aquatic/Riparian system modification	7 Modification of natural systems	Utilize Jefferson riparian standards
Elymus canadensis	2.5 Aquatic/Riparian system modification	7 Modification of natural systems	Utilize Jefferson riparian standards
Elymus trachycaulus	1.2.1 Modification of vegetation structure	7.1 Fire and fire suppression	Establish fire objective of 12,000 to 20,000 acres per year
Empidonax alnorum	1.2 Modification of vegetation	11 Climate Change and Weather	Establish management strategy for climate change incl land allocation, obj and desired conditions
Epilobium ciliatum	2 Aquatic System/Habitat Stresses	7 Modification of natural systems	Utilize Jefferson riparian standards
Epilobium leptophyllum	2.5 Aquatic/Riparian system modification	7 Modification of natural systems	Utilize Jefferson riparian standards
Equisetum sylvaticum	2.5 Aquatic/Riparian system modification	7 Modification of natural systems	Utilize Jefferson riparian standards
Eriocaulon aquaticum	2.5 Aquatic/Riparian system modification	7 Modification of natural systems	Utilize Jefferson riparian standards
Eriogonum allenii	1.2.1 Modification of vegetation structure	7.33 Lack of disturbance; succession	Establish fire objective of 12,000 to 20,000 acres per year
Eriogonum allenii	1.2.1 Modification of vegetation structure	7.33 Lack of disturbance; succession	Utilize timber harvest to create early successional habitat, annual harvest of 1,800 - 3,000 acres
Eriogonum allenii	1.2.2 Modification of vegetation composition	8.1 Non-native invasive species	Establish Invasive Species Control Guidelines

Species Name	Stress	Threat	Management Strategies
Erora laeta	1 Terrestrial System/Habitat Stresses	8 Invasive & problematic species	Establish Lepidopteran guidelines
Erora laeta	1.2 Modification of vegetation	7 Modification of natural systems	Establish guidelines for species occurrence
Erora laeta	3.1.2 Persecution mortality	5.1.2 Collection of terrestrial animals	Establish guidelines for overcollection
Erynnis martialis	1 Terrestrial System/Habitat Stresses	7.1 Fire and fire suppression	Establish Lepidopteran guidelines
Erynnis martialis	1 Terrestrial System/Habitat Stresses	8.1 Non-native invasive species	Establish Lepidopteran guidelines
Erynnis martialis	1.2 Modification of vegetation	7.33 Lack of disturbance; succession	Establish fire objective of 12,000 to 20,000 acres per year
Erynnis martialis	1.2 Modification of vegetation	7.33 Lack of disturbance; succession	Utilze timber harvest to create early successional habitat, annual harvest of 1,800 - 3,000 acres
Erynnis martialis	1.2 Modification of vegetation	8.2 Problematic native species	
Erynnis martialis	3.1.2 Persecution mortality	5.1.2 Collection of terrestrial animals	Establish guidelines for overcollection
Erynnis persius	1 Terrestrial System/Habitat Stresses	7.33 Lack of disturbance; succession	Establish fire objective of 12,000 to 20,000 acres per year
Erynnis persius	1 Terrestrial System/Habitat Stresses	7.33 Lack of disturbance; succession	Utilize timber harvest to create early successional habitat, annual harvest of 1,800 - 3,000 acres
Erynnis persius	1.1 Conversion and fragmentation	8.1 Non-native invasive species	Establish Lepidopteran guidelines
Erynnis persius	3.1.2 Persecution mortality	5.1.2 Collection of terrestrial animals	Establish guidelines for overcollection
Erysimum capitatum	1.2.1 Modification of vegetation structure	7.1 Fire and fire suppression	Establish fire objective of 12,000 to 20,000 acres per year
Euchloe olympia	1 Terrestrial System/Habitat Stresses	A Highly modified land uses	Establish Lepidopteran guidelines
Euchloe olympia	3 Species Population Stresses	8.1 Non-native invasive species	Establish Lepidopteran guidelines
Euchloe olympia	3.1.2 Persecution mortality	5.1.2 Collection of terrestrial animals	Establish guidelines for overcollection
Eumeces anthracinus	1.2.1 Modification of vegetation structure	7.1 Fire and fire suppression	Establish fire objective of 12,000 to 20,000 acres per year
Eupatorium maculatum	2.5 Aquatic/Riparian system modification	7 Modification of natural systems	Utilize Jefferson riparian standards
Euphorbia purpurea	2.5 Aquatic/Riparian system modification	7 Modification of natural systems	Utilize Jefferson riparian standards
Gaylussacia brachycera	1.2 Modification of vegetation	7.1 Fire and fire suppression	Establish fire objective of 12,000 to 20,000 acres per year
Gaylussacia brachycera	1.2.1 Modification of vegetation structure	7.1 Fire and fire suppression	
Geranium robertianum	1.3 Limited distribution of the system/habitat	5.3 Timber harvest	Establish guidelines for cliff and talus and shale barren areas

Species Name	Stress	Threat	Management Strategies
Glaucomys sabrinus fuscus	1.2 Modification of vegetation	11 Climate Change and Weather	Establish management strategy for climate change incl land allocation, obj and desired conditions
Glyceria acutiflora	2.5 Aquatic/Riparian system modification	7 Modification of natural systems	Utilize Jefferson riparian standards
Glyceria grandis	2.5 Aquatic/Riparian system modification	7 Modification of natural systems	Utilize Jefferson riparian standards
Glyphyalinia raderi	1 Terrestrial System/Habitat Stresses	A Highly modified land uses	Establish guidelines for species occurrence
Glyphyalinia raderi	1.2 Modification of vegetation	7.1 Fire and fire suppression	Establish guidelines for species occurrence
Glyphyalinia raderi	3 Species Population Stresses	9.5.1 Acid deposition	Continue air resource management activities to reduce impacts of acid deposition
Glyphyalinia raderi	3.1.1 Accidental mortality	6.1 Recreational activities	Establish guidelines for species occurrence
Glyphyalinia raderi	3.3 Interspecific interactions	8.1 Non-native invasive species	
Glyptemys insculpta	2 Aquatic System/Habitat Stresses	7 Modification of natural systems	Establish management strategy for managing wood turtle habitat
Glyptemys insculpta	2.5 Aquatic/Riparian system modification	7 Modification of natural systems	
Glyptemys insculpta	3.1.2 Persecution mortality	5.1.1 Hunting and/or poaching of terrestrial animals	Enforce laws on off road use, illegal hunting
Glyptemys insculpta	3.1.2 Persecution mortality	5.1.1 Hunting and/or poaching of terrestrial animals	Establish guidelines for overcollection
Gnaphalium uliginosum	2.5 Aquatic/Riparian system modification	7 Modification of natural systems	Utilize Jefferson riparian standards
Goodyera repens	1.2 Modification of vegetation	5.3 Timber harvest	Establish guidelines for species occurrence
Gymnocarpium appalachianum	1.2 Modification of vegetation	11 Climate Change and Weather	Establish management strategy for climate change incl land allocation, obj and desired conditions
Gymnocarpium appalachianum	1.2 Modification of vegetation	5.3 Timber harvest	Establish guidelines for species occurrence
Hansonoperla appalachia	2 Aquatic System/Habitat Stresses	7 Modification of natural systems	Utilize Jefferson riparian standards
Helenium virginicum	1.2.1 Modification of vegetation structure	7.1 Fire and fire suppression	Establish fire objective of 12,000 to 20,000 acres per year
Helenium virginicum	2.5 Aquatic/Riparian system modification	7 Modification of natural systems	Utilize Jefferson riparian standards
Helianthemum bicknellii	1.2.1 Modification of vegetation structure	7.1 Fire and fire suppression	Establish fire objective of 12,000 to 20,000 acres per year
Helianthemum propinquum	1.2.1 Modification of vegetation structure	7.1 Fire and fire suppression	Establish fire objective of 12,000 to 20,000 acres per year

Species Name	Stress	Threat	Management Strategies
Helicodiscus diadema	1 Terrestrial System/Habitat Stresses	7.32 Off Road Vehicles	Enforce laws on off road use, illegal hunting
Helicodiscus diadema	1 Terrestrial System/Habitat Stresses	A Highly modified land uses	Establish guidelines for species occurrence
Helicodiscus diadema	1.2 Modification of vegetation	7.1 Fire and fire suppression	Establish guidelines for species occurrence
Helicodiscus diadema	3 Species Population Stresses	9.5.1 Acid deposition	Continue air resource management activities to reduce impacts of acid deposition
Helicodiscus diadema	3.1.1 Accidental mortality	6.1 Recreational activities	Establish guidelines for species occurrence
Helicodiscus diadema	3.3 Interspecific interactions	8.1 Non-native invasive species	
Helicodiscus triodus	1 Terrestrial System/Habitat Stresses	A Highly modified land uses	Establish guidelines for species occurrence
Helicodiscus triodus	1.2 Modification of vegetation	7.1 Fire and fire suppression	Establish guidelines for species occurrence
Helicodiscus triodus	3 Species Population Stresses	9.5.1 Acid deposition	Continue air resource management activities to reduce impacts of acid deposition
Helicodiscus triodus	3.1.1 Accidental mortality	6.1 Recreational activities	Establish guidelines for species occurrence
Helicodiscus triodus	3.3 Interspecific interactions	8.1 Non-native invasive species	
Helonias bullata	1.3.2 Limited potential distribution of system/habitat	7 Modification of natural systems	
Helonias bullata	2.5 Aquatic/Riparian system modification	7 Modification of natural systems	Utilize Jefferson riparian standards
Helonias bullata	3.3.2 Predation	8.2 Problematic native species	
Heuchera alba	1.2 Modification of vegetation	11 Climate Change and Weather	Establish management strategy for climate change incl land allocation, obj and desired conditions
Heuchera alba	3.5 Limited population size	7 Modification of natural systems	Establish guidelines for species occurrence
Houstonia canadensis	1.3 Limited distribution of the system/habitat	7 Modification of natural systems	Protect and maintain occurrences of rare communities in SBAs in addition to those in 1993 Plan
Huperzia appalachiana	1.2 Modification of vegetation	11 Climate Change and Weather	Establish management strategy for climate change incl land allocation, obj and desired conditions
Huperzia appalachiana	1.3 Limited distribution of the system/habitat	7 Modification of natural systems	Utilize Jefferson riparian standards
Hydraena maureenae	2 Aquatic System/Habitat Stresses	11.2 Droughts	Utilize Jefferson riparian standards
Hypericum boreale	2.5 Aquatic/Riparian system modification	7 Modification of natural systems	Utilize Jefferson riparian standards

Species Name	Stress	Threat	Management Strategies
Hypericum mitchellianum	1.2 Modification of vegetation	11 Climate Change and Weather	Establish management strategy for climate change incl land allocation, obj and desired conditions
Hypericum mitchellianum	1.2 Modification of vegetation	5.3 Timber harvest	Establish guidelines for species occurrence
Iliamna remota	2.5 Aquatic/Riparian system modification	7 Modification of natural systems	Utilize Jefferson riparian standards
Incisalia polia	1.2.2 Modification of vegetation composition	7 Modification of natural systems	Establish Lepidopteran guidelines
Isoetes lacustris	2.5 Aquatic/Riparian system modification	7 Modification of natural systems	Utilize Jefferson riparian standards
Isonychia tusculanensis	0.3 Unknown	0.2 Unknown	
Isonychia tusculanensis	2.5 Aquatic/Riparian system modification	7 Modification of natural systems	Utilize Jefferson riparian standards
Juglans cinerea	3.3.5 Disease	8 Invasive & problematic species	
Juncus brachycephalus	2.5 Aquatic/Riparian system modification	7 Modification of natural systems	Utilize Jefferson riparian standards
Juncus brevicaudatus	2.5 Aquatic/Riparian system modification	7 Modification of natural systems	Utilize Jefferson riparian standards
Juniperus communis var depressa	1.2.1 Modification of vegetation structure	7.1 Fire and fire suppression	Establish fire objective of 12,000 to 20,000 acres per year
Kleptochthonius anophthalmus	1 Terrestrial System/Habitat Stresses	A Highly modified land uses	Establish guidelines for caves and karstlands
Lepus americanus	1.2 Modification of vegetation	11 Climate Change and Weather	Establish management strategy for climate change incl land allocation, obj and desired conditions
Lepus americanus	1.2 Modification of vegetation	7.33 Lack of disturbance; succession	Establish fire objective of 12,000 to 20,000 acres per year
Lepus americanus	1.2 Modification of vegetation	7.33 Lack of disturbance; succession	Utilize timber harvest to create early successional habitat, annual harvest of 1,800 - 3,000 acres
Leucothoe fontanesiana	1.3 Limited distribution of the system/habitat	7 Modification of natural systems	Protect and maintain occurrences of rare communities in SBAs in addition to those in 1993 Plan
Leuctra mitchellensis	0.3 Unknown	0.2 Unknown	
Leuctra mitchellensis	2.5 Aquatic/Riparian system modification	7 Modification of natural systems	Utilize Jefferson riparian standards
Leuctra monticola	0.3 Unknown	0.2 Unknown	
Leuctra monticola	2.5 Aquatic/Riparian system modification	7 Modification of natural systems	Utilize Jefferson riparian standards
Liatris helleri	1.2.1 Modification of vegetation structure	7.1 Fire and fire suppression	Establish fire objective of 12,000 to 20,000 acres per year

Species Name	Stress	Threat	Management Strategies
Linum lewisii	1.3.2 Limited potential distribution of system/habitat	7 Modification of natural systems	
Linum sulcatum	1.2.1 Modification of vegetation structure	7.1 Fire and fire suppression	Establish fire objective of 12,000 to 20,000 acres per year
Liochlorophis vernalis	1.2.1 Modification of vegetation structure	7.1 Fire and fire suppression	Establish fire objective of 12,000 to 20,000 acres per year
Liparis loeselii	2.5 Aquatic/Riparian system modification	7 Modification of natural systems	Utilize Jefferson riparian standards
Lonicera canadensis	1.2 Modification of vegetation	11 Climate Change and Weather	Establish management strategy for climate change incl land allocation, obj and desired conditions
Lonicera canadensis	2 Aquatic System/Habitat Stresses	7 Modification of natural systems	Utilize Jefferson riparian standards
Loxia curvirostra	1.2 Modification of vegetation	11 Climate Change and Weather	Establish management strategy for climate change incl land allocation, obj and desired conditions
Lycopodiella inundata	2.5 Aquatic/Riparian system modification	7 Modification of natural systems	Utilize Jefferson riparian standards
Lythrum alatum	2.5 Aquatic/Riparian system modification	7 Modification of natural systems	Utilize Jefferson riparian standards
Maianthemum stellatum	2.5 Aquatic/Riparian system modification	7 Modification of natural systems	Utilize Jefferson riparian standards
Martes pennanti	1.2 Modification of vegetation	11 Climate Change and Weather	Establish management strategy for climate change incl land allocation, obj and desired conditions
Megaleuctra flinti	2 Aquatic System/Habitat Stresses	7 Modification of natural systems	Utilize Jefferson riparian standards
Megaleuctra flinti	2 Aquatic System/Habitat Stresses	7.2 Dams and water management	Utilize Jefferson riparian standards
Megaleuctra flinti	2.3 Water temperature modification	11.3 Temperature extremes	Utilize Jefferson riparian standards
Megaleuctra flinti	2.4 Water chemistry modification	9.5.1 Acid deposition	Utilize Jefferson riparian standards
Melica nitens	1.3.2 Limited potential distribution of system/habitat	7 Modification of natural systems	
Microtus chrotorrhinus carolinensis	1.2 Modification of vegetation	11 Climate Change and Weather	Establish management strategy for climate change incl land allocation, obj and desired conditions
Miktoniscus racovitzai	1 Terrestrial System/Habitat Stresses	A Highly modified land uses	Establish guidelines for caves and karstlands
Minuartia groenlandica	3.1.1 Accidental mortality	6.1 Recreational activities	Establish guidelines for recreation traffic
Monotropsis odorata	0 None or Unknown	0 None or Unknown	
Muhlenbergia glomerata	2.5 Aquatic/Riparian system modification	7 Modification of natural systems	Utilize Jefferson riparian standards

Species Name	Stress	Threat	Management Strategies
Myotis sodalis	1.3 Limited distribution of the system/habitat	0.1 None	
Myotis sodalis	3.2 Disrupted activity/energy budgets	6 Human intrusions and disturbance	Establish guidelines for caves and karstlands
Myotis sodalis	3.3.5 Disease	8 Invasive & problematic species	Establish guidelines for caves and karstlands
Nampabius turbator	1 Terrestrial System/Habitat Stresses	6.1 Recreational activities	Establish guidelines for caves and karstlands
Nannaria shenandoah	0.3 Unknown	0.2 Unknown	
Nannaria shenandoah	1 Terrestrial System/Habitat Stresses	A Highly modified land uses	Establish guidelines for species occurrence
Nemotaulius hostilis	0.3 Unknown	0.2 Unknown	
Nemotaulius hostilis	2.5 Aquatic/Riparian system modification	7 Modification of natural systems	Utilize Jefferson riparian standards
Oenothera argillicola	1.2.1 Modification of vegetation structure	7.1 Fire and fire suppression	Establish fire objective of 12,000 to 20,000 acres per year
Oligoneuron rigidum	1.2.1 Modification of vegetation structure	7.1 Fire and fire suppression	Establish fire objective of 12,000 to 20,000 acres per year
Onosmodium virginianum	1.3.2 Limited potential distribution of system/habitat	7.1 Fire and fire suppression	Establish fire objective of 12,000 to 20,000 acres per year
Oporornis philadelphia	1.2 Modification of vegetation	11 Climate Change and Weather	Establish management strategy for climate change incl land allocation, obj and desired conditions
Oryzopsis asperifolia	1.2.1 Modification of vegetation structure	7.1 Fire and fire suppression	Establish fire objective of 12,000 to 20,000 acres per year
Osmunda cinnamomea var. glandulosa	2.5 Aquatic/Riparian system modification	7 Modification of natural systems	Utilize Jefferson riparian standards
Panax quinquefolius	3.1 Direct mortality	5.2 Collection of plants	
Panax quinquefolius	3.1.2 Persecution mortality	5.2 Collection of plants	Establish guidelines for overcollection
Panax trifolius	3.1.2 Persecution mortality	5.2 Collection of plants	Establish guidelines for overcollection
Panicum hemitomon	2.5 Aquatic/Riparian system modification	7 Modification of natural systems	Utilize Jefferson riparian standards
Paragnetina ishusa	0.3 Unknown	0.2 Unknown	
Paragnetina ishusa	2.5 Aquatic/Riparian system modification	7 Modification of natural systems	Utilize Jefferson riparian standards
Paraleptophlebia jeanae	0.3 Unknown	0.2 Unknown	
Paraleptophlebia jeanae	2.5 Aquatic/Riparian system modification	7 Modification of natural systems	Utilize Jefferson riparian standards
Parnassia grandifolia	2.5 Aquatic/Riparian system modification	7 Modification of natural systems	Utilize Jefferson riparian standards
Paronychia argyrocoma	1.2.1 Modification of vegetation structure	7.33 Lack of disturbance; succession	Establish fire objective of 12,000 to 20,000 acres per year

Species Name	Stress	Threat	Management Strategies
Paronychia argyrocoma	1.2.1 Modification of vegetation structure	7.33 Lack of disturbance; succession	Utilize timber harvest to create early successional habitat, annual harvest of 1,800 - 3,000 acres
Paronychia argyrocoma	1.2.2 Modification of vegetation composition	8.1 Non-native invasive species	Establish Invasive Species Control Guidelines
Paronychia virginica	1.2.1 Modification of vegetation structure	7.1 Fire and fire suppression	
Paronychia virginica	1.3.2 Limited potential distribution of system/habitat	7 Modification of natural systems	Establish fire objective of 12,000 to 20,000 acres per year
Paxistima canbyi	1.3.2 Limited potential distribution of system/habitat	7 Modification of natural systems	
Peltigera hydrothyria	2 Aquatic System/Habitat Stresses	11 Climate Change and Weather	Establish management strategy for climate change incl land allocation, obj and desired conditions
Peltigera hydrothyria	2 Aquatic System/Habitat Stresses	11 Climate Change and Weather	Utilize Jefferson riparian standards
Peltigera hydrothyria	2.1 Stream flow modification	7.2 Dams and water management	Utilize Jefferson riparian standards
Peltigera hydrothyria	2.5 Aquatic/Riparian system modification	7 Modification of natural systems	
Peltigera hydrothyria	3.5 Limited population size	0.2 Unknown	
Perlesta frisoni	0.3 Unknown	0.2 Unknown	
Phlox amplifolia	0 None or Unknown	0 None or Unknown	
Phlox buckleyi	1.2.1 Modification of vegetation structure	7.1 Fire and fire suppression	Establish fire objective of 12,000 to 20,000 acres per year
Phyciodes batesii	1.2.2 Modification of vegetation composition	7 Modification of natural systems	Establish Lepidopteran guidelines
Phyciodes cocyta	1 Terrestrial System/Habitat Stresses	7 Modification of natural systems	Establish Lepidopteran guidelines
Phyciodes cocyta	3.1.2 Persecution mortality	5.1.2 Collection of terrestrial animals	Establish guidelines for overcollection
Pituophis melanoleucus	1.2.1 Modification of vegetation structure	7.1 Fire and fire suppression	Establish fire objective of 12,000 to 20,000 acres per year
Platanthera grandiflora	2.5 Aquatic/Riparian system modification	7 Modification of natural systems	Utilize Jefferson riparian standards
Platanthera peramoena	2.5 Aquatic/Riparian system modification	7 Modification of natural systems	Utilize Jefferson riparian standards
Plethodon punctatus	1.2 Modification of vegetation	11 Climate Change and Weather	Establish management strategy for climate change incl land allocation, obj and desired conditions
Plethodon punctatus	1.2.1 Modification of vegetation structure	5.3 Timber harvest	Protect and maintain occurrences of rare communities in SBAs in addition to those in 1993 Plan
Plethodon punctatus	1.2.1 Modification of vegetation structure	7 Modification of natural systems	

Species Name	Stress	Threat	Management Strategies
Plethodon sherando	0 None or Unknown	0 None or Unknown	
Plethodon sherando	1.2.1 Modification of vegetation structure	5.3 Timber harvest	Protect and maintain occurrences of rare communities in SBAs in addition to those in 1993 Plan
Plethodon virginia	1.2 Modification of vegetation	11 Climate Change and Weather	Establish management strategy for climate change incl land allocation, obj and desired conditions
Plethodon virginia	1.2.1 Modification of vegetation structure	5.3 Timber harvest	Protect and maintain occurrences of rare communities in SBAs in addition to those in 1993 Plan
Plethodon virginia	1.2.1 Modification of vegetation structure	7 Modification of natural systems	
Poa paludigena	2.5 Aquatic/Riparian system modification	7 Modification of natural systems	Utilize Jefferson riparian standards
Poa palustris	2.5 Aquatic/Riparian system modification	7 Modification of natural systems	Utilize Jefferson riparian standards
Poa saltuensis	1.2.1 Modification of vegetation structure	7.1 Fire and fire suppression	Establish fire objective of 12,000 to 20,000 acres per year
Polanisia dodecandra	2.1 Stream flow modification	7.2 Dams and water management	Utilize Jefferson riparian standards
Polanisia dodecandra	2.5 Aquatic/Riparian system modification	7 Modification of natural systems	Utilize Jefferson riparian standards
Polygonia progne	1 Terrestrial System/Habitat Stresses	7 Modification of natural systems	Establish objective for grasslands of various sizes
Polygonia progne	1 Terrestrial System/Habitat Stresses	7 Modification of natural systems	Establish objective for oak open woodlands
Polygonia progne	3.1.2 Persecution mortality	5.1.2 Collection of terrestrial animals	Establish guidelines for overcollection
Potamogeton amplifolius	2.5 Aquatic/Riparian system modification	7 Modification of natural systems	Utilize Jefferson riparian standards
Potamogeton hillii	2.5 Aquatic/Riparian system modification	7 Modification of natural systems	Utilize Jefferson riparian standards
Potamogeton oakesianus	2.5 Aquatic/Riparian system modification	7 Modification of natural systems	Utilize Jefferson riparian standards
Potamogeton tennesseensis	2.5 Aquatic/Riparian system modification	7 Modification of natural systems	Utilize Jefferson riparian standards
Potentilla arguta	1.2.1 Modification of vegetation structure	7 Modification of natural systems	Protect and maintain occurrences of rare communities in SBAs in addition to those in 1993 Plan
Prunus alleghaniensis	1.2.1 Modification of vegetation structure	7.1 Fire and fire suppression	Establish fire objective of 12,000 to 20,000 acres per year
Prunus nigra	1.2.1 Modification of vegetation structure	7.1 Fire and fire suppression	Establish fire objective of 12,000 to 20,000 acres per year
Pseudanophthalmus avernus	1 Terrestrial System/Habitat Stresses	6.1 Recreational activities	Establish guidelines for caves and karstlands

Species Name	Stress	Threat	Management Strategies
Pseudanophthalmus avernus	1 Terrestrial System/Habitat Stresses	7 Modification of natural systems	Establish guidelines for caves and karstlands
Pseudanophthalmus intersectus	1 Terrestrial System/Habitat Stresses	6.1 Recreational activities	Establish guidelines for caves and karstlands
Pseudanophthalmus intersectus	1 Terrestrial System/Habitat Stresses	7 Modification of natural systems	Establish guidelines for caves and karstlands
Pseudanophthalmus nelsoni	1 Terrestrial System/Habitat Stresses	6.1 Recreational activities	Establish guidelines for caves and karstlands
Pseudanophthalmus nelsoni	1 Terrestrial System/Habitat Stresses	7 Modification of natural systems	Establish guidelines for caves and karstlands
Pseudanophthalmus petrunkevitchi	1 Terrestrial System/Habitat Stresses	6.1 Recreational activities	Establish guidelines for caves and karstlands
Pseudanophthalmus petrunkevitchi	1 Terrestrial System/Habitat Stresses	7 Modification of natural systems	Establish guidelines for caves and karstlands
Pseudognaphalium macounii	1.2.1 Modification of vegetation structure	7.1 Fire and fire suppression	Establish fire objective of 12,000 to 20,000 acres per year
Pseudognaphalium macounii	3.3.1 Competition	7.33 Lack of disturbance; succession	Utilize timber harvest to create early successional habitat, annual harvest of 1,800 - 3,000 acres
Pseudotremia princeps	0.3 Unknown	0.2 Unknown	
Pseudotremia princeps	1 Terrestrial System/Habitat Stresses	6.1 Recreational activities	Establish guidelines for caves and karstlands
Pseudotremia princeps	1 Terrestrial System/Habitat Stresses	7 Modification of natural systems	Establish guidelines for caves and karstlands
Pycnanthemum torreyi	1.2.1 Modification of vegetation structure	7.1 Fire and fire suppression	Establish fire objective of 12,000 to 20,000 acres per year
Pygmarrhopalites carolynae	0.3 Unknown	0.2 Unknown	
Pygmarrhopalites sacer	0.3 Unknown	0.2 Unknown	
Pygmarrhopalites caedus	0.3 Unknown	0.2 Unknown	
Pyrgus wyandot	1 Terrestrial System/Habitat Stresses	7.33 Lack of disturbance; succession	Establish fire objective of 12,000 to 20,000 acres per year
Pyrgus wyandot	1 Terrestrial System/Habitat Stresses	7.33 Lack of disturbance; succession	Utilize timber harvest to create early successional habitat, annual harvest of 1,800 - 3,000 acres
Pyrgus wyandot	1.2.1 Modification of vegetation structure	7.33 Lack of disturbance; succession	Establish fire objective of 12,000 to 20,000 acres per year
Pyrgus wyandot	1.2.1 Modification of vegetation structure	7.33 Lack of disturbance; succession	Utilize timber harvest to create early successional habitat, annual harvest of 1,800 - 3,000 acres
Pyrgus wyandot	1.2.2 Modification of vegetation composition	7.1 Fire and fire suppression	Establish fire objective of 12,000 to 20,000 acres per year
Pyrgus wyandot	1.2.2 Modification of vegetation composition	7.1 Fire and fire suppression	Establish Lepidopteran guidelines

Species Name	Stress	Threat	Management Strategies
Pyrgus wyandot	1.3.1 Limited existing distribution of system/habitat	7 Modification of natural systems	Protect and maintain occurrences of rare communities in SBAs in addition to those in 1993 Plan
Pyrgus wyandot	3 Species Population Stresses	8.1 Non-native invasive species	Establish Lepidopteran guidelines
Pyrgus wyandot	3.1.2 Persecution mortality	5.1.2 Collection of terrestrial animals	Establish guidelines for overcollection
Pyrola elliptica	1.2 Modification of vegetation	11 Climate Change and Weather	Establish management strategy for climate change incl land allocation, obj and desired conditions
Pyrola elliptica	1.2 Modification of vegetation	5.3 Timber harvest	
Pyrola elliptica	1.3.1 Limited existing distribution of system/habitat	0 None or Unknown	
Regulus satrapa	1.2 Modification of vegetation	11 Climate Change and Weather	Establish management strategy for climate change incl land allocation, obj and desired conditions
Ribes americanum	2.5 Aquatic/Riparian system modification	7 Modification of natural systems	Utilize Jefferson riparian standards
Rosa setigera	1.2.1 Modification of vegetation structure	7.1 Fire and fire suppression	Establish fire objective of 12,000 to 20,000 acres per year
Rubus idaeus ssp. strigosus	1.2.1 Modification of vegetation structure	7.1 Fire and fire suppression	Establish fire objective of 12,000 to 20,000 acres per year
Ruellia purshiana	1.2.1 Modification of vegetation structure	7.1 Fire and fire suppression	Establish fire objective of 12,000 to 20,000 acres per year
Sabatia campanulata	2.5 Aquatic/Riparian system modification	7 Modification of natural systems	Utilize Jefferson riparian standards
Sagittaria calycina var calycina	2.5 Aquatic/Riparian system modification	7 Modification of natural systems	Utilize Jefferson riparian standards
Sagittaria rigida	2.5 Aquatic/Riparian system modification	7 Modification of natural systems	Utilize Jefferson riparian standards
Satyrium favonius ontario	1 Terrestrial System/Habitat Stresses	8.1 Non-native invasive species	Establish Invasive Species Control Guidelines
Satyrium favonius ontario	1.2.2 Modification of vegetation composition	7.1 Fire and fire suppression	Establish Lepidopteran guidelines
Satyrium favonius ontario	3.1.2 Persecution mortality	5.1.2 Collection of terrestrial animals	Establish guidelines for overcollection
Satyrium favonius ontario	3.5 Limited population size	0.2 Unknown	
Saxifraga pensylvanica	2.5 Aquatic/Riparian system modification	7 Modification of natural systems	Utilize Jefferson riparian standards
Schizachne purpurascens	1 Terrestrial System/Habitat Stresses	11 Climate Change and Weather	Establish management strategy for climate change incl land allocation, obj and desired conditions

Species Name	Stress	Threat	Management Strategies
Schizachne purpurascens	1.2 Modification of vegetation	7 Modification of natural systems	Protect and maintain occurrences of rare communities in SBAs in addition to those in 1993 Plan
Schoenoplectus subterminalis	2.5 Aquatic/Riparian system modification	7 Modification of natural systems	Utilize Jefferson riparian standards
Scirpus ancistrochaetus	2.5 Aquatic/Riparian system modification	7 Modification of natural systems	Utilize Jefferson riparian standards
Scirpus torreyi	2.5 Aquatic/Riparian system modification	7 Modification of natural systems	Utilize Jefferson riparian standards
Scutellaria parvula var. parvula	1.2.1 Modification of vegetation structure	7.1 Fire and fire suppression	Establish fire objective of 12,000 to 20,000 acres per year
Scutellaria saxatilis	0 None or Unknown	0 None or Unknown	
Seiurus noveboracensis	1.2 Modification of vegetation	11 Climate Change and Weather	Establish management strategy for climate change incl land allocation, obj and desired conditions
Semionellus placidus	1 Terrestrial System/Habitat Stresses	7 Modification of natural systems	Establish guidelines for species occurrence
Sibbaldiopsis tridentata	3.1.1 Accidental mortality	6 Human intrusions and disturbance	Establish guidelines for recreation traffic
Sida hermaphrodita	2.1 Stream flow modification	7.2 Dams and water management	Utilize Jefferson riparian standards
Sida hermaphrodita	2.5 Aquatic/Riparian system modification	7 Modification of natural systems	Utilize Jefferson riparian standards
Sitta canadensis	1.2 Modification of vegetation	11 Climate Change and Weather	Establish management strategy for climate change incl land allocation, obj and desired conditions
Solidago arguta var. harrisii	1.2.1 Modification of vegetation structure	7.33 Lack of disturbance; succession	Establish fire objective of 12,000 to 20,000 acres per year
Solidago arguta var. harrisii	1.2.1 Modification of vegetation structure	7.33 Lack of disturbance; succession	Utilize timber harvest to create early successional habitat, annual harvest of 1,800 - 3,000 acres
Solidago arguta var. harrisii	1.2.2 Modification of vegetation composition	8.1 Non-native invasive species	Establish Invasive Species Control Guidelines
Solidago randii = S. simplex var. randii	1.2.1 Modification of vegetation structure	7.1 Fire and fire suppression	Establish fire objective of 12,000 to 20,000 acres per year
Solidago rupestris	2.5 Aquatic/Riparian system modification	7 Modification of natural systems	Utilize Jefferson riparian standards
Solidago uliginosa	2.5 Aquatic/Riparian system modification	7 Modification of natural systems	Utilize Jefferson riparian standards
Sorex palustris punctulatus	1 Terrestrial System/Habitat Stresses	11 Climate Change and Weather	Establish management strategy for climate change incl land allocation, obj and desired conditions
Sparganium chlorocarpum = S. emersum	2.5 Aquatic/Riparian system modification	7 Modification of natural systems	Utilize Jefferson riparian standards

Species Name	Stress	Threat	Management Strategies
Spartina pectinata	2.5 Aquatic/Riparian system modification	7 Modification of natural systems	Utilize Jefferson riparian standards
Speyeria atlantis	1 Terrestrial System/Habitat Stresses	7 Modification of natural systems	Establish Lepidopteran guidelines
Speyeria atlantis	3.1.2 Persecution mortality	5.1.2 Collection of terrestrial animals	Establish guidelines for overcollection
Speyeria diana	1 Terrestrial System/Habitat Stresses	A.3.2 Mining and quarrying	Establish Lepidopteran guidelines
Speyeria diana	1.2 Modification of vegetation	8.1 Non-native invasive species	Establish Invasive Species Control Guidelines
Speyeria diana	1.2 Modification of vegetation	8.2 Problematic native species	
Speyeria diana	3.1.2 Persecution mortality	5.1.2 Collection of terrestrial animals	Establish guidelines for overcollection
Speyeria idalia	1.1 Conversion and fragmentation	7.1 Fire and fire suppression	Establish fire objective of 12,000 to 20,000 acres per year
Speyeria idalia	1.1 Conversion and fragmentation	7.1 Fire and fire suppression	Establish Lepidopteran guidelines
Speyeria idalia	1.2 Modification of vegetation	7.1 Fire and fire suppression	Establish fire objective of 12,000 to 20,000 acres per year
Speyeria idalia	1.2 Modification of vegetation	7.1 Fire and fire suppression	Establish Lepidopteran guidelines
Speyeria idalia	1.2 Modification of vegetation	7.33 Lack of disturbance; succession	Establish fire objective of 12,000 to 20,000 acres per year
Speyeria idalia	3.1.2 Persecution mortality	5.1.2 Collection of terrestrial animals	Establish guidelines for overcollection
Speyeria idalia	3.6 Isolation of metapopulations	7 Modification of natural systems	
Sphagnum russowii	2.5 Aquatic/Riparian system modification	7 Modification of natural systems	Utilize Jefferson riparian standards
Sphyrapicus varius	1.2 Modification of vegetation	11 Climate Change and Weather	Establish management strategy for climate change incl land allocation, obj and desired conditions
Spilogale putorius	3.3.2 Predation	8.2 Problematic native species	
Spiranthes lucida	2.5 Aquatic/Riparian system modification	7 Modification of natural systems	Utilize Jefferson riparian standards
Spiranthes ochroleuca	1.2.1 Modification of vegetation structure	7.1 Fire and fire suppression	Establish fire objective of 12,000 to 20,000 acres per year
Sporobolus neglectus	1.3.1 Limited existing distribution of system/habitat	7 Modification of natural systems	
Stygobromus gracilipes	1 Terrestrial System/Habitat Stresses	6.1 Recreational activities	Establish guidelines for caves and karstlands
Stygobromus gracilipes	1 Terrestrial System/Habitat Stresses	7 Modification of natural systems	Establish guidelines for caves and karstlands
Stygobromus hoffmani	1 Terrestrial System/Habitat Stresses	6.1 Recreational activities	Establish guidelines for caves and karstlands

Species Name	Stress	Threat	Management Strategies
Stygobromus hoffmani	1 Terrestrial System/Habitat Stresses	7 Modification of natural systems	Establish guidelines for caves and karstlands
Stygobromus morrisoni	1 Terrestrial System/Habitat Stresses	6.1 Recreational activities	Establish guidelines for caves and karstlands
Stygobromus morrisoni	1 Terrestrial System/Habitat Stresses	7 Modification of natural systems	Establish guidelines for caves and karstlands
Stygobromus mundus	1 Terrestrial System/Habitat Stresses	6.1 Recreational activities	Establish guidelines for caves and karstlands
Stygobromus mundus	1 Terrestrial System/Habitat Stresses	7 Modification of natural systems	Establish guidelines for caves and karstlands
Stygobromus sp. 7	1 Terrestrial System/Habitat Stresses	6.1 Recreational activities	Establish guidelines for caves and karstlands
Stygobromus sp. 7	1 Terrestrial System/Habitat Stresses	7 Modification of natural systems	Establish guidelines for caves and karstlands
Stygobromus sp. 7	1 Terrestrial System/Habitat Stresses	7 Modification of natural systems	Utilize Jefferson riparian standards
Stygobromus sp. nov.	0.3 Unknown	0.2 Unknown	
Stygobromus sp. nov.	2.5 Aquatic/Riparian system modification	7 Modification of natural systems	Utilize Jefferson riparian standards
Sylvilagus obscurus	1.2.1 Modification of vegetation structure	7.33 Lack of disturbance; succession	Establish fire objective of 12,000 to 20,000 acres per year
Sylvilagus obscurus	1.2.1 Modification of vegetation structure	7.33 Lack of disturbance; succession	Utilize timber harvest to create early successional habitat, annual harvest of 1,800 - 3,000 acres
Sylvilagus obscurus	1.2.1 Modification of vegetation structure	A.2 Agriculture	
Sylvilagus obscurus	3.3.1 Competition	7 Modification of natural systems	
Symphoricarpos albus	1.2.1 Modification of vegetation structure	7.1 Fire and fire suppression	Establish fire objective of 12,000 to 20,000 acres per year
Taenidia montana	1.2.1 Modification of vegetation structure	7.1 Fire and fire suppression	Establish fire objective of 12,000 to 20,000 acres per year
Thuja occidentalis	1.2.1 Modification of vegetation structure	7.1 Fire and fire suppression	Establish fire objective of 12,000 to 20,000 acres per year
Triadenum fraseri	2.5 Aquatic/Riparian system modification	7 Modification of natural systems	Utilize Jefferson riparian standards
Triantha racemosa	2.5 Aquatic/Riparian system modification	7 Modification of natural systems	Utilize Jefferson riparian standards
Trichostema setaceum	1.2.1 Modification of vegetation structure	7.1 Fire and fire suppression	Establish fire objective of 12,000 to 20,000 acres per year
Trifolium virginicum	1.2.1 Modification of vegetation structure	7.1 Fire and fire suppression	Establish fire objective of 12,000 to 20,000 acres per year
Trillium pusillum var. virginianum	1.2 Modification of vegetation	11 Climate Change and Weather	Establish management strategy for climate change incl land allocation, obj and desired conditions

Species Name	Stress	Threat	Management Strategies
Trillium pusillum var. virginianum	2.5 Aquatic/Riparian system modification	7 Modification of natural systems	Utilize Jefferson riparian standards
Triodopsis picea	1 Terrestrial System/Habitat Stresses	A Highly modified land uses	Establish guidelines for species occurrence
Triodopsis picea	1.2 Modification of vegetation	7.1 Fire and fire suppression	Establish guidelines for species occurrence
Triodopsis picea	3 Species Population Stresses	9.5.1 Acid deposition	Continue air resource management activities to reduce impacts of acid deposition
Triodopsis picea	3.1.1 Accidental mortality	6.1 Recreational activities	Establish guidelines for recreation traffic
Triodopsis picea	3.3 Interspecific interactions	8.1 Non-native invasive species	
Triphora trianthophora	0 None or Unknown	0 None or Unknown	
Troglodytes troglodytes	1.2 Modification of vegetation	11 Climate Change and Weather	Establish management strategy for climate change incl land allocation, obj and desired conditions
Vaccinium macrocarpon	2.5 Aquatic/Riparian system modification	7 Modification of natural systems	Utilize Jefferson riparian standards
Verbena scabra	2.5 Aquatic/Riparian system modification	7 Modification of natural systems	Utilize Jefferson riparian standards
Veronica scutellata	2.5 Aquatic/Riparian system modification	7 Modification of natural systems	Utilize Jefferson riparian standards
Viburnum lentago	2.5 Aquatic/Riparian system modification	7 Modification of natural systems	Utilize Jefferson riparian standards
Vicia americana	1.2.1 Modification of vegetation structure	7.1 Fire and fire suppression	Establish fire objective of 12,000 to 20,000 acres per year
Viola pedatifida	1.2.1 Modification of vegetation structure	7.1 Fire and fire suppression	Establish fire objective of 12,000 to 20,000 acres per year
Virginia valeriae pulchra	0 None or Unknown	0 None or Unknown	
Vitis rupestris	2.5 Aquatic/Riparian system modification	7 Modification of natural systems	Utilize Jefferson riparian standards
Woodwardia virginica	2 Aquatic System/Habitat Stresses	7 Modification of natural systems	Utilize Jefferson riparian standards
Zigadenus elegans ssp. glaucus = Anticlea glauca	1.2.1 Modification of vegetation structure	7.1 Fire and fire suppression	Establish fire objective of 12,000 to 20,000 acres per year
Zygonopus weyeriensis	0.3 Unknown	0.2 Unknown	
Zygonopus weyeriensis	1 Terrestrial System/Habitat Stresses	6.1 Recreational activities	Establish guidelines for caves and karstlands
Zygonopus weyeriensis	1 Terrestrial System/Habitat Stresses	7 Modification of natural systems	Establish guidelines for caves and karstlands
Zygonopus whitei	1 Terrestrial System/Habitat Stresses	6.1 Recreational activities	Establish guidelines for caves and karstlands
Zygonopus whitei	1 Terrestrial System/Habitat Stresses	8.1 Non-native invasive species	Establish guidelines for caves and karstlands

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APPENDIX G – AQUATIC ECOLOGICAL SUSTAINABILITY ANALYSIS

George Washington National Forest

April 2011

Updated February 2013

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1. INTRODUCTION

National Forest Management Act (NFMA) regulation, adopted in 1982, requires that habitat be managed to support viable populations of native and desirable non-native vertebrates within the planning area (36 CFR 219.19). For planning purposes, a viable population is one that has numbers and distribution of reproductive individuals to insure its continued existence and is well distributed in the planning area. USDA regulation 9500-004, adopted in 1983, reinforces the NFMA viability regulation by requiring that habitats on national forests be managed to support viable populations of native and desired non-native plants, fish, and wildlife. These regulations focus on the role of habitat management in providing for species viability. Supporting viable populations involves providing habitat in amounts and distributions that can support interacting populations at levels that result in persistence of the species over time.

Aquatic habitats are unique in that they are found in and adjacent to streams and lakes. The mobility of aquatic species is usually limited to these habitats. Habitat alteration is probably the major cause of decline of aquatic diversity in the South. Channelization, impoundment sedimentation, and flow alterations are the most common physical habitat alterations associated with the decline of aquatic species (Walsh et al. 1995; Etnier 1997; Burkhead et al. 1997). Other human-induced impacts to aquatic species include pollutions, introduced species, and over-harvesting (Miller 1989).

The initial focus of this aquatic ecological sustainability analysis is on ecosystem diversity of aquatic habitats within the GWNF, and the key factors within those habitats for maintaining aquatic ecological integrity. This approach is supplemented with a complementary species-specific approach that focuses on quantifying the habitats where individual species are found within the GWNF.

The goals of this analysis are:

1) Develop plan components for a framework that provides characteristics of ecosystem diversity and contributes to the diversity of native plant and animal species.
2) Evaluate if additional provisions are needed for specific federally listed species, FS sensitive species, and locally rare species consistent with the limits of agency authorities, the capability of the plan area, and overall multiple use objectives.

2. ECOSYSTEM DIVERSITY

Ecosystem diversity is defined as the variety and relative extent of ecosystem types including their composition, structure, and processes.

The GWNF developed an aquatic habitat classification to facilitate the Aquatic Ecological Sustainability Analysis (see Appendix G1). The methods used in this classification follow the basic structure of The Nature Conservancy (TNC) aquatic community classification, and the Virginia and West Virginia Comprehensive Wildlife Action Plans, yet habitat classifications were focused on land managed by the GWNF.

As described in Appendix G1, this habitat classification is hierarchical and is based on an understanding of how habitat influences the composition and distribution of aquatic biological communities. It is based on four assumptions (Higgins et al. 1998):

1. Physiographic and climatic patterns influence the distribution of organisms, and can be used to predict the expected range of biological community types (Jackson and Harvey 1989; Tonn 1990; Maxwell et al. 1995; Angermeier and Winston 1998; Burnett et al. 1998).
2. The physical structure of aquatic habitats (or ecosystems) can be used to predict the distribution of aquatic communities (Gorman and Karr 1978; Schlosser 1982).
3. Aquatic habitats are continuous; however, generalizations about discrete patterns in habitat use can be made (Vannote et al. 1980; Schlosser 1982).
4. Using a nested classification system, (i.e. stream reach habitat types within species ranges), we can account for community diversity that is difficult to observe or to measure (taxonomic, genetic, or ecological) (Frissell et al. 1986; Angermeier and Schollsser 1995).

2.1 Spatial Scales for Ecosystem Diversity

Physiographic Provinces

The GWNF lies in two physiographic provinces or ecoregions, the Blue Ridge and Ridge and Valley. Both of these ecoregions have their own unique geology and landtype characteristics. The following descriptions are summarized from Jenkins and Burkhead (1993).

Blue Ridge
This montane-upland province extends northeast-southwest from southern Pennsylvania to northern Georgia. The GWNF is in the narrow Northern Blue Ridge province (north of the Roanoke River) which is an irregular chain of mountains one to a few peaks wide, about 2-12 miles wide overall; its maximum elevation is about 4,000 feet. It is effectively the frontal mountain range of the adjacent Valley and Ridge Province. Together they apparently represent an erosional system that had been uplifted.

The rocks of the Blue Ridge are largely resistant types; thus Blue Ridge streams tend to be the softwater type. A chief feature of small Blue Ridge streams is high gradient, reflected by a high frequency of rapids, by cascades and falls in many headwaters, and by bottoms chiefly of large gravel, rubble boulder, and bedrock. Small streams are cool or cold during summer; rain-caused turbidity clears quickly.

Ridge and Valley
This province consists of parallel, northeast-southwest lines of mountains and valleys adjoining the northwest boarder of the Blue Ridge. It is marked by long narrow parallel ridges oriented with the long axis of the province. Consequently its streams form a rectilinear trellis drainage pattern of parallel-flowing stream in the valleys that are connected by right-angle valleys through the ridges. Mountain ridges are capped by protruding edges of resistant sandstone and quartzite formations; the tops of many are 3,200-4,100 feet in elevation. Intermontane valleys are floored by easily erodible carbonate (limestone and dolomite) and shale rocks; in transecting the province, carbonate valleys often alternate with shale valleys.

Small montane streams of the Valley and Ridge closely resemble the tumbling streams at similar elevations in the Blue Ridge. Streams in the valleys are of moderate gradient; shoals, runs and riffles usually compose one-third to one-sixth or less of the length. In valley streams, gravel rubble, and boulder bottoms are characteristic of both pools and riffles; bedrock is a common substrate. Substrates in calm pools of most valley streams often are quite silted; notable patches of sand are rare throughout the province. Montane streams of the province tend to carry soft water, whereas valley streams typically are the hard-water type. Almost all streams generally are clear but become heavily turbid from moderate or heavy rain. The Valley and Ridge is noted for watered caves and high-volume spring streams.

River Drainages

Within the GWNF, the two physiographic provinces are drained by two major river drainages, the James and Potomac. Both of these drainages are Atlantic slope, and drain into the Chesapeake Bay. Geological history has shaped the evolution and distribution of modern aquatic fauna. Former climates have strongly influenced this fauna as well. The following descriptions of the drainages are summarized from Jenkins and Burkhead (1993).

James Drainage
This drainage is nearly wholly within Virginia; only a short segment of each of two streams originates in West Virginia. The watershed encompasses 10,102 sq. miles. The main channel of 432 miles is the longest in the state. The James River takes its name at the confluence of the Cowpasture and Jackson rivers near Clifton Forge; 94 miles of the Jackson are included in the total length. Major portions of the drainage are in the Coastal Plain, Piedmont, and Valley and Ridge; many tributaries drop from the Blue Ridge.

The James drainage fish assemblage is fairly specious for an Atlantic slope drainage, with 109 total taxa; 73 native (3 endemic), 26 introduced, and 10 estuarine or diadromous taxa. Many range terminations fall in and adjacent to the James. Three fish are endemic to the drainage: roughhead shiner (*Notropis semperasper*), longfin darter (*Etheostoma longimanum*), and a stripeback darter subspecies (*Percina notogramma montuosa*).

Potomac Drainage

The portion of the Potomac watershed in Virginia is 5,706 sq. miles in surface area, 39% of the whole Potomac watershed; the remainder is in Pennsylvania, Maryland, and West Virginia. The Shenandoah system is the largest division of the Potomac in Virginia. The Shenandoah system is partitioned into the large North Fork and South Fork subsystems and the smaller lower Shenandoah subsystem. The Shenandoah system meanders through the Valley and Ridge for 205 miles.

Two Valley and Ridge portions of the upper Potomac system proper (above the Shenandoah mouth) drain Virginia and cross into West Virginia. The portion in the small northern area just west of the lower Shenandoah River flows directly to the Potomac River. The few short, cool or cold streams heading in Highland County go to the South Branch Potomac River.

The Potomac drainage has 61 native, 30 introduced, and 11 diadromous or estuarine taxa – 102 in all. Its endemic taxon is an undescribed sculpin, either a subspecies of *Cottus cognatus* (slimy sculpin) or a closely related species. The Shenandoah River system has a montane and upland fauna that basically is typical of other western Chesapeake basin fauna; however, several species unexpectedly are localized or missing. No consistent basis was discerned for any of the odd Shenandoah patterns; long-standing deforestation of the broad divisions of the fertile valley may be involved. The system may have suffered higher silt levels earlier than most others in Virginia. European settlers found the valley to be a huge, partly cultivated prairie the Indians had maintained through burning. Siltation associated with extensive tilling by the settlers certainly worsened stream conditions.

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Within this framework of physiographic provinces and river drainages, the GWNF manages 1,065,389 acres of land (see Figure G-1). The characteristics of the aquatic habitats (streams, rivers, lakes, and wetlands) managed by the GWNF are described in the next section.

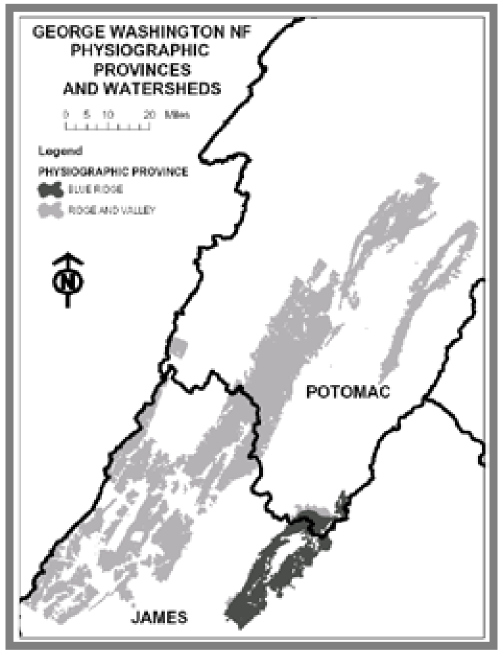

Figure G-1. GWNF Land within the Potomac and James Watersheds and the Blue Ridge and Ridge and Valley Provinces.

2.2 Characteristics of Ecosystem Diversity

Stream Reach Classification

Streams display continuous changes in physical and chemical characteristics from headwaters to mouth, which may influence the structure and function of biological communities along this continuum (Vannote et al. 1980). Factors of watershed size, elevation, and geology are interrelated along the continuum. These are the factors that were used to classify the lotic (stream) habitat on the GWNF. See Appendix G1 for a detailed description of the factors and classification process. Springs and seeps were not included in this classification because of modeling constraints. The importance of springs and seeps is recognized and they should be treated as an aquatic component of the riparian area during project planning and implementation.

Based on five categories for size, two categories for elevation, and five categories for geology (see Table G-1), there were 38 different stream habitat types (within 1,178.7 miles of perennial water) identified within GWNF ownership (see Table G-2). However, over 82% are characterized by only 10 different stream habitat types, with only three habitat types comprising almost 50% of the Forest streams. These include 20% in the headwater, higher elevation, sandstone/quartzite classification (121); and another 28% in the headwater, lower elevation, shale and sandstone/quartzite classifications (113 and 111).

Table G-1. Aquatic Habitat Classification Categories Used For Continuous Variables

Category	Range of Values	Assigned Number
Stream Size:	Watershed area (sq. miles)	Class
Headwater	<2	100
Stream	2-10	200
Large stream	10-20	300
Small River	20-70	400
Large River	>70	500
Elevation (temperature regime):	Elevation (ft):	Class
Lower elevation (warm/cool water)	≤2000	10
Higher elevation (cold water)	>2000	20
Geology:	Rock Types:	Class
Sandstone/quartzite	sandstone & quartzite	1
Limestone	limestone	2
Shale	shale	3
Granite	granite, metabasalt, proxene, gneiss	4
Charnokite/mylonite	charnikite & mylonite	5

Table G-2. Lotic Habitat Classification

Stream Type	Sum of Miles	Percent of Miles	Description	Example
121	240.60	20.41%	Headwater, higher elevation, sandstone/quartzite	Locust Spring Run, Highland Co.
113	181.61	15.41%	Headwater, lower elevation, shale	Downy Branch, Allegheny Co.
111	153.41	13.02%	Headwater, lower elevation, sandstone/quartzite	Buck Lick Run, Rockingham Co.
211	100.01	8.49%	Stream, lower elevation, sandstone/quartzite	Slate Lick Branch, Rockingham Co.
213	74.76	6.34%	Stream, lower elevation, shale	Little Fork, Pendleton Co.
221	61.43	5.21%	Stream, higher elevation, sandstone/quartzite	Little Back Creek, Bath Co.
112	50.38	4.27%	Headwater, lower elevation, limestone	Upper Kelly Run, Bath Co.
123	47.98	4.07%	Headwater, higher elevation, shale	Upper Pitt Spring Run, Page Co.
212	36.46	3.09%	Stream, lower elevation, limestone	Cub Run, Page Co.
122	24.93	2.11%	Headwater, higher elevation, limestone	Jordan Run, Bath Co.
411	21.21	1.80%	Small river, lower elevation, sandstone/quartzite	North River, Augusta Co.
513	20.62	1.75%	Large river, lower elevation, shale	Cowpasture River, Bath Co.
114	18.44	1.56%	Headwater, lower elevation, granite	King Creek, Amherst Co.
313	16.88	1.43%	Large stream, lower elevation, shale	Wilson Creek, Bath Co.
512	13.91	1.18%	Large river, lower elevation, limestone	Jackson River, Bath Co.
124	12.93	1.10%	Headwater, higher elevation, granite	Crabtree Creek, Nelson Co.
311	12.52	1.06%	Large stream, lower elevation, sandstone/quartzite	Lower Cove Run, Hardy Co.
321	11.27	0.96%	Large stream, higher elevation, sandstone/quartzite	Skidmore Fork, Rockingham Co.
214	10.45	0.89%	Stream, lower elevation, granite	Shoe Creek, Nelson Co.
223	9.06	0.77%	Stream, higher elevation, shale	Little Mill Creek, Bath Co.
115	8.08	0.69%	Headwater, lower elevation, charnokite/mylonite	Cedar Creek, Amherst Co.

Stream Type	Sum of Miles	Percent of Miles	Description	Example
413	8.07	0.68%	Small river, lower elevation, shale	Dunlap Creek, Allegheny Co.
222	5.59	0.47%	Stream, higher elevation, limestone	Muddy Run, Bath Co.
224	5.39	0.46%	Stream, higher elevation, granite	S.F. Piney River, Amherst Co.
314	5.38	0.46%	Large stream, lower elevation, granite	Pedlar River, Amherst Co.
312	4.14	0.35%	Large stream, lower elevation, limestone	Smith Creek, Allegheny Co.
421	3.86	0.33%	Small river, higher elevation, sandstone/quartzite	Laurel Fork, Highland Co.
125	3.85	0.33%	Headwater, higher elevation, charnokite/mylonite	Upp. N.F. Piney R., Nelson/Amherst
414	3.84	0.33%	Small river, lower elevation, granite	Pedlar River, Amherst Co.
215	3.61	0.31%	Stream, lower elevation, charkonite/mylonite	Browns Creek, Amherst Co.
415	2.30	0.19%	Small river, lower elevation, charnokite/mylonite	Tye River, Nelson Co.
511	2.09	0.18%	Large river, lower elevation, sandstone/quartzite	Passage Creek, Shenandoah Co.
412	2.04	0.17%	Small river, lower elevation, limestone	Trout Run, Hardy Co.
315	1.08	0.09%	Large stream, lower elevation, charnokite/mylonite	Piney River, Nelson/Amherst Co.
322	0.28	0.02%	Large stream, higher elevation, limestone	Dry Run, Bath Co.
423	0.14	0.01%	Small river, higher elevation, shale	Back Creek, Highland Co.
225	0.06	0.00%	Stream, higher elevation, charkonite/mylonite	Lower N.F. Piney R., Nelson/Amherst
323	0.03	0.00%	Large stream, higher elevation, shale	Shaws Fork, Highland Co.
Total	1178.66	100.00%		

The Ecosystem Diversity Report for the George Washington National Forest identified two aquatic-related ecological systems that cross-walk with the stream reach classification.

Ecological System from Ecosystem Diversity Report	Lotic Habitat Classification
Central Appalachian Floodplain	Stream size classes of: Small River and Large River
Central Appalachian Riparian	Stream size classes of: Headwater, Stream and Large Stream

Lake, Pond, and Wetland Classification

Lentic aquatic habitat has standing water and includes lakes, ponds, and swamps. It is primarily determined by slope (or gradient) and substrate or storage capacity.

Lakes and ponds were classified by size and connectivity to a stream. A waterbody greater than five acres was called a lake; a waterbody equal to or less than five acres was called a pond. Wetlands were classified according to the type of vegetation within the wetland. Six habitat types were identified (see Table G-3). The category of “Lake Connected to A Stream” covered the greatest amount of acres on the Forest because this category included the 2,530-acre Lake Moomaw.

Table G-3. Lentic Habitat Classification

Category	Abbreviation	Number	Acres on GWNF	Percent
Lake Connected To A Stream	LCS	34	2830.6	87.7%
Woody Wetland	WW	189	185.7	5.8%
Emergent Herbaceous Wetland	EHW	139	85.0	2.6%
Pond Not Connected To A Stream	PNCS	81	70.5	2.2%
Pond Connected To A Stream	PCS	29	36.0	1.1%
Lake Not Connected To A Stream	LNCS	2	20.9	0.6%
TOTAL		474	3228.7	100.0%

The Ecosystem Diversity Report for the George Washington National Forest identified four aquatic-related ecological systems that cross-walk with the lake, pond and wetland classification.

Ecological System from Ecosystem Diversity Report	Lentic Habitat Classification
Central Interior Highlands and Appalachian Sinkhole and Depression Pond	Pond not connected to a stream, Woody wetland, Emergent Herbaceous Wetland
Southern and Central Appalachian Bog and Fen	Woody wetland, Emergent Herbaceous Wetland
North-Central Appalachian Acidic Swamp	Woody wetland
North-Central Appalachian Seepage Fen	Emergent Herbaceous Wetland

2.3 Key Factors

Aquatic ecological integrity must include physical, chemical, and biological integrity. Furthermore, biological integrity is dependent on physical and chemical integrity. Key factors related to physical, chemical, and biological integrity have been identified that are important for maintaining aquatic ecological sustainability.

Aquatic Ecological Integrity	Key Factors
Physical Integrity	Riparian Areas, Instream Habitat, Lake and Wetland Habitat, Thermal Regime
Chemical Integrity	Dissolved Oxygen, pH and Alkalinity, Other Elements
Biological Integrity	Species Occurrence, Watershed Health

Physical Integrity

Riparian Areas

Riparian areas sustain the aquatic environment by influencing water temperature, light, habitat diversity, channel morphology, food webs and productivity, and the species diversity of stream and lake systems. Intact riparian areas are important in all aquatic habitats.

Maintenance of consistent daily and seasonal fluctuations in water temperature and ambient light levels is crucial to the viability of plant and animal populations. Riparian forests dampen fluctuations in stream water temperature; blocking out heat to keep water cooler during the day and summertime, and capturing heat as it radiates from the soil and water to keep the stream environment warmer during the night and wintertime. The net effect is an environment more conducive to life with fewer tendencies for wide fluctuations in stream temperature. Light levels are regulated in similar fashion.

Litterfall and algal production are the two primary sources of food energy inputs to streams. Both are intimately tied to the presence of riparian forest. Litterfall (leaves, twigs, fruit seeds, and other organic debris), is most abundant when riparian forests are present. Because large pieces of litter do not travel very far away from their origin, a streamside forest is often desirable along the entire length of a stream to provide the necessary balance of food inputs appropriate to the food chain of native species. In addition, terrestrial insects falling into the water from riparian vegetation can comprise a major portion of the summer diet of fish in headwater streams (LaRoche 2008).

Instream macroinvertebrate populations are affected by changes in litter inputs, as well. The metabolic activity of some of these organisms may increase as streamside plants are removed. This allows woody material to be decomposed more quickly, making nutrients in this material less available to fish and other aquatic species.

The type and amount of algae produced in a stream is affected by the amount of light striking the water surface. Studies show that the algal community of a stream well shaded by older trees is dominated by single celled algae (diatoms) throughout the year. Streams in deforested areas often contain many threadlike (filamentous) green algae, and few diatoms. While some macroinvertebrates such as crayfish and waterboatmen insects readily consume filamentous green algae, most herbivorous species of stream macroinvertebrates have evolved mouth parts specialized for scraping diatoms from the surface of rocks and wood. They cannot eat filamentous algae. Macroinvertebrate diversity tends to decline if a streamside zone is deforested (Austin 2005).

In addition, riparian forests remove, sequester, or transform nutrients, sediments and other pollutants. Pollution removal depends on (1) the capability to intercept surface water and groundwater borne pollutants, and (2) the activity levels of certain pollutant removal processes. Rain and sediment that runs off the land in sheet flow can be slowed and filtered in the forest, settling out sediment, nutrients, and other potential pollutants before they reach the water. Some potential pollutants, such as fertilizers or pesticides, which originate on land, are taken up by plant roots. Nutrients are stored in leaves, limbs, and roots instead of reaching the stream or lake.

Riparian areas will be discussed in Section 2.5 in terms of the current condition and trend on the Forest for stable and complex riparian vegetation community and recreation impacts.

Instream Habitat

The substrate is the bottom of, or bottom material in, the stream. The substrate is directly determined by the underlying geologic material. Many aquatic species require specific substrates for their different feeding, hiding, and reproductive strategies. Loose coarse substrate has abundant spaces between and under stones to support the invertebrate foods of many fishes and to serve as egg deposition sites and cover from predators. Freshwater mussels generally need a mixture of loose gravel and sand in which to burrow. Siltation occurs when suspended solids settle from the water column. This fine sediment tends to smother gravel and rubble and fill interstices around boulders, and thus reduces benthic biota and buries breeding sites.

Generally, the more complex the stream habitat, the more complex the stream community. Habitat complexity can come from substrate, gradient, and outside influences such as large woody debris (LWD). In streams with steep gradient and large substrate, boulders often are the dominant structure in the channel (ex. stream type 221, Stream, higher elevation, sandstone/quartzite). In high gradient streams, there is a large range of particle sizes. In contrast, lower gradient streams have primarily smaller particle sizes. Where substrate sizes are small, LWD is an important feature in channel morphology. Lower elevation small streams with smaller particle sizes where LWD could be an important feature include stream types 212 (Stream, lower elevation, limestone) and 213 (Stream, lower elevation, shale). In addition to habitat formation, LWD retains organic and inorganic matter, provides food for invertebrates, and serves as habitat for both invertebrates and fish

Instream habitat will be discussed in Section 2.5 in terms of the current condition and trend on the Forest for LWD and stream habitat complexity.

Lake and Wetland Habitat

There are only two natural lakes in Virginia, Lake Drummond in the Dismal Swamp, and Mountain Lake near the top of a mountain in Giles County. Neither of which is on the GWNF. One natural lake/pond, Trout Pond, exists in West Virginia on the GWNF. However, there are numerous smaller natural ponds and wetlands, in addition to human-built impoundments (reservoirs). Because they vary in size, depth, chemistry, hydro-period, and vegetation, there are often unique flora and fauna associated with these habitats. Beaver ponds, especially, offer a unique habitat that stores water, traps sediment, reduces erosion, and enhances riparian vegetation. Because of their location on gentle terrain, and easy access, natural ponds and wetlands are often vulnerable to human exploitation and alteration; while man-made reservoirs are usually a center for water-based recreation.

Thermal Regime

Water temperature is a characteristic that can vary widely and is influenced by a number of variables including latitude, altitude, season, weather, shade, and proximity to springs.

Geology directly affects water temperature through elevation changes, and the influence of springs and groundwater. Groundwater influence is a function of watershed storage capacity. The greater the storage, the higher the percent of flow from groundwater, and the cooler the stream water temperature. Watersheds with a large amount of limestone geology generally have a greater amount of groundwater influence because of the presence of large underground aquifers, springs and seeps (ex. stream types 112 (Headwater, lower elevation, limestone) and 222 (Stream, higher elevation, limestone)).

Temperature has a great influence in determining what organisms can survive in a waterbody. Temperature directly affects the amount of oxygen that can be dissolved in water; the rate of photosynthesis by algae and larger aquatic plants; the metabolic rates of aquatic organisms; and the sensitivity of organisms to toxic wastes, parasites and diseases. Fish such as trout depend upon cool, oxygen-rich waters.

Human activities influence water temperature. Thermal pollution and streamside clearing can create changes in water temperature. Soil erosion and sedimentation raises water temperature by increasing the amount of suspended solids in the water. Suspended solids make water cloudy. Cloudy water absorbs more radiation (and warmth) from the sun than clear water does.

Chemical Integrity

Dissolved Oxygen

Dissolved oxygen (DO) comes from a variety of sources. The action of waves and water tumbling over rocks helps mix oxygen in the atmosphere with moving water. Geology directly affects DO by controlling not only elevation, but also stream gradient. Rock with higher mass strength produces larger stream particle sizes (for example, granitic formation), and thus steeper gradients.

Plants release oxygen into the water as a byproduct of photosynthesis during daylight hours, but plants and animals also use oxygen during respiration and produce carbon dioxide. Both oxygen and carbon dioxide are more soluble in water at low temperatures than at high ones. Large amounts of carbon dioxide are a sign of accumulating organic material and low dissolved oxygen.

Human activities have great potential to influence dissolved oxygen levels because they are so closely linked to temperature and nutrient levels. Increased nutrients (like phosphorus and nitrogen) stimulate algal growth. Eventually the algae die and accumulate. Animal waste, sewage and other industry discharges, agricultural and urban runoff, in addition to the dead algae, create a large amount of organic material.

Bacteria and fungi use oxygen to break down this organic material and cause the biochemical oxygen demand within the system to increase. Biochemical oxygen demand refers to the amount of oxygen required by microorganisms to oxidize an amount of organic materials. A high demand lowers the availability of dissolved oxygen in the water.

When oxygen is consumed by aerobic bacteria, there is less available for other aquatic organisms. Only organisms, such as carp, midge flies and leeches that are tolerant of low dissolved oxygen levels will survive. This reduces the diversity within the system, creating a system that is less stable ecologically.

pH and Alkalinity

The pH of a water body is affected by its age, geology and the chemicals discharged into it by communities and industries. Alkalinity refers to the ability of a solution to resist changes in pH. Alkalinity buffers waters against dramatic changes in pH.

Geology directly affects pH because the main sources of natural alkalinity are rocks that contain carbonate, bicarbonate and hydroxide compounds. Borates, silicates and phosphates also may contribute to alkalinity. Waters flowing through limestone typically have good buffering capacity (ex. stream classifications 222, 512, 312). Waters flowing through granite and quartzite areas typically have low alkalinity and poor buffering capacity (ex. stream classifications 111, 211).

Since buffering capacity ultimately depends on the weathering of acid-neutralizing material from the bedrock, hard bedrock types produce less buffering capacity for streams than soft bedrock types. Mountains by their very nature are more resistant to weathering than surrounding lowlands, so mountain streams and lakes are usually the most sensitive to acidification. In contrast, large valley streams and lakes are the recipients of upstream weathering products and are often less sensitive to acidification.

Human activities also affect the pH of water bodies. Acid precipitation is the result of nitrogen oxide gases and sulfur dioxide combining with water in the atmosphere to produce nitric and sulfuric acids. These gases are produced and released into the atmosphere during the burning of fossil fuels such as gas, oil and coal. Acid precipitation falls into water bodies and makes some of them acidic. Runoff from acidic Soils also contributes to acid waters. Waterbodies that have limestone geology are less susceptible because the alkaline carbonates of limestone help neutralize the effects of acid precipitation.

Unpolluted rain has a pH of around 5.6 (slightly acid). Currently, the average rain and snowfall in most states east of the Mississippi River measures between 4 and 5 on the pH scale. Some individual storms go as low as 3.0.

Most aquatic organisms survive best within a limited pH range. Even small changes in pH are harmful to acid sensitive species. Most fish can tolerate pH values of about 5.0 to 9.0. pH values outside that range can create problems for reproduction and survival. Alkalinity helps fish and aquatic life because it protects against pH changes and makes water less vulnerable to acid precipitation. When alkalinity falls below 2 mg/l the pH of waters can change easily. During the spring alkalinity is especially important for protecting aquatic organisms in their early life stages from large amounts of acidic snowmelt and runoff.

Other Elements

Magnesium, calcium, sodium, potassium, chloride, aluminum, iron, manganese, copper, and zinc are just a few of the elements that can occur in stream water. The level of these elements in stream water is directly related to the underlying bedrock material. Often these elements are in excess in stream water as a result of human activity (such as mining).

A note about aluminum is warranted because it is extremely toxic to aquatic life, and it has a unique relationship to pH. Aluminum is the most abundant metal on the earth's surface, and the third most abundant element. It is non-toxic and insoluble under acid-neutral conditions, but very toxic to fish and other aquatic species under acidic conditions. Unfortunately, the solubility of aluminum increases exponentially as pH falls below 5.6; its maximum toxicity occurs at about pH 5.0. Acid deposition results in the release of aluminum from Soils and its transport in solution to streams and lakes.

Biological Integrity

Species Occurrence

Aquatic species are not found uniformly distributed across all habitat types; many are tied to specific habitat needs or preferences. The specific habitat associations for Threatened and Endangered, FS sensitive species and locally rare species are found later in this report. In general, aquatic species distributions are determined by major river drainage, size of the water body, and local characteristics (substrate, light, velocity, temperature, energy sources, and chemistry).

Biogeography

Geography directly influences the distribution of aquatic organisms at a large scale through the division of major river drainages. For example, some species are naturally found in the James River watershed, and not the Tennessee River watershed, or vice versa. Those species that are native and restricted to a given area or watershed are called "endemic". Species richness, as well as degree of endemism varies greatly by major river drainage.

Longitudinal Zonation

As previously stated in this report, most species occupy streams or stream reaches of particular size ranges, thus their distributions are longitudinally zoned. Species richness in stream reaches is related to longitudinal zonation. Headwaters nearly universally have fewer species than do medium and large streams in the same system.

The River Continuum Concept (paraphrased from Cushing 1995).

This concept explains how geology, light, current velocity, temperature, and energy sources interact to produce the changing mosaic of aquatic insects from headwaters to river mouth.

- In the headwaters, the stream is narrow and generally well-shaded by the riparian canopy. Primary producer energy for the stream comes from riparian vegetation. The stream is dominated by insects that are shredders and collectors.
- The stream's mid-reaches have a wider bed, warmer temperatures, more light, and nutrients. Algae is abundant on the stream bottom, and the stream is dominated by insects that are grazers and collectors.
- The lower reaches of a river are slow-flowing and deeper. Increased turbidity prevents sunlight from supporting algal growth on the bottom. In-stream primary production takes place within the water column where suspended algae and macrophytes are abundant. The insect community is largely made up of collectors, both filterers and gatherers.

Species occurrence will be discussed in Section 2.5 in terms of Management Indicator Species in the current GW Forest Plan and barriers to aquatic organism passage. It also will be discussed in terms of habitat on the Forest for FS sensitive species or locally rare species in Section 3.2.

Watershed Health

The living systems of a water body are the product of millennia of adapting to climatic, geological, chemical, and biological factors. Their very existence integrates everything that has happened where they live, as well as what has happened upstream and upland. When something alters the landscape around a river's headwaters, life in lowland reaches feels the effects (Karr and Chu 1999).

Recent research comparing stream segments having 30 meter wide buffers to stream segments with 15 meter wide buffers, found that those with 15 meter buffers have: 1) higher peak temperatures, and 2) more fine sediments (Jones et al. 2006). In addition, trout populations were shown to respond markedly to these habitat changes. Streams with 15 meter buffers would not be able to maintain the temperatures necessary to sustain young trout. Furthermore, studies in deforested watersheds (e.g., intensive agriculture and urban systems) have shown that wide land-use alterations can overwhelm the capacity of riparian buffers to support high-quality instream habitats and associated biotic communities (Roth et al. 1996; Wang et al. 2003; Roy et al. 2005).

Terrestrial and aquatic invasive species can alter habitat and biologic interactions. Examples of forest-altering species include the gypsy moth and hemlock woolly adelgid. Examples of non-native invasive aquatic species are didymo algae and Asian clams.

Watershed health will be discussed in Section 2.5 in terms of benthic macroinvertebrate monitoring on the Forest, and invasive species examples.

2.4 Range of Variation

The physical and biological characteristics of ecosystems do not remain constant over time, as plant and animal communities are continually altered in response to changes in physiographic and climatic conditions. In many cases, periodic disturbance is required to foster ecological processes (e.g., flooding promotes nutrient cycling in riparian soils), or to complete the life cycles of various organisms (e.g., pond drying/filling to facilitate marbled salamander reproduction). A certain amount of change is therefore unavoidable and essential in watershed ecosystems. For this reason, a key element in maintaining aquatic ecological integrity is the ecosystem's ability to evolve over time and to self-regulate following disturbance (Helfield et al. 1998).

Floods and Droughts

The watersheds of the GWNF periodically experience extreme flow events. Virginia lies in the path of cyclone storms that originate in the Gulf of Mexico and the Atlantic Ocean and carry large amounts of moisture. Flooding is common in the state, especially in the western mountain regions, where high precipitation and steep topography produce rapid runoff. The lands of the GWNF have been touched by floods of magnitude greater than 50-year recurrence interval in 1940, 1969, 1972, 1977, and 1985, as well as 1996 (van der Leeden, 1993). Most of these were produced by hurricanes. The potential for flooding is greatest when Soils are near saturation as they are in the spring or at any time of year following several days of rain. The presence of a forest canopy in a watershed can reduce flood peaks from small-to-moderate storms during the growing season because the growing trees utilize soil moisture and transpire it to the atmosphere. However, this soil moisture difference becomes negligible during large-storm events. A small mountain watershed on the GWNF can produce flood peaks approaching 1,000-cubic feet per second, per square mile. In contrast, a larger river basin like the James River at Holcomb Rock will have a maximum peak discharge of only 50-cubic feet per second, per square mile.

Historically, the great floods in western Virginia have been associated with hurricanes, which form part of the ecological disturbance regime for aquatic ecosystems. The way that a watershed responds to a hurricane event is strongly influenced by watershed condition and also by natural factors of sensitivity. A healthy watershed is resilient and can rapidly recover from the effects of a large flood. A watershed under stress from historic or ongoing land uses may show disproportionately more watershed damage and channel impacts, and will take much longer to recover. The watersheds of the Appalachians are in the process of seeking a new equilibrium partly, in response to the loss of American chestnut from the forests. Because of its resistance to rot, large woody debris produced from downed chestnuts would persist for decades and add stability to headwaters streams. In addition to increased longevity in the aquatic system, the mature chestnut trees were much larger than the trees of the second growth forests of today. When compared to streams in virgin forests in the Appalachian Mountains, the streams in second growth forests have significantly less large woody debris.

Low flows typically occur during late summer and early autumn when precipitation is low and soil moisture is utilized by growing vegetation. Water in the stream represents the release of water from groundwater and soil storage. Because of the wide range in topography, rock types, and soils, there is a wide variation of low flows in the streams of the GWNF. Where soils are deep, slopes are gentle, and drainage density is low, precipitation can be stored within the watershed and released slowly. Thus, peak flows are moderated and low flows are sustained. As greater flow contributions are from groundwater, water temperature is usually lower and less variable. Based on years of data from U.S. Geological Survey (USGS) stream gages across the Forest, for the same low flow recurrence interval, streams in the Ridge and Valley have one half of the flow rates of Blue Ridge streams.

Sediment

There is a great deal of variability in the sediment yield from year to year, which is termed "interannual variability." In part, this is because sediment yield is much greater during high runoff years with more stormflow to erode and transport sediment. Conversely, sediment yield is much less during drought years when high flows may be less than bankfull. However, interannual variability is a function of much more than the weather.

Data from the USGS gage on the Rappahannock River at Remington provides an expression of the variability of annual sediment yield. For the 42 years with flow and sediment data, each year's percent difference from the long-term mean ranges from plus 184 percent to minus 82 percent. A change of annual sediment yield of plus or minus 60 percent represents one standard deviation from the long-term mean. This value is also termed the coefficient of variation. According to Bunte and MacDonald (1999), "very few records of annual sediment yield have a coefficient of variation of less than 50%, and most values are closer to 100%." Therefore, the data from the Rappahannock provide a good but conservative estimate of the coefficient of variation for watershed systems on the George Washington National Forest. Figure G-2 displays the interannual sediment variability for the Rappahannock River at Remington.

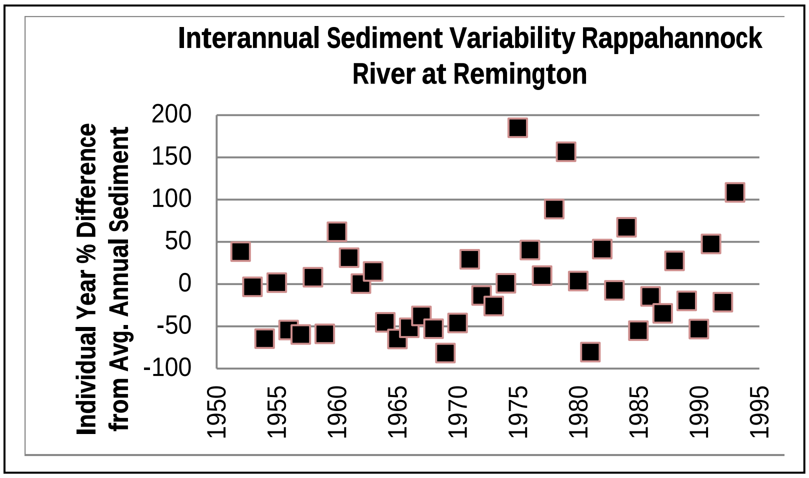

Figure G-2. Interannual Sediment Variability Example

2.4a Disturbance Processes

Natural Change Processes

Natural disturbance processes are typically characterized according to the frequencies at which they occur, and the intensity of their effects. Intensity of disturbance is typically defined according to the magnitude of effects on biotic communities. Frequency and intensity are generally inversely proportional to one another, as plant and animal communities associated with frequently disturbed habitats tend to develop adaptations that allow them to persist or even thrive under those conditions.

Within the watershed, upper reaches (low order streams or headwaters) are affected primarily by infrequent, high-intensity events (e.g., landsides, debris flows), whereas lower reaches (high order streams or rivers) tend to be affected by frequent, low-intensity events (e.g., flood scour/deposition) (Helfield et al. 1998). A description of these streams follows:

Low Order Streams (Headwaters)
The channel morphology of a low order stream is characterized by high gradient step-pools formed by large substrate particles (boulders) and large wood. The floodplain is narrow and constrained. Disturbance is infrequent, but often extreme, in the form of landslides and debris flows. The effects of the disturbance are severe hillslope and channel erosion, and channel aggradation and degradation.

Mid-Order Streams (Streams to Large Streams)
The channel morphology of a mid-order stream is characterized by a moderate gradient assemblage of pools, riffles, and runs. Particle sizes are mixed, but predominantly cobble size, with some exposed bedrock. The floodplain ranges from unconstrained to constrained. Disturbance is more frequent, and in the form of debris flows, landslide/dam break floods (torrents), and bank erosion. The effects are cycles of aggradation and degradation, mass transfer and deposition of LWD, and alteration of riparian zone.

High Order Streams (Small to Large Rivers)
The channel morphology of a high order stream is characterized by low gradient pools, riffles and runs. Particle sizes are smaller, dominated by sand and gravel. The floodplain is wide to accommodate the sinuous channel. Disturbance is frequent, but of lower intensity, in the form of floods, and treefall. The effects of disturbance are bank erosion, evulsions, and alteration of the riparian zone.

Wetlands and natural lakes and ponds are likewise affected and maintained by natural change processes. As described by Euliss and others (2008), these habitats “occur at positions in the landscape where the underlying geology creates hydrologic conditions suitable for their development”. The fundamental ecological processes at work in these lentic systems are a balance of hydrodynamics (including flooding and drought), erosional properties, and nutrient cycling (Euliss et al. 2008; Pearson 1994). An example of a natural disturbance process in these systems is the never ending cycle of beaver ponds filling with debris and being abandoned to the forces of erosion and terrestrial recolonization. Hackney and Adams (1992) state that beavers have probably created more aquatic and wetland habitats than human efforts have ever done.

Anthropogenic Change Processes

A biota can sustain itself- it is very resilient- when faced with normal environmental variation, even when that variation is large (e.g., variation in river flow). But the same biota may not be able to withstand even the smallest disturbance outside the range of its evolutionary experience (Karr and Chu 1999). Habitat alteration is the major cause of decline of aquatic diversity in the South (Clingenpeel and Leftwich 2008). Channelization, impoundment, sedimentation, and flow alterations are the most common physical habitat alterations associated with the decline of aquatic species (Walsh et al. 1995; Etnier 1997; Burkhead et al. 1997). Other human-induced impacts to aquatic species include pollution, introduced species, and over-harvesting (Miller 1989). Euliss and others (2008) likewise note that human stressors on lake and wetland habitat include: shoreline alteration, altered sediment supply and transport, altered hydrology, land-use change, development on uplands, invasive species, introduction of non-native organisms, and disruption of fire regimes.

Habitat quality within a freshwater ecosystem is determined by activities within the watershed (Abell et al. 2000; Scott and Helfman 2002). A resource assessment was conducted using information from the Eastern Watershed Assessment Protocol (EWAP 2002) and is documented in Appendix G5. Fifth code HUC watersheds were evaluated in a GIS environment to characterize the watersheds based on the following conditions, or human-caused disturbances that can affect aquatic biota outside their normal range of variation.

Disturbance or Condition	Watershed Parameter	Data Management from EWAP 2002*
Characterization	National Forest ownership	Percent of national forest within the watershed
Characterization	Land Use (forested)	Percent of forest cover within the watershed
Deforestation/channelization/grazing streambanks	Forested riparian	Length of streams flowing through forested land cover divided by total length of streams in watershed
Sediment and impacts from roads	Road Density	Length of highway divided by watershed area expressed as a percentage
Sediment and impacts from roads	Road – riparian interaction	Percent of total stream length in each HUC that has road within 30 meters.

Disturbance or Condition	Watershed Parameter	Data Management from EWAP 2002*
Point and non-point source pollution	Point sources of pollution	Sum of ricris, cercla, pcs, and ifd sites
Dams/impoundment construction	Dams / Diversions	Number of dams found in the watershed
Point and non-point source pollution	State Impaired Waters	Total length of impaired streams divided by total stream length expressed as a percentage.
Acid deposition	Acid deposition sensitivity	Percent of watershed with high acid deposition sensitivity
Characterization	Public water supply sources	Number of drinking water sources found in the watershed
Characterization	Drainage Density	Length of streams divided by watershed area expressed as a percentage.
Characterization	Number of aquatic TE/S/LR	Number of aquatic TE/S/LR not counting birds and non-TE plants

* Except for Number of aquatic TE/S/LR, these are from 2009 analysis.

The analysis in Appendix G5 is a description of the major resource components within the watersheds that contain the GWNF; it is a coarse evaluation of the interactions among the physical, biological and human aspects of the watersheds and the processes influencing them (Regional Ecosystem Office 1995). As seen in Chart G-1, the percent forested land use in a watershed generally mirrors the percent National Forest in that watershed, with the exception of the east side of the Blue Ridge Mountains on the Pedlar District where there are large tracts of private forested land (HUC codes 0208020301-0208020306). HUCs 0207000102 and 0208020108 are Laurel Fork and Craig Creek, respectively, where a large part of the watersheds are on other National Forests (the Monongahela (41% NF) and Jefferson (62%NF)). This watershed analysis is a snapshot in time, incorporating many human disturbances outside the control of, and area managed by, the Forest Service. For example, the percent of impaired streams in a watershed is generally the inverse of the percent National Forest in that watershed (see Chart G-2). The analysis shows the relative condition of the watersheds, and the relative importance of Forest lands to aquatic TE/S/LR species and their habitat (see Charts G-3 and G-4). As outlined by Kershner (1997), this characterization step is followed by the identification of current conditions related to issues and current plan management (Section 2.5), and finally, development of recommended goals and guidelines to maintain the key factors of ecological integrity (Section 2.6).

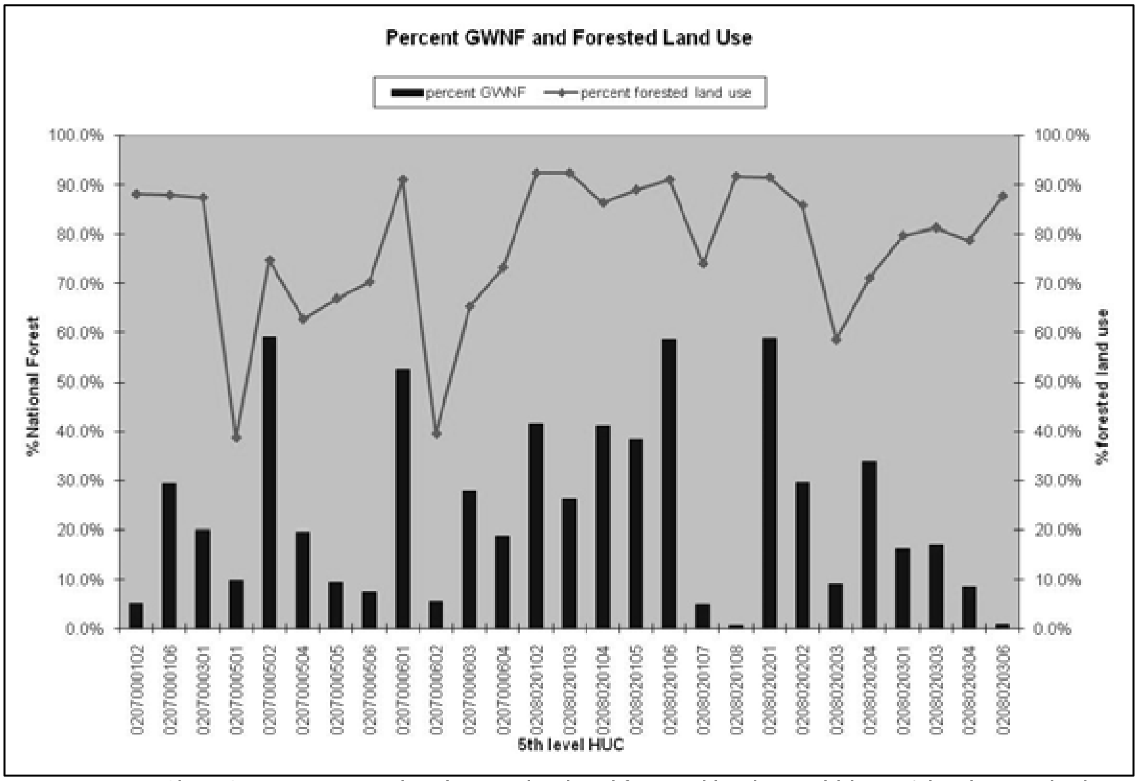

Chart G-1. Percent National Forest land and forested land use within a 5th level watershed

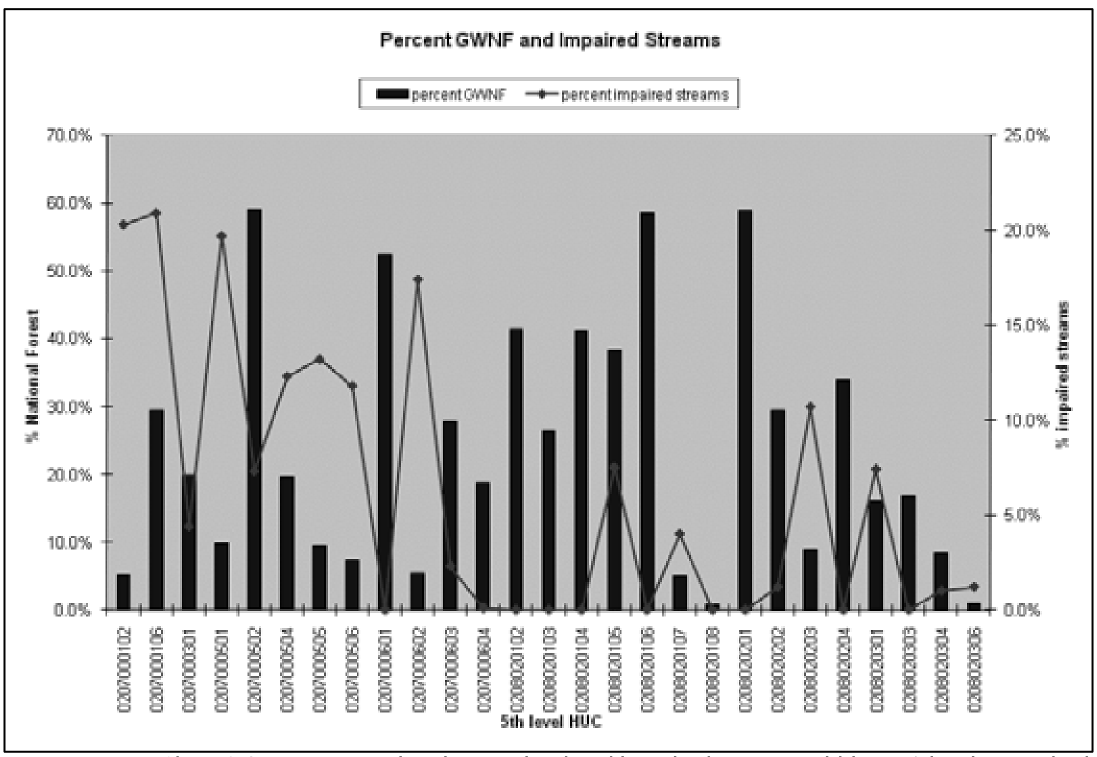

Chart G-2. Percent National Forest land and impaired streams within a 5th level watershed

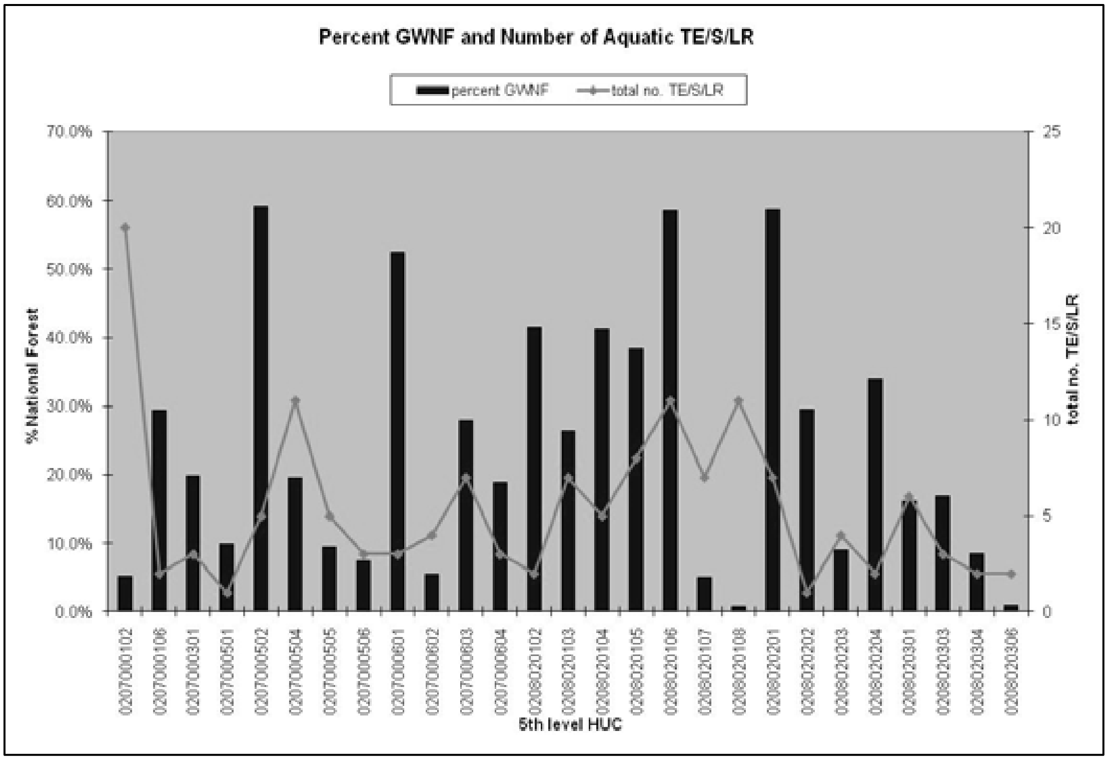

Chart G-3. Percent National Forest land and total number of aquatic TE/S/LR species within a 5th level watershed

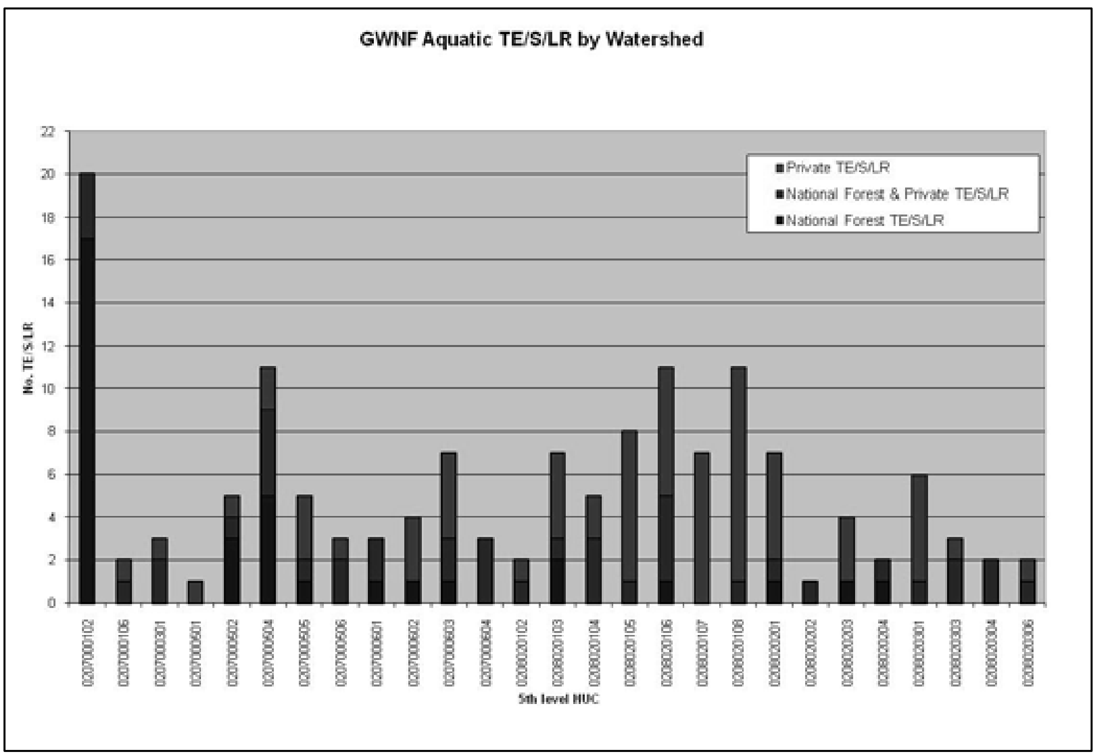

Chart G-4. Number of Aquatic TE/S/LR species on National Forest, National Forest and Private land, and Private land within a 5th level watershed

2.5 Current Condition and Trend of Ecosystem Characteristics and Status of Ecosystem Diversity

Physical Integrity

Riparian Areas

Stable and complex vegetation community

Current Condition: The 1993 Forest Plan allows up to 20% basal area removal of trees along perennial non-native trout streams and 50% basal area removal along intermittent streams. There is no regulation of vegetation management along ephemeral streams. One timber sale was designed to specifically address the issue of removing non-native pine plantations along the North River. Otherwise, no projects were known to have removed any vegetation within riparian areas of the GWNF.

See discussion under *invasive species*, about the hemlock woolly adelgid and riparian vegetation.

Trend: Riparian vegetation across most of the Forest is undisturbed and growing older, except in areas where hemlock woolly adelgid and gypsy moth have caused mortality, and in developed or dispersed recreation areas.

Dispersed Recreation opportunities and impacts

Current Condition: Projects that were done to improve riparian conditions included closing or moving roads and trails, improving stream crossings, and planting a forested riparian buffer. This is not an all-inclusive list, and it is recognized that many more projects have occurred to improve watershed conditions. It is also recognized that many more dispersed recreation opportunities and problems exist across the Forest, and have yet to be addressed.

Trend: Mitigation of recreation impacts to riparian areas is an on-going process; as some areas are rehabilitated; other user-created areas are degraded.

Instream Habitat

Large Woody Debris (LWD) and instream habitat surveys

Current Condition: Forest personnel surveyed stream habitat to measure desired future condition (DFC) parameters identified in the 1993 Revised GWNF Forest Plan. Surveys were conducted on portions of the Pedlar Ranger District in 1995 and 2005, Lee District in 2001, Dry River District in 2002, 2003, 2004 and 2005, and the Warm Springs in 2005. Overall, 631 km (392 miles) of streams were surveyed using a modified Basinwide Visual Estimation Technique (BVET [Dolloff et al. 1993]) to estimate woody debris loading, percentage of pool and riffle area, and the width of the riparian area of streams. The distribution of woody debris was also mapped. See Table G-4 for a summary of LWD and % pool area.

Table G-4. Miles of Stream Habitat Surveyed In 1995-2005
George Washington National Forest

Year Surveyed	# of Stream Miles Surveyed	% of Streams Below Minimum Pool Area DFC	% of Streams Below Minimum LWD DFC
1995	113	48	44
2001	75	75	35
2002	57	62	33
2003	55	70	19
2004	35	71	78
2005	57	96	83

A comparison of individual streams surveyed in 1995 and again in 2005 on the Pedlar District showed a decrease in the median number of pools, number of riffles, and total LWD per km, while the median pool and riffle surface area increased. This report suggests that in 1995 only 25% of streams met the DFC for stream area in pools and less than half of streams met the DFC for total LWD. By 2005 no streams met the DFC for pool area and 75% of streams did not meet the DFC for total LWD. The changes in pool/riffle ratio, number of pools and riffles per km, and pool and riffle surface area are all consistent with decrease in total LWD. The largest decrease of LWD was in the smallest size class. These pieces most often form pool habitat by combining with other small woody debris to form debris jams. In general the smallest size classes are the most easily dislodged and transported downstream or out of the active stream channel during high flows (Hilderbrand et al. 1998; Montgomery et al. 2003). Loss of debris accumulations from long riffle areas following flood events could result in the changes in stream habitat observed. The median amount of the largest size classes of LWD either remained the same or increased in the reaches between 1995 and 2005.

Following Plan approval, across all Ranger Districts, large woody debris was deliberately added to many streams that did not meet the DFC. In addition, efforts were made in the North River to return a highly modified stream channel to a more natural condition. Past hydrological modifications of the North River include bank armoring with rock gabions and channelization to protect the road from frequent floods. These modifications resulted in a wide, shallow channel that lacks fisheries habitat complexity. Under a recent project, rock veins and weirs, and other structures made of natural materials were placed in the stream channel to consolidate streamflow and increase sinuosity. Non-functional rock gabions blocking the natural floodplain were removed.

Trend: Management actions such as adding large woody debris and other types of in-stream structures moved particular streams toward meeting the DFC. However, the vast majority of the Forest's streams received no direct management action. Although comparisons of 1995 and 2005 stream surveys showed a decrease in streams meeting the desired future conditions for pool/riffle ratio and total LWD, the median amount of the largest size classes of LWD either remained the same or increased during that time period. The largest size classes (size 3: > 5 m long, 10-50 cm diameter; size 4: >5 m long, >50 cm diameter) are most stable and can easily have residence times of greater than 10 years in Appalachian streams with relatively little movement (Andy Dolloff, unpublished data). Continued supply of these size classes to the stream may result in increases in total pool habitat in the future.

Such differences highlight the fact that LWD dynamics are governed by a wide array of chronic and acute events, both natural and anthropogenic, including flooding, fires, stand maturation, riparian composition, and timber harvest (Dolloff and Warren 2003; Benda et al. 2003). For example, insect infestations such as gypsy moth or hemlock woolly adelgid can result in the relatively rapid death of many trees. Smaller size classes of LWD are added to the stream as dead trees standing in the riparian area begin to shed branches, and larger size classes are added as these trees continue to decompose and eventually fall across the stream channel. Natural additions of LWD can come through slow attrition or in large pulses if stands are impacted by events such as hurricanes. It is expected that streams will move toward the DFC through natural process if riparian forests are allowed to mature and more trees are left in the vicinity for recruitment of future LWD (Benda et al. 2003; Boyer and Berg 2003; Dolloff and Warren 2003; Morris et al. 2007; Reich et al. 2003).

Lake and Wetland Habitat

Current Condition: National Forest lakes and reservoirs have been managed to support balanced, productive self-sustaining recreational fisheries, in addition to other water-based recreation (swimming and boating). Fisheries Management was practiced in cooperation with State agencies to provide fishing opportunities to the public. Management practices included angler access improvement, liming and fertilization, aquatic weed control, fish habitat improvement, and fish stocking.

Wetlands and natural ponds have been managed to support self-sustaining populations of native species associated with permanent pond, wetland, and vernal pool habitat. The benefit of fishless ponds and vernal pools to many amphibians and insects is recognized and stocking fish has been discouraged. In several cases, fish have been removed from these ponds.

Trend: Many of the reservoirs on the Forest were built in the 1950s for flood control or water supply. They are becoming increasingly filled with sediment, and many are in need of dredging. Wetlands and natural ponds are protected on the Forest, and beaver ponds and meadows are increasing in number with the expanding beaver population in Virginia (Feis 2009).

Thermal Regime

Current Condition: Water temperatures have not been systematically tracked across the Forest. The Virginia Department of Environmental Quality has listed six streams in the 2008 303d report as being impaired for temperature within the GW proclamation boundary. In addition, Switzer Lake was listed as impaired for temperature. These impairments are attributed to natural conditions, drought-related impacts, or unknown sources; they are not attributed to any Forest management activities.

Trend: It is expected that with the warming climate over the past several decades and into the future, stream temperatures will likely increase (Flebbe et al. 2006). A multi-agency cooperative project is being planned to look at short and long term temperature changes in headwater streams throughout western Virginia. Protecting and restoring riparian forests will help moderate these changes. See Section 3.4, temperature change species group for additional discussion.

Chemical Integrity

Dissolved Oxygen

Current Condition: The 2008 303d reports for Virginia and West Virginia list 49 streams that run through the Forest as being impaired, none for DO. The sources of these impairments are off-Forest (acid deposition, fecal coliform, E. coli, agriculture), or are described as “natural.” Of the five reservoirs listed, none are impaired for DO. Their impairments are pH and temperature.

Trend: Two streams and two reservoirs that are within the National Forest have been removed from the impaired waters list since the 2006 report.

pH and Alkalinity

Current Condition: Water quality has been systematically monitored on Forest streams since 1987. As expected, the general water quality of any given stream is strongly tied to the underlying geology coupled with prevailing air quality. The collected data has been used to determine trends and changes in stream water composition, and to project the future chemical status of native trout streams. A 1998 report (Bulger et al. 1998) found that of the study streams in non-limestone geology, 50 percent are “non-acidic.” An estimated 20 percent are extremely sensitive to further acidification; another 24 percent experience regular episodic acidification at levels harmful to brook trout and other aquatic species. The remaining 6 percent of streams are “chronically acidic” and cannot host populations of brook trout or any other fish species.

Atmospheric deposition is listed as the cause of impairment for 21 of the 49 impaired streams running through the Forest, and 4 of the 5 reservoirs, in the 2008 303d reports.

Trend: Modeling conducted by the Southern Appalachian Mountain Initiative (SAMI) and reported in their 2002 publication on acid deposition showed that even with the sulfate deposition declining considerably, as new air regulations are implemented, stream recovery will be slow or non-existent over the next 100 years. Chronically acidic streams may improve slightly and be only episodically acidic by 2100, but they will still be marginal for brook trout (see Figure G-3).

Due to the lengthy recovery time anticipated for acidified streams on the Forest, selective liming to improve water chemistry should continue to be considered.

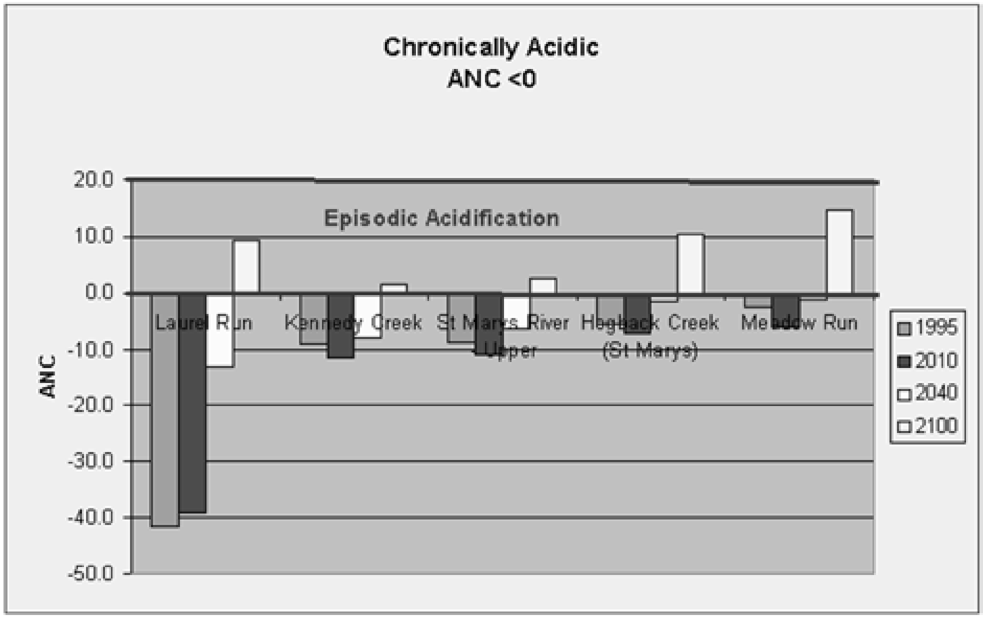

Figure G-3. SAMI Modeling Results for Selected Streams on the GWNF.

The following streams have been limed on the GW Forest since 1989:

Table G-5. Streams Limed on GWNF

Date	Stream	County
1990, 1997	Cedar Creek	Shenandoah
1993, 1994, 1997, 2006	Laurel Run	Shenandoah
1997, 2000, 2003, 2006, 2009	Little Passage Creek	Shenandoah
1989, 1990,1991, 1998, 2001, 2004, 2007, 2010	Little Stony Creek	Shenandoah
1990, 1998, 2001, 2007	Mill Creek	Shenandoah
1993,1997, 1999, 2002, 2005, 2008	Mountain Run	Rockingham
1999	St. Mary's River & 5 tribs	Augusta
2005	St. Mary's River & 6 tribs	Augusta
1995, 1996, 1997, 1998, 1999	Trout Pond Run	Hampshire, WV

Trends in pH for several of the limed streams are shown in Figures G-4 and G-5.

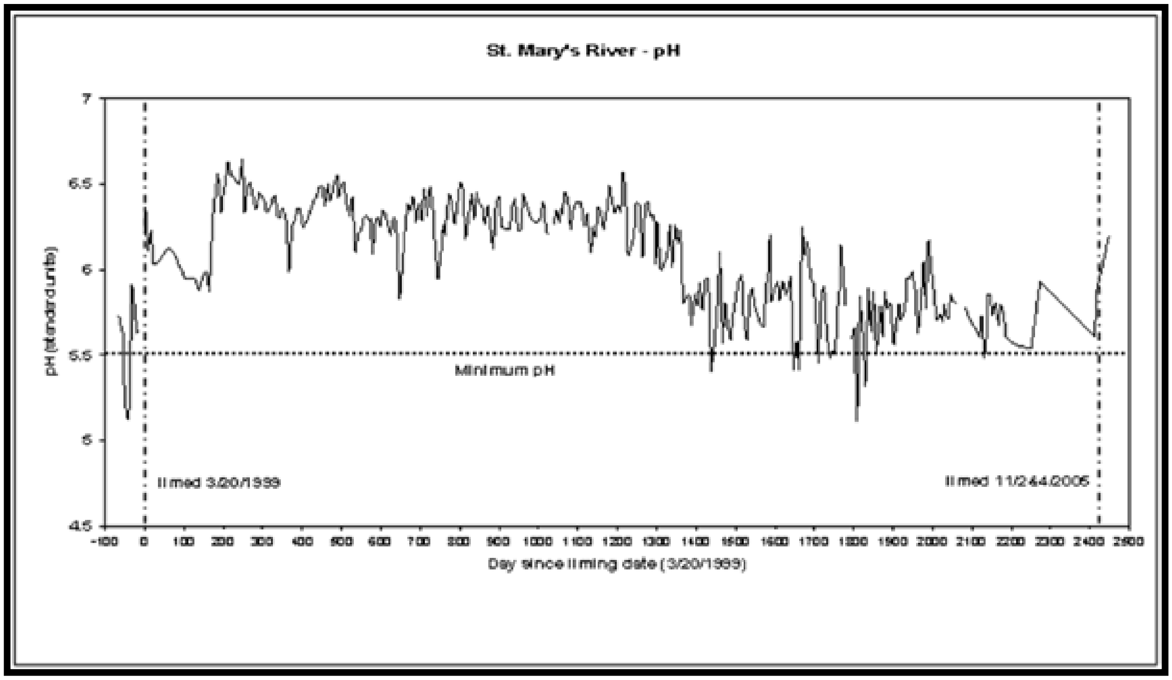

Figure G-4. St. Mary's River pH following liming

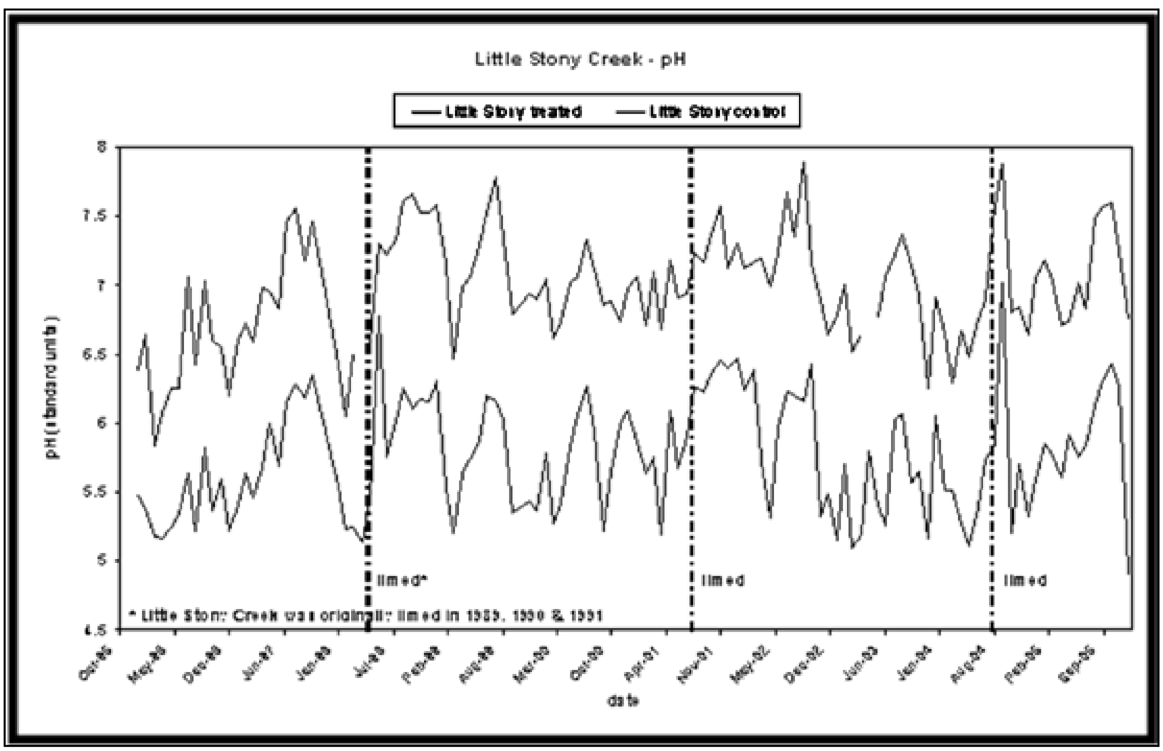

Figure G-5. Little Stony Creek pH following liming

Additional trend information on the effects of acidification and liming is documented in Appendix G, Brook Trout and Wild Trout section, of the annual M&E reports since the 1997-1998 report.

Other Elements

Current Condition: Aluminum is soluble and toxic to aquatic organisms under acidic conditions as described in Section 2.3, and warrants further discussion.

Trend: Aluminum levels were monitored in stream water following a liming treatment at St. Mary's River. Total aluminum concentration levels above 130 g / L are considered hazardous for aquatic life and thus were chosen as the maximum acceptable amount for this study. Figure G-6 below shows the total aluminum concentration for the St. Mary's River in the weekly samples taken at the gauging location (site 1) on the top graph and the quarterly aluminum values taken at the control site (site 11) upstream of the limestone treatment. The graphs show that aluminum was mobilized during high flow periods due to low pH and flushing in the untreated reach of the stream. Episodic short-term spikes in aluminum concentrations as well as the base flow concentrations were less than the target value downstream of limestone treatment. Aluminum concentration at site 1 averaged 39.3 + 16.9 ppb prior to liming and 21.3 + 18.0 ppb since the liming.

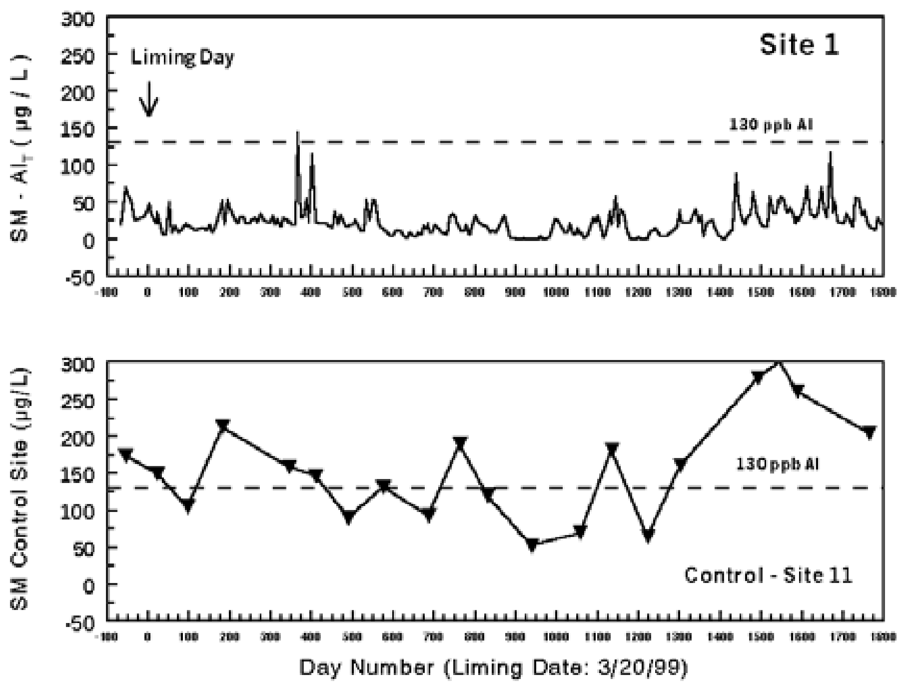

Figure G-6. Total aluminum concentration for the St. Mary's River

Biological Integrity

Species Occurrence

Management Indicator species

Current Condition: The 1993 GWNF included brook trout as a Management Indicator Species (MIS) for cold water stream habitat, the centrarchid family for warmwater/lake habitat, and the James spinymussel as a T&E species. The trends for these aquatic species on the Forest are discussed below. Occurrences of other FS sensitive species or locally rare species are discussed elsewhere in this report.

Trend: *Brook Trout* - As shown in Figure G-7 below, populations of brook trout tend to fluctuate greatly over time. These findings do not necessarily suggest negative impacts to those streams from management activities, but rather that trout numbers are often highly variable due to natural occurrences (drought, floods, high temperatures, etc.). As documented in Appendix G of the annual M&E reports, timber harvesting and other management activities did not significantly decrease habitat or populations of brook trout. Furthermore, some management activities, such as stream liming and habitat restoration, were specifically designed to improve brook trout habitat and increase their populations. Because of ecological and recreational interest in this species, we recommend wild brook trout as a MIS in the revised Forest Plan. Additional discussion of brook trout is in Section 3.4 under Temperature Change Species group.

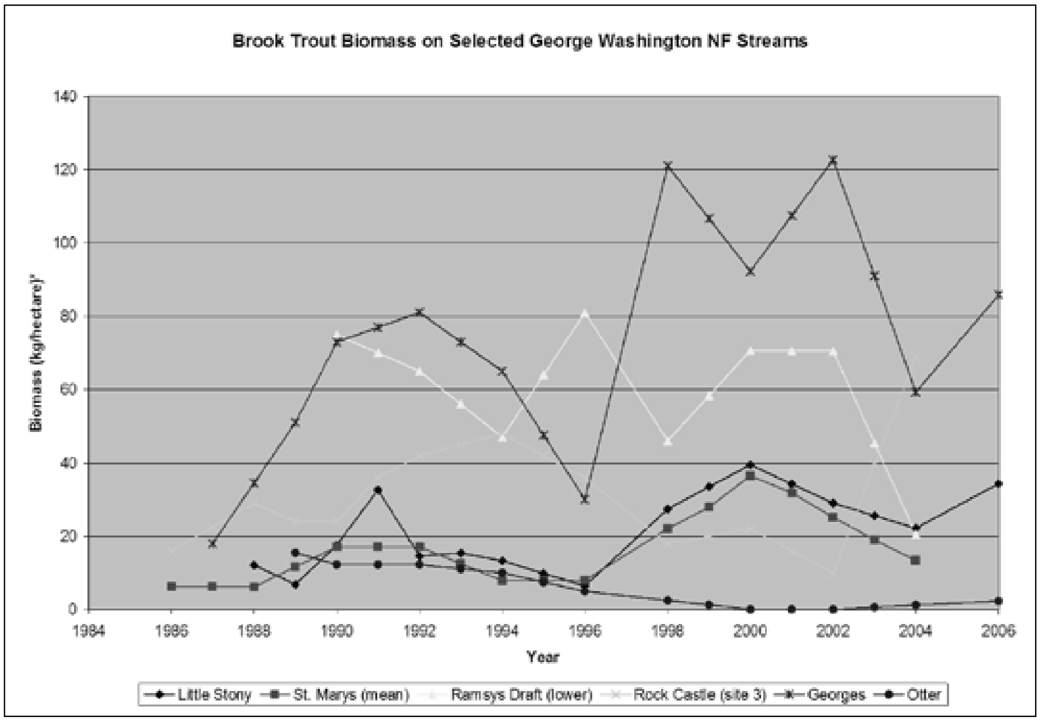

Figure G-7. Brook Trout Biomass on Selected GWNF streams

*Not all streams were surveyed every year. For those years without a survey, an average was added to the data table in order to draw a continuous trend line.

Centrarchid (Sunfish) Family - As documented in Appendix G of the annual M&E reports, Forest Service activities, such as the creation of structures in reservoirs, are beneficial to members of the sunfish family. However, even though the addition and maintenance of underwater structures in Forest reservoirs is necessary for healthy self-sustaining warm water fish populations, these populations are heavily manipulated through fishing regulations and harvest pressure (Noble 2002; Quinn 2002; Spotte 2007; Swennson 2002; Wilson and Dicenzo 2002). Reservoirs are not a natural system, supporting native fish communities. Because of this, we recommend that the Forest continue to work with State agencies to monitor warm water fish and enhance habitat on the Forest land, but not include the sunfish family as a MIS in the revised Forest Plan.

James spinymussel - As documented in Appendix G of the annual M&E reports, several new occurrences of the James spinymussel were located from surveys conducted on streams in Bath County in 2000-2004. The James spinymussel does occur in watersheds that contain NFS land and occurs both upstream and downstream from the Forest. Current Forest management provides for water quantity and quality that contributes to the persistence of mussel populations.

Overall, viability remains a concern for the James spinymussel on the GWNF, yet management has little ability to affect its overall viability. Factors outside the authority of this agency affect the viability of the James spinymussel.

The Forest is currently working with the US Fish and Wildlife Service and VDGIF to locate James spinymussel populations on National Forest and habitat suitable for augmentation. This Federally endangered species should be considered in the revised Plan.

Aquatic Organism Passage (AOP)

Current Condition: Recent National and Regional attention has focused on the issue of aquatic organism passage. Land managers recognized that instream barriers can prevent migration, dispersal, and colonization, leading to genetic isolation and possible extirpation. Specifically, culverts, where roads cross streams, can be barriers to fish or other aquatic organisms (Gibson et al. 2005; Verry 2000).

Forest Service researchers used the 'National Inventory and Assessment Procedure for Identifying Barriers to Aquatic Organism Passage at Road-Stream Crossings' developed by the USFS San Dimas Technology and Development Center to assess road stream crossings on the Forest. On the GWNF, over 500 stream-road crossing surveys were conducted between 2003 and 2006. The majority of crossings (i.e. culverts or low-water fords) were not passable for all fish types (strong, moderate, or weak swimmers and leapers). This inventory can be used to identify barriers to aquatic passage and prioritize them for replacement/repair based on maximum benefit to aquatic organisms or habitat.

Streams where bottomless arch culverts were installed at road crossings to improve aquatic organism passage on the GWNF include:

Laurel Run and Hunkerson Gap on the Lee District
Pitts Spring Run and Roaring Run on the Lee District
Middle River and Slatelick on the North River District
Mill Creek on the Pedlar District
Little Irish Creek on the Pedlar District.

Trend: Culverts are being replaced/repaired with designs that allow for AOP where appropriate. Likewise, new road crossings are designed to allow for AOP when it is desirable (does not provide a pathway for invasive species). AOP is increasing across the Forest.

Watershed Health

Benthic macroinvertebrates

Current Condition: Benthic macroinvertebrates are organisms that live in or on the bottom substrates of rivers, streams, or other waterbodies. These organisms are primarily insect larvae, but also include worms, crustaceans and mollusks. The use of macroinvertebrates has proven to be a reliable monitoring tool, as they are sensitive to changes in aquatic habitat and water quality, which in turn reflects the overall health of the watershed. Benthic macroinvertebrates are included as a monitoring item in the current GW Forest Plan, and have been monitored on the GWNF since 1993.

Sample sites were selected downstream of management activity areas to monitor the impacts on stream health of projects including but not limited to timber sales and prescribed burns. Other samples were collected to create a baseline of stream conditions within the forest. Across the Forest, 728 samples were collected, analyzed and assigned an overall MAIS (Macroinvertebrate Aggregated Index for Streams) score. The MAIS incorporates nine metrics to evaluate the current condition of a stream relative to others within the ecological unit. It ranges from 0 to 18. Less than 6 is very poor, between 7 and 12 is poor/fair, between 13 and 16 is good, and between 17 and 18 is very good.

Of these samples, 84% were in the "good" and "very good" categories.

Trend: Trends for aquatic macroinvertebrates have been fully documented in Chapter 2 (Management Area 18) of the annual M&E reports since the 1997-1998 report.

A paired t-test was used to compare the MAIS scores of 18 streams before and after timber harvests that occurred at various locations across the Forest. Only samples collected from March through the first week in June were compared to minimize seasonal variability in structure of macroinvertebrate communities. There was no significant difference between the pre and post timber harvest MAIS scores; both the pre and post mean scores were in the “Good” category (See Table G-6 below).

Table G-6. Paired samples t-test on pre and post MAIS scores from 18 different timber sales

Mean MAIS pre	16
Mean MAIS post	15
95% CI	-0.365 to 2.365
P value	0.140

A paired t-test was used to compare the MAIS scores of 7 streams before and after prescribed burn that occurred at various locations across the Forest. There was no significant difference between the pre and post prescribed burn MAIS scores; both the pre and post mean scores were in the “Good” category (see Table G-7 below).

Table G-7. Paired samples t-test on pre and post MAIS scores from 7 different prescribed burns

Mean MAIS pre	16
Mean MAIS post	16
95% CI	-1.098 to 1.669
P value	0.631

Invasive Species – several examples

Current Condition: *Adelges tsugae* (Hemlock woolly adelgid) - The Hemlock woolly adelgid, is native to Asia and was first introduced to North America in British Columbia in the 1920s and was later discovered in the Shenandoah Mountains of Virginia in the 1950s. Adelgids feed by sucking sap from hemlock twigs and when they reach very high densities they can cause dieback and mortality of their hosts. In the eastern US, the adelgid’s principal host is eastern hemlock, *Tsuga Canadensis*, a tree typically associated with streams and riparian areas. Heavy infestations have killed trees in as little as four years, but some trees have survived infestations for more than 10 years.

Currently, hemlock woolly adelgid has only invaded part of the range of eastern hemlock in the United States and Canada. On average, the insect has spread about 15-20 miles per year. Wind, birds, animals, and accidental movement by people cause this rapid spread. In Asia, the insect is found in very cold climates. Thus, it is likely to colonize most or all of the range of the eastern hemlock species. Eastern hemlocks contribute to stream habitat by providing dense shade in the summer and thermal control in the winter. The wood of the hemlock decays relatively slowly and can contribute long-lasting LWD and to the stream’s overall stability.

Forest inventories list 1,092 acres of hemlock stands on the GWNF. Another 5,584 acres are listed as hemlock-hardwood, meaning that they are greater than 70% hemlock. The GWNF sprays individual trees or injects the soil with a systemic insecticide within recreation areas to protect them from the adelgid. At this time it is not economically or technically feasible to treat large stands of hemlock within the forest.

Trend: It is expected that there will be a large increase in LWD to streams with hemlocks in their riparian corridor. In addition, for those streams with a significant portion of the riparian forest in hemlock, summer temperatures may increase with the loss of streamside shading.

Current Condition: *Didymosphenia geminata* (Didymo) – Didymo is a freshwater diatom (type of alga) that historically was only found in pristine lakes and streams of northern latitudes. Its range is now expanding in North America to include lower elevation clear, cool streams. It can form massive blooms on the bottoms of streams and rivers where it attaches itself to the streambed by stalks. These stalks can form a thick brown mat that smothers rocks, submerged plants and other materials. Established mats form flowing streamers that can turn white at their ends and look similar to tissue paper. Although the alga appears slimy, it feels like wet cotton wool. Didymo was found in the Jackson River and Smith River tailwaters in Virginia in spring of 2006, the Pound River tailwater in 2007, and Dan River in 2008. Information sheets were posted at Forest Service angler access points along the Jackson River to inform anglers and instruct them on how to prevent the spread of this invasive species. The Smith and Dan Rivers are not on or near National Forest land.

Trend: Didymo colonization was monitored monthly over a 12 month period at a single transect in the Jackson River downstream of Gathright Dam to observe its growth over time. In 2008, didymo density steadily increased from February – April, peaked in May - June, then rapidly declined in the period from July – October. Transect scores were plotted against discharge, water temperature, and depth to evaluate relationships between alga density and non-biological factors. Positive, but weak, relationships were determined with all three criteria, but the strongest was between transect score and discharge. Biological response to didymo infestation was also examined by electrofishing and benthic macroinvertebrate monitoring before and after 2006. Post-infestation catch rates for wild rainbow trout (*Onchorhynchus mykiss*) in the Gathright Dam area were not significantly different than historic values ($t0.05, 5 = 0.949$). Stream metrics calculated for macroinvertebrates from the Gathright Dam area in 2007-08 showed a decline in ecological health from 1992-93 samples. Results from this preliminary investigation indicated that didymo infestation has had a variable impact on aquatic fauna in one reach of the Jackson River Tailwater.

2.6 Plan Components for Ecosystem Diversity

The 1993 GWNF Plan went a long way in providing sound direction for managing aquatic resources. Aquatic and riparian Desired Future Conditions (DFCs) were allocated to riparian ecosystems associated with ponds, lakes, and perennial streams. These areas were managed to restore, maintain, and/or enhance the inherent ecological processes and functions of the associated aquatic and riparian communities as described by the DFC for Management Area 18. Management did focus on providing habitat for species that depend on riparian resources for at least a part of their life-cycle. Yet, some more can be done. The GWNF Plan revision effort should recognize and address the following:

1. Recognize riparian values other than, and in addition to, aquatic resources and buffering streams from other management practices;
2. Recognize the important role of intermittent and channeled ephemeral headwater streams in maintaining water quality and quantity, recycling nutrients, and providing habitat for plants and animals. It is appropriate to provide management direction for the areas around not only perennial stream channels, but also intermittent and channeled ephemeral streams;
3. The Forest also developed a Federally Listed Mussel and Fish Conservation Plan cooperatively with the USFWS and state partners. The intent was to provide pro-active and consistent management direction for watersheds that contained T&E fish and mussels. The USFWS Federally Listed Mussel and Fish Conservation Plan needs to be incorporated into the revised plan as guidelines for site-specific projects;
4. Address a new issue over aquatic organism passage; and
5. Address whether grazing should continue within riparian areas as a suitable use.

Aquatic and riparian Desired Future Conditions (DFCs) should be allocated to all riparian areas across the George Washington National Forest. Riparian corridors should be managed to restore, maintain, and/or enhance the inherent ecological processes and functions of the associated aquatic and riparian communities as described by the DFC. Management should focus on providing habitat for species that depend on riparian resources for at least a part of their life-cycle. The following Plan Components should be carried forward from the 1993 Plan or developed to address either a Key Factor in maintaining Aquatic Ecological integrity, or a disturbance process. These plan components were developed from previous Forest Plans, state Best

Management Practices, and current research. They are building on the approach that was used in the 1993 Plan, an approach that was successful in maintaining aquatic integrity as documented by the monitoring and evaluation reports.

PHYSICAL INTEGRITY

Goal 1 **Watershed**

Manage watersheds to maintain or restore resilient and stable conditions to support the quality and quantity of water necessary to protect ecological functions and support beneficial water uses. Channeled ephemeral streams maintain the ability of the land to filter sediment from upslope disturbances and to provide forest material as nutrient input while achieving the Desired Conditions of the adjacent management prescription area. (Corresponding standards: 002, 007, 008, 013, 014, 015, 016, 019, 020, 021, 022, 029, 030, 031)

Goal 2 **Sediment Regime**

Restore and maintain the sediment regime under which the aquatic system evolved. Sediment regime elements include the timing, volume, rate, and character of sediment input, storage, and transport. Maintain sedimentation rates that are in dynamic equilibrium with the watershed, and stabilize or improve the biological condition of the stream. (Corresponding standards: 001, 002, 005, 006, 012, 013, 014, 015, 017, 018, 019, 020, 021, 022, 023, 024, 025, 026, 028, 029, 030, 031, 032, 033, 034, 035, 036, 037, 038, 043)

Objective: Streams are managed in a manner that results in sedimentation rates that stabilize or improve the biological condition category of the stream as monitored using aquatic macroinvertebrates.

Goal 3 **Instream Flow**

Instream flows (or lake levels) provide the amounts necessary to: 1) maintain the capacity of the channels to transport water and sediment; 2) protect aquatic organisms and provide habitat for all life history stages and migration; 3) transport nutrients; and 4) sustain or restore riparian habitats and communities. (Corresponding standards: 008, 023, 024, 025, 027, 042)

Goal 4 **Connectivity**

Maintain and restore spatial and temporal connectivity within and among stream segments and watersheds. Maintain physically unobstructed routes to areas that fulfill critical life history requirements of aquatic and riparian-dependent species; and prevent further human caused fragmentation of aquatic habitats. (Corresponding standards: 023, 027, 043, 044)

Goal 5 **Riparian - Aquatics**

Restore and maintain native species composition and the structural diversity of plant communities in riparian zones and wetlands to provide adequate thermal regulation, nutrient filtering, appropriate rate of surface and bank erosion, and sufficient amount and distributions of large wood to sustain physical habitat complexity and stability. Riparian areas will contain a minimum amount of exposed mineral Soil and effective mitigation measures will be taken where surface disturbances or modifications concentrate runoff, accelerate soil erosion, or transport sediment to stream channels. Management will focus on restoring and/or maintaining riparian-dependent plant and animal species. (Corresponding standards: 003, 004, 009, 010, 011, 043)

Objective: Streamsides are managed in a manner that restores and maintains amounts of large woody debris (LWD) sufficient to maintain habitat diversity for aquatic and riparian species (approximately 200 pieces per stream mile).

Goal 6 Riparian - Terrestrial

Restore and maintain taxonomically diverse vegetation (both living and dead) with both horizontal and vertical structural diversity consisting of distinct vegetation layers from the water surface to the canopy top. Riparian diversity can be enhanced by habitat differences along the length of the ecosystem. Rehabilitation of past and future impacts (both natural and human-caused) may be necessary to protect resource value and facilitate recovery of riparian structure and functions. geomorphic and Soil bioengineering, vegetation management, and other rehabilitation techniques should follow ecological principals and emphasize recovery of the diversity and complexity of native vegetative communities. (Corresponding standards: 005, 009, 010, 011)

CHEMICAL INTEGRITY

Goal 7 Water Quality

Maintain or exceed State water quality standards for aquatic biodiversity and beneficial downstream uses. Maintain and restore water quality necessary to support healthy riparian, aquatic and wetland ecosystems. (Corresponding standards: 018, 035, 039, 040, 045, 046, 047, 048)

Objective: Streams are managed in a manner that ensures water quality remains in the range that ensures survival, growth, reproduction, and migration of individual aquatic and riparian-dependent species and individual organisms.

BIOLOGICAL INTEGRITY

Goal 8 Aquatic Biodiversity

Manage aquatic habitats to maintain or restore native aquatic biodiversity. Streams and other aquatic habitats should foster the species composition, diversity, and functional organization that is common and comparable to natural habitat. Exceptions can be made for desired, non-native sport fish species, especially in modified habitats such as reservoirs. (Corresponding standards: 041, 043, 044, 045, 046, 047, 048)

STANDARDS (The Goals that are addressed by that guideline are listed in parentheses at the end.) The Plan should adopt the Jefferson Forest Plan Riparian Corridor and Forestwide Channeled Ephemeral standards (consistent with the Federally Listed Mussel and Fish Conservation Plan).

001 Any human caused disturbances or modifications that may concentrate runoff, erode the soil, or transport sediment to the channel or water body are rehabilitated or mitigated to reduce or eliminate impacts. Channel stability of streams is protected during management activities. (Goal 2)

002 Motorized vehicles are restricted to designated crossings. Motorized vehicles may be allowed on a case-by-case basis, after site-specific analysis, outside of designated crossings where it can be shown to benefit riparian resources. (Goal 1, Goal 2)

003 The removal of large woody debris (pieces greater than 4 feet long and 4 inches in diameter on the small end) is allowed if it poses a risk to water quality, degrades habitat for aquatic or riparian wildlife species, impedes water recreation (e.g. rafting) or when it poses a threat to private property or Forest Service infrastructure (e.g., bridges). The need for removal must be determined on a case-by-case basis. (Goal 5)

004 The addition of large woody debris for stream habitat diversity will generally favor stream reaches with an average bank full width of less than 30 feet in Rosgen B channel types. Log length will generally be 50% greater than bank full width. In stream reaches where there may be potential debris impacts to downstream private or public infrastructure (e.g., bridges) or to water-based recreation (e.g. rafting), the active recruitment (placement) of large woody debris will be limited in quantity and scope. (Goal 5)

005 Existing permanent wildlife openings may be maintained within the riparian corridor. However, permanent wildlife openings identified as causing environmental degradation through concentrated runoff, Soil erosion, sediment transport to the channel or water body are mitigated or closed and restored. New permanent wildlife openings within the riparian corridor are permitted where needed to provide habitat for riparian species, or threatened, endangered, sensitive, and locally rare species. (Goal 2, Goal 6)

006 Use no-till mechanical cultivation methods for maintenance of wildlife openings. (Goal 2)

007 Management actions that may negatively alter the hydrologic conditions of wetland rare communities are prohibited. Such actions may include livestock grazing and construction of roads, plowed or bladed firelines, and impoundments in or near these communities. (Goal 1)

008 Allow beaver pond complexes to develop naturally where not impacting developed recreation sites or open system roads. (Goal 1, Goal 3)

009 Insect and disease control measures will be determined on the basis of risk to adjacent resources, long-term sustainability, and appropriate needs for the function and condition of the riparian area. Cut and leave is the preferred method for control and suppression of insects and disease in the core of the riparian corridor. Cut and remove is permitted in the extended area beyond the core. Other control measures may be used when a condition poses a risk to stream stability, degrades water quality, adversely affects habitat for aquatic or riparian species, poses a threat to public safety or facilities, or when "cut and leave" is not effective. (Goal 5, Goal 6)

010 Tree removals from the core of the riparian corridor may only take place if needed to:

Enhance the recovery of the diversity and complexity of vegetation native to the site;
Rehabilitate both natural and human-caused disturbances;
Provide habitat improvements for aquatic or riparian species, or threatened, endangered, sensitive, and locally rare species;
Reduce fuel buildup;
Provide for public safety;
For approved facility construction/renovation (Goal 5, Goal 6)

011 Permitted firewood cutting within the riparian corridor must take into consideration large woody debris needs. Ranger Districts will identify areas where firewood cutting is not permitted due to large woody debris concerns. (Goal 5, Goal 6)

012 Construction of firelines with heavy mechanized equipment (e.g. bulldozers) in riparian corridors is prohibited. Hand lines, wet lines, or black lines are used to create firelines within the riparian corridor to minimize Soil disturbance. Water diversions are used to keep sediment out of streams. Firelines are not constructed in stream channels, but streams may be used as firelines. (Goal 2)

013 New trails will normally be located outside of the riparian corridor except at designated crossings or where the trail location requires some encroachment (e.g. to accommodate stream crossings in steep terrain, etc.), or to manage access to water bodies. (Goal 1, Goal 2)

014 New motorized trails are prohibited within the riparian corridor except at designated crossings or where the trail location requires some encroachment; for example, to accommodate steep terrain. When existing OHV trails within riparian corridor are causing unacceptable resource damage, appropriate mitigation measures (which may include OHV trail closure) will be implemented. (Goal 1, Goal 2)

015 Proposed recreation facilities will be located outside of the riparian corridor or 100-year floodplain (Executive Order 11988) and wetlands (Executive Order 11990) unless no practicable alternative location exists. Where future facilities cannot be located out of the 100-year floodplain, structural mitigation and best management practices will be used. Trails, campsites, and other recreational developments are located, constructed, and maintained to minimize impacts to channel banks and other resources. When existing facilities are causing unacceptable resource damage appropriate mitigation measures will be implemented. Soils are stabilized on eroding trails and recreational sites. (Goal 1, Goal 2)

016 Where grazing is currently allowed and under a permit, grazing is controlled and mitigated to restore, maintain or enhance the integrity of stream channels and banks and prevent unacceptable resource damage. Reauthorizing grazing in riparian corridors within these existing allotments may occur if continued grazing would have no unacceptable resource damage on riparian resources. New grazing allotments or new permits for inactive allotments will exclude the riparian corridor. (Goal 1)

017 Where authorized by permit, livestock watering areas, stream crossings, and stream banks are managed to maintain bank stability. Designated entry points, crossings, and watering points are located, sized, and maintained to minimize the impact to riparian vegetation and function. (Goal 2)

018 Feeding troughs and salt and mineral blocks are not allowed inside the riparian corridor unless the entire pasture is within the riparian corridor, in which case they are located as far away from streams as possible. Watering troughs are appropriately located to protect the streams. (Goal 2, Goal 7)

019 New roads are located outside the riparian corridor except at designated crossings or where the road location requires some encroachment; for example to accommodate steep terrain, or are allowed within the corridor if the road will cause more resource damage if it were located outside the corridor. When existing roads within riparian corridor are causing unacceptable resource damage, appropriate mitigation measures will be implemented. (Goal 1, Goal 2)

020 In-stream use of heavy equipment or other in-stream disturbance activities is limited to the amount of time necessary for completion of the project. Construction of crossings is completed on all streams as soon as possible after work has started on the crossing. Permanent and temporary roads on either side of stream crossings within the riparian corridor are graveled. (Goal 1, Goal 2)

021 When constructing roads, each road segment will be stabilized prior to starting another segment. Stream crossings will be stabilized before road construction proceeds beyond the crossing. (Goal 1, Goal 2)

022 To minimize the length of streamside disturbance, ensure that approach sections are aligned with the stream channel at as near a right angle as possible. Locate riparian corridor crossings to minimize the amount of fill material needed and minimize channel impacts. Generally, permanent structures or temporary bridges on permanent abutments are provided when developing new crossings on perennial streams. Permanent structures, temporary bridges or hardened fords are used when crossing intermittent streams. (Goal 1, Goal 2)

023 Design structures (culverts, bridges, etc.) to accommodate storm flows expected to occur while the structures will be in place. Use scientifically accepted methods for calculating expected storm flows. (Goal 2, Goal 3, Goal 4)

024 Design crossings so stream flow does not pond above the structure during normal flows in order to reduce sediment deposition immediately above the crossing and maintain the channel's ability to safely pass high flows. (Goal 2, Goal 3)

025 Design the crossing so that stream flow will not be diverted along the road if the structure fails, plugs with debris, or is over-topped. (Goal 2, Goal 3)

026 Fords associated with new road construction are not used in perennial streams without site-specific environmental analysis. Establish fords only under conditions that will not cause significant streambank erosion. Erosion stone or larger rock is used to increase load bearing strength at the water/land interface. (Goal 2)

027 Riparian corridors are generally unsuitable for new human created stream channel impoundments, but may be considered on a project specific basis, consistent with appropriate Federal and state regulations. Impoundments will generally be designed to allow complete draining, with minimum flows, cold-water releases, and re-aeration in trout waters and other specific waters when needed. Downstream catch basins and fish ladders are constructed for fish salvage/passage, if necessary. New human-constructed impoundments are unsuitable on streams where federally listed species will be negatively affected. (Goal 3, Goal 4)

028 For activities not already covered in the above standards, ground disturbing activities are allowed within the corridor if the activity will cause more resource damage if it were located outside the corridor, on a case-by-case basis following site-specific analysis. Any activity allowed under these conditions is minimized and effective sediment trapping structures such as silt fences, brush barriers, hay bale barriers, gravelling, etc., are required. Sediment control, prior to, or simultaneous with, the ground disturbing activities, is provided. (Goal 2)

029 Within the channeled ephemeral zone, up to 50% of the basal area may be removed down to a minimum basal area of 50 square feet per acre. Removal of additional basal area is allowed on a case-by-case basis when needed to benefit riparian-dependent resources. (Goal 1, Goal 2)

030 At least partial suspension is required when yarding logs over channeled ephemeral streams. (Goal 1, Goal 2)

031 The addition of large woody debris in channeled ephemeral reaches will primarily be through passive recruitment rather than active placement. (Goal 1, Goal 2)

032 When crossing channeled ephemeral streams, culverts, temporary bridges, hardened fords, or corduroy are used where needed to protect channel or bank stability. (Goal 2)

033 New motorized trails are prohibited within the channeled ephemeral zone except at designated crossings or where the trail location requires some encroachment; for example, to accommodate steep terrain. (Goal 2)

034 Where grazing is currently allowed and under a permit, control and mitigate to restore, enhance, or maintain the integrity of channels and banks. Grazing permit reauthorization is allowed, provided progress towards mitigation of negative impacts on the channeled ephemeral zones has occurred. New grazing permits will be designed to prevent negative impacts to the channeled ephemeral zone. Livestock will be excluded from channeled ephemeral zones whenever the zone cannot be maintained or restored otherwise. (Goal 2)

035 Feeding troughs, watering troughs, and salt and mineral blocks are not allowed inside the channeled ephemeral zone. Watering troughs are appropriately located to protect the streams. (Goal 2, Goal 7)

036 During prescribed fire operations in the channeled ephemeral zone, use the least ground disturbing method of fireline construction, favor blacklines and handtools. (Goal 2)

037 Do not disk, blade, or plow fireline within the ephemeral stream channels, use them as natural firebreaks (This applies to the actual stream channel, not the entire 25 foot zone). (Goal 2)

038 Revegetate and water bar firelines as quickly as possible, where necessary to prevent erosion. Use water diversions to keep sediment out of channels. (Goal 2)

039 Restoration of chemical integrity of aquatic ecosystems (from impacts such as acid deposition and acid mine drainage) is allowed on a site-specific basis for protection or for restoration of aquatic species. (Goal 7)

040 Fire retardants should not be applied directly over open water. (Goal 7)

041 Stocking of new non-native species and stocking of previously unstocked areas is not allowed where it will negatively impact native aquatic species or communities. Prior to any stocking, national forests coordinate with the appropriate State and Federal agencies to ensure that populations and habitats of native species are maintained. (Goal 8)

042 Instances where the flow regime is modified for other purposes (such as reservoir releases for recreational sports or hydroelectric demand), evaluate instream flow needs in accordance with the national strategy for water rights and instream flows. (Goal 3)

043 In-stream habitat improvements and stream-connected disturbance will be designed and implemented after consideration of the life-cycle requirements of aquatic species. (Goal 2, Goal 4, Goal 5, Goal 8)

044 All new stream crossings will be constructed to allow the passage of aquatic organisms, and maintain natural flow regime. Exceptions may be allowed in order to prevent the upstream migration of undesired species. (Goal 4, Goal 8)

045 Insecticides known to have adverse impact on aquatic ecosystems are not applied within 200 feet of perennial or intermittent streams, or open bodies of water. (Goal 7, Goal 8)

046 No herbicide is broadcast on rock outcrops or sinkholes. No Soil-active herbicide with a half-life longer than 3 months is broadcast on slopes over 45 percent, erodible Soils, or aquifer recharge zones. Such areas are clearly marked before treatment so applicators can easily see and avoid them. (Goal 7, Goal 8)

047 No herbicide is aerially applied within 200 horizontal feet, nor ground-applied within 30 horizontal feet of lake, wetlands, perennial or intermittent springs and streams. No herbicide is applied within 100 horizontal feet of any public or domestic water source. Selective treatments (which require added site-specific analysis and use of aquatic-labeled pesticides may occur within these buffers only to prevent significant environmental damage such as noxious week infestations. Buffers are clearly marked before treatment, so applicators can easily see and avoid them. (Goal 7, Goal 8)

048 Pesticide mixing, loading, or cleaning areas in the field are not located within 200 feet of open water or wells, or other sensitive areas. (Goal 7, Goal 8)

3. SPECIES DIVERSITY

3.1 Ecosystem Context for Species

The second purpose of this sustainability analysis was to provide a dataset that can be used to describe species-habitat associations for specific federally listed species, other locally rare species, and species of management concern. All aquatic species are contained in the habitats described above, and the Forest Plan components are to be designed to maintain the key characteristics that are necessary to sustain aquatic habitat.

A determination was made regarding how much of a particular habitat is on the GWNF, and whether or not it currently supports the associated species. This level of classification does not capture finer scale habitat attributes (i.e. pool/riffle composition depth, specific substrate composition, etc.) that may be important to refine the predictive habitat maps. However, it is useful in determining general patterns in species distributions, and may indicate areas to survey for a species, or areas in which to promote habitat restoration and private land conservation measures. In addition, since each species is associated with a particular habitat, the Forest Plan components designed to maintain key characteristics of that particular habitat can be tracked. From this documented review, recommendations may be forthcoming to the Forest Supervisor on whether additional aquatic species-specific plan components may be necessary.

3.2 Identification and Screening of Species

Three categories of species were identified for consideration in planning:

- Species that are federally listed as T&E under the Endangered Species Act (ESA).
- Species for which management actions may be necessary to prevent listing under the ESA.
- Species for which management actions may be necessary to achieve ecological or other multiple-use objectives. They may be species for which there are local concerns resulting from declines in habitat, population, and/or distribution, species that are of high public interest, or species such as invasives for which control measures may be desirable.

Only species whose ranges overlap the GWNF proclamation boundary were considered.

A comprehensive list of species of potential viability concern was compiled for the GWNF that include those species found, or potentially found, on the GWNF that are (a) listed as proposed, threatened, or endangered under the federal Endangered Species Act, (b) listed on the regional Forester's Sensitive Species list, (c) identified as locally rare on the National Forest within the ecoregion by Forest Service biologists, or (d) included in either the Virginia or West Virginia Wildlife Action Plans. Each species was assessed according to the criteria below and then placed into the appropriate category, or dropped from further consideration (see Appendix G6 for a list of species dropped from further consideration).

3.2a Federally Listed Species

The Forest worked cooperatively with the U.S. Fish and Wildlife Service to determine the list of threatened or endangered species appropriate to address in this Forest Plan Revision.

There are four aquatic species listed by the Department of Interior, U.S. Fish and Wildlife Service as threatened or endangered that have been documented on GWNF (see Table G-8 for a summary of habitat on the GWNF). A more detailed habitat description for these species is found in Appendix G2.

Table G-8. Federally Threatened or Endangered Aquatic Species on the GWNF

Group	Scientific Name	Common Name	G-Rank	S-Rank VA	S-Rank WV	Status	Stream Habitat	Lake Habitat	Potential Habitat
mussel	*Pleurobema collina*	James spinymussel	G1	S1	S1	FE	312, 313, 415, 513		14.3 mi
plant	*Helenium virginicum*	Virginia sneezeweed	G3	S2		FT		EHW, PNCS, WW	4.0 ac
plant	*Helonias bullata*	swamp pink	G3	S2S3		FT	111, 121, 123, 211, 221		7.3 mi
plant	*Scirpus ancistrochaetus*	northeastern bulrush	G3	S2	S1	FE		WW, PNCS	1.1 ac

Despite extensive searches, no occurrences of the spinymussel have been located on the GWNF (Watson 2010). The 14 miles of potential habitat modeled for this species (Table G-8) assumes all of the river mileage is suitable substrate, which is not probable; in all of the watersheds with spinymussels near the GWNF, the occurrences are all on private land (Appendix G5, Table 3). The direct importance of Forest lands to spinymussel habitat from a global and eco-regional perspective is very limited. However, the Forest contributes indirectly by providing good water quality to downstream spinymussel habitat. In addition, the several isolated reaches of habitat on the Forest could provide sites for augmentation if the substrate was suitable, and thus become locally important.

The Virginia sneezeweed is found only in Virginia and Missouri. Although there is only approximately four acres of habitat on the GWNF (Table G-8), one of the two 5th level HUC watersheds in Virginia where this plant is found includes occurrences on the GWNF (Appendix G5, Table 3). The Forest is important to this species at a global, eco-regional, and local level.

Both swamp pink and northeastern bulrush are found in a total of 8 states, thus, the GWNF is moderately important at a global scale. There are occurrences on both private and Forest land (Appendix G5, Table 3). For swamp pink, much of the in-tact habitat in Virginia is on the GWNF, therefore, at the eco-regional and local level, the Forest is very important. For the bulrush, there are only a few acres of habitat on the GWNF, but the Forest is still important at the eco-regional and local level. More information on the threats and importance of Forest land to these plant species can be found in the Terrestrial Ecological Sustainability Analysis.

3.2b Other at Risk Species and Species of Management Concern

Criteria for identifying other species to be addressed are as follows:

- Species identified as proposed and candidate species under ESA.
- Species ranked G-1, G-2 and G-3 by NatureServe.
- Subspecific taxa ranked T-1, T-2 and T-3 by NatureServe.
- Species that have been petitioned for federal listing and for which a positive "90-day finding" has been made.
- Species that have been recently delisted including those delisted within the past five years and other delisted species for which regulatory agency monitoring is still considered necessary.
- Species with ranks of S-1, S-2, N-1 or N-2 on the NatureServe ranking system.
- State listed threatened and endangered species.
- Species identified as species of conservation concern in State Comprehensive Wildlife Strategies.
- Species on the U.S. Fish & Wildlife Service Birds of Conservation Concern National Priority List.
- Additional species that may be of regional or local conservation concern due to:
    - o Significant threats to populations or habitat
    - o Declining trends in populations or habitat
    - o Rarity
    - o Restricted ranges (e.g., narrow endemics, disjunct populations, species at the edge of their ranges)
- Species hunted or fished.
- Other species of public interest.
- Invasive or other species for which control measures are needed.

One hundred thirty-two aquatic species that occur on the GWNF have been identified for further consideration in the planning process (see Tables G-9 & G-10 for a summary of these species by habitat on the GWNF). A more detailed habitat description for most of the faunal species is found in Appendix G2.

Table G-9. Aquatic At-Risk Species Addressed on the GWNF

Group	SCIENTIFIC NAME	COMMON NAME	G-RANK	S-RANK VA	S-RANK WV	STATUS	STREAM HABITAT	LAKE HABITAT	POTENTIAL HABITAT
fish	*Notropis semperasper*	Roughhead shiner	G2G3	S2S3	_	S	413, 423, 512, 513, 123		73.7 mi
fish	*Noturus gilberti*	Orangefin madtom	G2	S2	_	S	512, 513		6.5 mi
insect	*Hydraena maureenae*	Maureen's shale stream beetle	G1G3	S1S3	_	S	113		150.9 mi
insect	*Cicindela ancocisconensis*	Appalachian tiger beetle	G3	S2	S3	S	513		6.20 mi
mammal	*Sorex palustris punctulatus*	southern water shrew	G5T3	S1S2	S1	S	121, 221, 321, 411, 421		13.5 mi
mussel	*Alasmidonta varicosa*	Brook floater	G3	S1	S1	S	513		1.3 mi
mussel	*Elliptio lanceolata*	Yellow lance	G2G3	S2S3	_	S	512, 513		30.8 mi
mussel	*Fusconaia masoni*	Atlantic pigtoe	G2	S2	_	S	313		0.2 mi
mussel	*Lasmigona subviridis*	Green floater	G3	S2	S2	S	415, 513		21.9 mi
bird	*Haliaeetus leucocephalus*	Bald eagle	G5	S23B/ S3N	S2B/ S3N	S			Riparian
plant	*Boltonia montana*	Doll's daisy	G1G2	S1	_	S			Riparian

Group	SCIENTIFIC NAME	COMMON NAME	G-RANK	S-RANK VA	S-RANK WV	STATUS	STREAM HABITAT	LAKE HABITAT	POTENTIAL HABITAT
plant	*Iliamna remota*	Kankakee globe-mallow	G1Q	S1	_	S			Riparian
plant	*Isoetes virginica*	Virginia quillwort	G1Q	S1?	_	S			Riparian
plant	*Peltigera hydrothyria*	waterfan	G3G5	S1	_	S	113, 114, 121, 124, 221		515.0 mi
plant	*Poa paludigena*	bog bluegrass	G3	S2	S1	S			Riparian
plant	*Potamogeton hillii*	Hill's pondweed	G3	S1	_	S			Riparian
plant	*Potamogeton tennesseensis*	Tennessee pondweed	G2	S1	S2	S			Riparian
plant	*Sida hermaphrodit a*	Virginia mallow	G3	S1	S2	S			Riparian
plant	*Vitis rupestris*	sand grape	G3	S1?	S2	S			Riparian

Both the roughhead shiner and Maureen's shale stream beetle are endemic to Virginia. They are found both on Forest land and private land (Appendix G5, Table 3). The GWNF not only provides some habitat directly, but indirectly contributes by providing good water quality to downstream habitat. The Forest is important to these species at the global, eco-regional, and local level.

The orangefin madtom is known only from Virginia and North Carolina. There are no documented occurrences of orangefin madtoms on the GWNF (Appendix G5, Table 3), and only 6.5 miles of potential habitat (Table G-9). Therefore, the direct importance of Forest lands to orangefin madtom habitat from a global and eco-regional perspective is very limited. However, the Forest contributes indirectly by providing good water quality to the downstream madtom habitat, and thus could be locally important.

The Appalachian tiger beetle is known from 15 states and Quebec. It is found on both Forest and private land (Appendix 5, Table 3) in Virginia, but there are only 6.2 miles of potential habitat on the GWNF (Table G-9). The direct importance of Forest lands to Appalachian tiger beetle habitat from a global and eco-regional perspective is very limited. However, the Forest contributes indirectly by providing good water quality to the downstream tiger beetle habitat, and thus could be locally important.

The southern water shrew is found in six states; in Virginia it is found in two watersheds, on both Forest and private land (Appendix G5, Table 3). With only about 13 miles of potential habitat on the Forest (Table G-9), the direct importance of Forest lands to southern water shrew habitat from a global and eco-regional perspective is moderate. However, the Forest is very important to this species at a local level.

There are no documented occurrences of the four FS Sensitive mussel species on the GWNF (Appendix G5, Table 3); with potential habitat ranging from less than a mile for the Atlantic pigtoe to approximately 31 miles for the yellow lance (Table G-9). Therefore, the direct importance of Forest lands to these mussel species from a global and eco-regional perspective is very limited. However, the Forest contributes indirectly by providing good water quality to the downstream mussel habitat, and thus could be locally important.

Information on the importance of Forest land to FS Sensitive plant and bird species can be found in the Terrestrial Ecological Sustainability Analysis.

Table G-10. Aquatic Species of Management Concern Addressed on the GWNF. Under Status, LR= locally rare, SMC=species of management concern, and MIS=Management Indicator Species.

Group	SCIENTIFIC NAME	COMMON NAME	G-RANK	S-RANK VA	S-RANK WV	STATUS	STREAM HABITAT	LAKE HABITAT	POTENTIAL HABITAT
amphib	*Ambystoma tigrinum*	eastern tiger salamander	G5	S1		LR		WW, PNCS, EHW	39.1 ac
bird	*Anas rubripes*	Amer. black duck	G5	S4	S2B/S4N	LR	511,512, 513	WW	36.6 mi & 185.7 ac
bird	*Empidonax alnorum*	alder flycatcher	G5	S1B	S3B/S4N	LR		WW	185.7 ac
bird	*Emidonax virescens*	Acadian flycatcher	G5	S5	S5B	MIS			Riparian
bird	*Melospiza georgiana*	swamp sparrow	G5	S1B/S4S5N	S3B/S4N	LR		EHW	85.0 ac
bird	*Nycticorax nycticorax*	black-crowned night-heron	G5	S3B/S4N	SHB	LR	511,512, 513	WW	36.6 mi & 185.7 ac
bird	*Nyctanassa violacea*	yellow-crowned night-heron	G5	S2S3B/S3N	S1N	LR	511,512, 513	WW	36.6 mi & 185.7 ac
bird	*Seiurus noveboracensis*	northern waterthrush	G5	S1B	S2B	LR		WW, EHW	270.7 ac
crayfish	*Cambarus monongalensis*	A Crayfish	G5	S1?	S3	LR	121, 221, 321, 411, 421		17.6 mi
fish	*Anguilla rostrata*	American eel	G4	S5	S2	SMC	114, 115, 211, 212, 214, 215, 314, 411, 413, 415, 513		145.6 mi
fish	*Cottus cf. cognatus*	Checkered sculpin	G4Q	_	_	LR			Riparian
fish	*Salvelinus fontinalus*	Brook trout	G5	S4	S5	MIS	111, 112, 113, 114, 115, 121, 122, 123, 124, 211, 212, 213, 214, 215, 221, 223, 224, 311, 312, 321, 411, 413, 421, 512		1,119.9 mi
insect/ odonate	*Aeshna canadensis*	Canada darner	G5	S1	S1	LR		EHW, PCS, PNCS	34.7 ac
insect/ odonate	*Aeshna tuberculifera*	black-tipped darner	G4	S2S3	S2	LR		WW, EHW, PCS, PNCS	89.4 ac
insect/ odonate	*Aeshna verticalis*	green-striped darner	G5	S1	S2	LR		EHW, PCS, PNCS	34.7 ac
insect/ odonate	*Anax longipes*	comet darner	G5	S3	S1	LR		WW, EHW, PCS, PNCS	49.4 ac

Group	SCIENTIFIC NAME	COMMON NAME	G-RANK	S-RANK VA	S-RANK WV	STATUS	STREAM HABITAT	LAKE HABITAT	POTENTIAL HABITAT
insect/ odonate	*Calopteryx amata*	Superb jewelwing	G4	S1	-	LR	121, 221, 321, 411, 421		17.6 mi
insect/ odonate	*Calopteryx angustipennis*	Appalachian jewelwing	G4	S2	S2	LR	513		.09 mi
insect/ odonate	*Celithemis martha*	Martha's penant	G4	S2	_	LR		WW, EHW, PCS, PNCS, LCS	54.7 ac
insect/ odonate	*Cordulegaster diastatops*	delta-spotted spiketail	G5	S1	S2	LR	121		10.23 mi
insect/ odonate	*Enallagma annexum (AKA cyathigerum)*	northern bluet	G5	S1	S2	LR		EHW, PCS, PNCS	34.7 ac
insect/ odonate	*Epitheca canis*	beaverpond baskettail	G5	S1	S1S2	LR		EHW, PCS, PNCS	34.7 ac
insect/ odonate	*Gomphus adelphus*	mustached clubtail	G4	S1	S2	LR	413, 513		23.9 mi
insect/ odonate	*Gomphus quadricolor*	rapids clubtail	G3/G4	S2	S2S3	LR	413, 513		23.9 mi
insect/ odonate	*Ladona julia (AKA Libellula julia)*	chalk-fronted corporal skimmer	G5	S1	S2	LR		EHW, PCS, PNCS	34.7 ac
insect/ odonate	*Lanthus parvulus*	double-striped clubtail	G4	S2	S2	LR	111, 112, 121, 122, 123		13.2 mi
insect/ odonate	*Lestes disjunctus*	northern spreadwing	G5	S2	S2S3	LR		EHW, PCS, PNCS	34.7 ac
insect/ odonate	*Leucorrhinia hudsonica*	Hudsonian whiteface	G5	S1	S1	LR		EHW, PCS, PNCS	34.7 ac
insect/ odonate	*Nehalennia irene*	sedge sprite	G5	S1	S3	LR		EHW, PCS, PNCS	34.7 ac
insect/ odonate	*Neurocordulia yamaskanensis*	stygian shadowdragon	G5	S2	S2	LR	512, 513		34.5 mi
insect/ odonate	*Rhionaeschna mutata (AKA Aeshna mutata)*	spatterdock darner	G3G4	S2	S1	LR		WW, EHW, PCS, PNCS	49.4 ac
insect/ odonate	*Somatochlora elongata*	Ski-tipped emerald	G5	S1S2	S2	LR		EHW, PCS, PNCS	34.7 ac
insect/ odonate	*Sympetrum obtrusum*	white-faced meadowhawk	G5	S1	S2	LR		EHW, PCS, PNCS	34.7 ac
insect	*Autochton cellus*	Golden banded skipper	G5	S3	S1S2	LR			Riparian
insect	*Boloria selene*	Silver-bordered fritillary	G5	S2	S3	LR			Riparian
insect	*Colias interior*	Pink-edged sulphur	G5	S1S2	S2	LR			Riparian

Group	SCIENTIFIC NAME	COMMON NAME	G-RANK	S-RANK VA	S-RANK WV	STATUS	STREAM HABITAT	LAKE HABITAT	POTENTIAL HABITAT
insect	*Isonychia hoffmani*	Hoffman's Isonychia mayfly	G1/G3	S1	-	LR	121, 221, 321, 411, 421		17.6 mi
insect	*Nemotaulius hostilis*	a limnephilid caddisfly	G5	S1	SNR	LR		EHW, PCS, PNCS	34.7 ac
insect	*Speyeria atlantis*	Atlantis fritillary	G5	S2	S3	LR			Riparian
mammal	*Castor canadensis*	beaver	G5	S5	S5	SMC			Riparian
mammal	*Lontra canadensis*	River otter	G5	S4	S1	LR			Riparian
mussel	*Villosa constricta*	Notched Rainbow	G3	S3	_	LR	415, 512, 513		33.1 mi
reptile	*Clemmys guttata*	spotted turtle	G5	S4	S1	LR		EHW, PNCS	6.45 ac
reptile	*Glyptemys insculpta*	wood turtle	G3	S2	S2	LR	111, 112, 113, 123, 211, 212, 213, 221, 313, 311, 312, 411, 413, 412, 513		217.6 mi
plant	*Alnus incana ssp. rugosa*	speckled alder	G5T5	S2		LR			Riparian
plant	*Arethusa bulbosa*	Dragon's mouth	G4	S1		LR			Riparian
plant	*Aster radula*	rough-leaved aster	G5	S1		LR			Riparian
plant	*Bromus ciliatus*	fringed brome grass	G5	S1	S4	LR			Riparian
plant	*Calopogon tuberosus*	Grass pink	G5	S1	S2	LR			Riparian
plant	*Carex aquatilis*	water sedge	G5	S1	S1	LR			Riparian
plant	*Carex arctata*	Black sedge	G5	S1	S1	LR			Riparian
plant	*Carex barrattii*	Barratt's sedge	G4	S2	_	LR			Riparian
plant	*Carex buxbaumii*	Buxbaum's sedge	G5	S2	S2	LR			Riparian
plant	*Carex conoidea*	field sedge	G5	S1S2	S1	LR			Riparian
plant	*Carex cristatella*	crested sedge	G5	S2	S4	LR			Riparian
plant	*Carex interior*	inland sedge	G5	S1	S1	LR			Riparian
plant	*Carex lasiocarpa var. americana*	slender sedge	G5T5	S1	?	LR			Riparian
plant	*Carex schweinitzii*	Schweinitz's sedge	G3G4	S1	_	LR			Riparian
plant	*Carex vesicaria*	inflated sedge	G5	S1S2	S2	LR			Riparian
plant	*Cyperus dentatus*	toothed flatsedge	G4	S1	SNR	LR			Riparian
plant	*Cypripedium reginae*	showy lady's-slipper	G4	S1	S1	LR			Riparian
plant	*Echinodorus tenellus*	dwarf burhead	G5?	S1	_	LR			Riparian
plant	*Eleocharis compressa*	flattened spikerush	G4	S2	S2	LR			Riparian

Group	SCIENTIFIC NAME	COMMON NAME	G-RANK	S-RANK VA	S-RANK WV	STATUS	STREAM HABITAT	LAKE HABITAT	POTENTIAL HABITAT
plant	*Eleocharis melanocarpa*	black-fruited spikerush	G4	S2	_	LR			Riparian
plant	*Eleocharis robbinsii*	Robbins spikerush	G4G5	S1	_	LR			Riparian
plant	*Elymus canadensis*	nodding wild rye	G5	S2?	S5	LR			Riparian
plant	*Epilobium leptophyllum*	linear-leaved willow-herb	G5	S2	S3	LR			Riparian
plant	*Equisetum sylvaticum*	Woodland horsetail	G5	S1	S1	LR			Riparian
plant	*Eriocaulon aquaticum*	white buttons	G5	S1	_	LR			Riparian
plant	*Eupatorium maculatum*	spotted joe-pye weed	G5	S2	S1	LR			Riparian
plant	*Glyceria acutiflora*	sharp-scaled manna-grass	G5	S3	S2	LR			Riparian
plant	*Glyceria grandis*	American manna-grass	G5T?	S1	S1	LR			Riparian
plant	*Huperzia appalachiana*	Appalachian fir clubmoss	G4/G5	S2	_	LR			Riparian
plant	*Hypericum boreale*	northern St. John's-wort	G5	S2	SH	LR			Riparian
plant	*Hypericum ellipticum*	pale St. John's-wort	G5	SH	S4	LR			Riparian
plant	*Isoetes lacustris*	lake quillwort	G5	S1?	_	LR			Riparian
plant	*Juncus brachycephalus*	small-head rush	G5	S2	_	LR			Riparian
plant	*Juncus brevicaudatus*	narrow-panicled rush	G5	S2	S4	LR			Riparian
plant	*Lachnanthes caroliniana*	Carolina redroot	G4	SH	_	LR			Riparian
plant	*Liparis loeselii*	Loesel's twayblade	G5	S2	S2	LR			Riparian
plant	*Lycopodiella inundata*	northern bog clubmoss	G5	S1	S2?	LR			Riparian
plant	*Lythrum alatum*	winged loosestrife	G5	S2	S1	LR			Riparian
plant	*Muhlenbergia glomerata*	marsh muhly	G5	S2	SNR	LR			Riparian
plant	*Osmunda cinnamomea var. glandulosa*	glandular cinnamon fern	G5TNR	S1	SNR	LR			Riparian
plant	*Panicum hemitomon*	maidencane	G5?	S2	_	LR			Riparian
plant	*Parnassia grandiflora*	Large-leaved grass of parnassus	G3	S2	S1	LR			Riparian
plant	*Platanthera grandiflora*	large purple fringed orchid	G5	S1	S4	LR			Riparian
plant	*Platanthera peramoena*	purple fringeless orchid	G5	S2	S4	LR			Riparian
plant	*Poa palustris*	fowl bluegrass	G5	S1S2	S4	LR			Riparian
plant	*Polanisia dodecandra*	common clammy-weed	G5QT?	S2		LR			Riparian

Group	SCIENTIFIC NAME	COMMON NAME	G-RANK	S-RANK VA	S-RANK WV	STATUS	STREAM HABITAT	LAKE HABITAT	POTENTIAL HABITAT
plant	*Potamogeton amplifolius*	Large leaf pondweed	G5	S1S2	S4	LR			Riparian
plant	*Potamogeton oakesianus*	Oakes pondweed	G4	S2	SH	LR			Riparian
plant	*Ribes americanum*	Wild black currant	G5	S1?	S2	LR			Riparian
plant	*Sabatia campanulata*	slender marsh rose-pink	G5	S2	_	LR			Riparian
plant	*Sagittaria calycina var calycina*	long-lobed arrowhead	G5T5?	S1	SH	LR			Riparian
plant	*Sagittaria rigida*	sessile-fruited arrowhead	G5	S1	SNA	LR			Riparian
plant	*Schoenoplectus subterminalis*	water bulrush	G4G5	S1S2	_	LR			Riparian
plant	*Scirpus torreyi*	Torrey's bulrush	G5?	S1	S1	LR			Riparian
plant	*Solidago rupestris*	riverbank goldenrod	G4?	S1	_	LR			Riparian
plant	*Solidago uliginosa*	bog goldenrod	G4G5T?	S2		LR			Riparian
plant	*Sparganium chlorocarpum*	narrow-leaf burreed	G5	S1		LR			Riparian
plant	*Spartina pectinata*	freshwater cordgrass	G5	S2	S4	LR			Riparian
plant	*Sphagnum russowii*	Russow's peatmoss	G5	S1S2		LR			Riparian
plant	*Spiranthes lucida*	shining ladies'-tresses	G5	S1	S1S2	LR			Riparian
plant	*Spiranthes ochroleuca*	yellow nodding ladies'-tresses	G4	S1	S5	LR			Riparian
plant	*Triadenum fraseri (Hypericum v.)*	Fraser's marsh St. John's-wort	G5	S1	S4	LR			Riparian
plant	*Triantha racemosa*	coastal false-asphodel	G5	S1	_	LR			Riparian
plant	*Vaccinium macrocarpon*	large cranberry	G4	S2	S2	LR			Riparian
plant	*Verbena scabra*	sandpaper vervain	G5	S2	S1	LR			Riparian
plant	*Veronica scutellata*	marsh speedwell	G5	S1	S2	LR			Riparian
plant	*Viburnum lentago*	nannyberry	G5	S1	S1S2	LR			Riparian
plant	*Vicia americana*	American purple vetch	G5	S1S2	S4	LR			Riparian
plant	*Woodwardia virginica*	Virginia chainfern	G5	S5	SNR	LR			Riparian

3.3 Information Collection

Species collection records were compiled from the Virginia Department of Game and Inland Fisheries (VDGIF) collections database, Virginia Department of Conservation and Recreation's Division of Natural Heritage (VDNH) records, West Virginia Division of Natural Resources (WVDNR) records, and USFS records. Using

ArcMap®, records of selected species were connected to the attributed stream reaches or lakes/wetlands, allowing for characterization of the species' habitats as noted in the above tables.

3.4 Species Groups

All of the above federally listed species, sensitive species and species of management concern are tied to the specified aquatic habitats. The following groups address threats that could affect habitat for a number of species.

Acid Sensitive Stream Species

Acid deposition rates and the underlying geology were used to analyze Forest watersheds for their sensitivity to acidification. They were put into three categories; high, moderate, and low sensitivity. When cross-walked with stream habitat types, 793 miles (67%) of perennial streams on the GWNF were within the highly sensitive watersheds. See Table G-11 for a list of stream habitats by watershed sensitivity. Of those, the smallest streams at the highest elevations are most susceptible. As discussed in the pH and alkalinity section, even if acid emissions are reduced, streams will continue to acidify for a number of years. It should be expected that species living in those streams will be negatively affected by acidification. Table G-12 is a list of those species found in the stream habitat types that occur in watersheds that are highly sensitive to acidification. Management strategies in the acid sensitive watersheds should address this issue and maximize nutrient replacement when planning vegetation management and/or look for alternative solutions (such as stream or watershed liming or fertilization), if negative effects to biota are to be avoided.

Table G-11. GWNF Stream Habitat Type by Watershed Acid Sensitivity

Watershed Sensitivity to Acidification	Stream Habitat Type	Miles	Percent of Miles
HIGH	111, 113, 114, 115, 121, 123, 125, 211, 213, 215, 221, 223, 225, 311, 313, 315, 321, 323, 411, 413, 415, 421, 423, 511, 513	792.9	67%
MODERATE	124, 214, 224, 314, 414	232.0	20%
LOW	112, 122, 212, 222, 312, 322, 412, 512	153.8	13%

Table G-12. Species Found in Watersheds with a High Sensitivity to Acidification

SCIENTIFIC NAME	COMMON NAME
Alasmidonta undulata	triangle floater
Alasmidonta varicosa	brook floater
Anas rubripes	northern black duck
Anguilla rostrata	American eel
Calopteryx angustipennis	Appalachian jewelwing
Cambarus monongalensis	a crayfish
Clemmys insculpta	wood turtle
Cordulegaster diastatops	delta-spotted spiketail
Elliptio lanceolata	yellow lance
Fusconaia masoni	Atlantic pigtoe
Gomphus viridifrons	green-faced clubtail
Helonias bullata	swamp pink
Hydraena maureenae	Maureen's shale stream beetle
Lanthus parvulus	double-striped clubtail
Lasmigona subviridis	green floater

SCIENTIFIC NAME	COMMON NAME
Notropis semperasper	roughhead shiner
Noturus gilberti	orangefin madtom
Nyctanassa violacea	yellow-crowned night-heron
Pleurobema collina	James spinymussel
Salvelinus fontinalus	brook trout
Sorex palustris punctulatus	southern water shrew
Villosa constricta	notched rainbow

Temperature Change Species

It is recognized that climate change will impact the ability of the Nation's forest to provide water and other critical watershed services (Knapp et al. 2008). Warming over the past several decades has fundamentally altered the hydrologic cycle, and these changes are percolating through our watersheds. Projected climate changes to the hydrologic cycle through warmer water temperatures, more intense storms, and greater inter-annual variability in precipitation, indicate the importance of maintaining and protecting healthy watersheds. Bakke (2008) describes three key components relating climate change processes to management and conservation of aquatic resources; resilient habitat, refugia, and restoration.

Resiliency refers to the ability of a system to return to its original condition after being disturbed. In ecology, resiliency carries the additional meaning of how much disturbance a system can "absorb" without crossing a threshold and entering an entirely different state of equilibrium. This requires that certain key habitat characteristics or processes will change little; with respect to stream aquatic habitat, these key elements are temperature and disturbance regime. Rivers and streams most resilient to temperature change include those dominated by groundwater input. Aspect, riparian shading, and valley shape also play a role in thermoregulation. A resilient disturbance regime would be one where peak flows and available sediment sources do not become altered. Likewise, streams most resilient to changes in disturbance regime would include those with flow dominated by groundwater. Resiliency can only function if the landscape offers a redundancy of habitat opportunities; there must be enough habitat and connectivity so that a disturbance to one area allows populations to recover and recolonize from another area.

Refugia are places in the landscape where organism can go to escape extreme conditions, be it short term or long term. Protecting these areas, and maintaining or improving connectivity will be increasingly important.

Restoration should include activities which reestablish the structures and function of the stream ecosystem in a manner that the ecosystem will become self-maintaining. High priority actions would be protection of good habitat, improving connectivity and access to existing habitat. If active restoration, such as enhancement of instream habitat with large wood, is to be performed in potentially unstable settings, it will be important to design these projects with the appropriate level of redundancy to accommodate greater rates of channel migration and flood magnitudes. Passive restoration techniques, such as establishment of wider riparian buffers, may be a more sustainable alternative in light of increased geomorphic instability.

Species that are non-tolerant of warmer water will find their habitat reduced (see brook trout discussion, below). As streams and lakes change, species that are unable to adapt will need to move to suitable habitat; this emphasizes the need for maintaining connectivity between habitat units. Management and land use decisions should be designed to maintain and protect healthy watersheds, and support watershed resilience. Specific management strategies the George Washington National Forest can adopt to address the management and conservation of aquatic resources in light of predicted effects from climate change are:

> Protect and restore beaver meadows, wetlands, and floodplains to improve natural storage, reduce flood hazards, and prolong seasonal flows. Beaver ponds and wetlands recharge groundwater, raise the water table, retain sediment and organic matter, store water during floods and release it slowly, mitigate low flows and drought, reduce carbon turnover rate, raise pH and ANC, while reducing SO^2, Al, and NO^3 .

Protect and restore riparian forests to moderate changes in stream temperature, maintain stream bank stability, and provide instream habitat.

Remove migration barriers and re-establish habitat connectivity so that species can more to more suitable habitat, or move to or from refugia.

Reduce flood and wildfire risks in vulnerable watersheds to prevent increased surface erosion and mass wasting leading to aggradation of river channels.

Improve or decommission roads to reduce adverse impacts during large storms to prevent surface erosion and fill slope failure and landslides. Construct stream crossings and bridges to withstand major storm and runoff events.

Brook trout are not only a MIS, but a coldwater species that depend on relatively low stream temperatures to survive. A recent study (Flebbe et al. 2006) projects that rising temperature changes from climate change (and the loss of hemlock along streams) will shrink natural trout habitat. Using the Hadley Centre and the Canadian Centre climate change models, Flebbe found that between 53 and 97 percent of wild trout populations in the Southern Appalachians could die out as streams become warmer by the year 2100. However, Trumbo (2010) used a direct measurement approach pairing air and water temperature relationships to classify the sensitivity and exposure (vulnerability) of individual brook trout populations to various climate change scenarios. Trumbo et al. (2010) identified potential refugia for brook trout at lower elevations and with higher air temperatures than previous larger scale modeling efforts. Site specific characteristics such as watershed area, percent riparian canopy, solar insolation, percent groundwater, elevation, and percent watershed in forest cover were useful for predicting individual brook trout population persistence. Combining the sensitivity scores with the vulnerability scores resulted in four classification categories: (high sensitivity/high vulnerability (HS-HV); high sensitivity/low vulnerability (HS-LV); low sensitivity/high vulnerability (LS-HV) and low sensitivity/low vulnerability (LS-LV). Out of the 1120 miles of potential brook trout habitat on the Forest, 309 miles are in the HS-HV category; 4 miles are in the HS-LV category; 233 miles are in the LS-HV category; and 65 miles are in the LS-LV category.

Currently, Virginia has one of the strongest native brook trout resources in the Southeast. Of the 2,350 miles of wild trout resource identified by the State, approximately 80% remains brook trout. Wild brook trout populations are generally limited to higher elevations in the western mountains of the state. However, brook trout were once found throughout the limestone spring creeks in the Great Valley region located between the Blue Ridge and Allegheny mountain ranges and along some of the smaller tributaries of the Potomac at least as far east as Fairfax County. Most of the valley limestone stream populations were likely extirpated a century or more ago with the agricultural development of the valley but some persisted as late as the mid-1960s. The populations within Potomac River tributaries were known to be strong through the 1950s and still persisted as late as the early 1980s. These populations were eliminated with residential development of the region. Recent research supports the relationship between forested watersheds and presence of brook trout; conversely, watersheds with extensive development (with as little as 4% impervious cover) were unable to support brook trout in their streams (Stranko et al. 2008). It is estimated that at least 38% of the original brook trout populations have been extirpated from Virginia.

Most of the remaining populations are well protected from land use changes due to public ownership by land management agencies such as the George Washington and Jefferson National Forest, the Shenandoah National Park and scattered holdings of the Virginia Department of Game and Inland Fisheries. However, they will not be immune to thermal and hydrologic effects resulting from climate change. Impacts to trout and other cold-water species can hopefully be reduced by implementing the management strategies outlined above that are designed to maintain and protect healthy watersheds, and support watershed resilience.

3.5 Plan Components for Species Diversity & Evaluation of Plan Components on Species Diversity

Plan components for ecosystem diversity identified in Sections 2.6 and 3.4 should satisfy most aquatic species diversity objectives on the GWNF. In addition, many of the species listed above are within existing or proposed

Special Biological Areas (SBA). With an SBA designation, management is focused on the unique species or biological communities that occur in the area. See Appendix G3 for a crosswalk of the aquatic species found in SBAs and Appendix G4 for those found in proposed SBAs.

Managing watersheds, riparian areas, and perennial, intermittent, and channeled ephemeral streams to maintain or restore resilient and stable conditions to support the quality and quantity of water necessary to protect ecological functions and support beneficial water uses will improve and maintain habitat conditions and habitat connections for aquatic species habitat groups and will maintain suitable habitat that is not currently occupied but has a likelihood of being occupied in the future by species identified in this analysis.

However, this analysis does recommend additional plan components specifically for two aquatic/riparian species on the GWNF: tiger salamander, and wood turtle. Each is discussed next along with the rationale as to why additional Plan components are necessary.

Tiger Salamander

The 1993 Plan created the Maple Flats SBA in part to protect the Easter tiger salamander. Appendix G of the 2004 M&E report states "Delineation of the Maple Flats Special Biological Area containing the eastern tiger salamander appears to have encompassed much, if not all, habitat used by this species on the GWNF. Observations made since this species was discovered on the Forest indicate that this species is still present at all locations where previously found. Population size and trend studies are ongoing, as are inventories of potential habitat. As new information on population trends and habitat use surface, management activities will be adjusted to protect the eastern tiger salamander where they occur on the Forest. Forest Service management activities are having no effect on the eastern tiger salamander since all sinkhole ponds in the Maple Flats area are avoided and buffered from management activities." In 2005-2007 eastern tiger salamander egg masses and adults were found at 6 sinkhole ponds outside, and 4-5 miles west, of the Maple Flats Sinkhole Complex. It is recognized that local amphibian population persistence requites sufficient terrestrial habitat, the maintenance of habitat quality, and connectivity among local populations (Harper et al. 2008). New Special Biological Areas should be created to protect the newly found eastern tiger salamander populations. This should include habitat management between all the ponds to allow for long-range dispersal, including mature forest and low stem densities.

Wood Turtle

Based on the assessment information (Huber et al. 2009), the agencies have identified strategies with the highest likelihood of improving wood turtle habitat and with the highest likelihood of mitigating the impacts of other activities on the Forest. It is recognized that the primary limiting factors affecting the viability of the wood turtle in the region are, illegal collection, habitat loss and fragmentation, and vehicular mortality (Buhlmann et al. 2008). Habitat maintenance and improvement is where the forest can make the biggest gains on conserving the wood turtle.

The assessment information on habitat indicates that wood turtles have both aquatic and terrestrial habitat needs. They benefit from high quality streams with some level of stream disturbance (beaver ponds, cut banks, large woody debris, alluvial depositions). Their terrestrial habitat needs for nesting and foraging appear to be best met by a variety of settings, including openings, shrub habitat and forested habitat. Aside from habitat needs, the main threats on the National Forest appear to be collection and mortality from vehicles.

Wood turtle conservation on the Forest will consist of goals and strategies designed to enhance habitat and reduce potential threats. Forest Plan riparian standards or guidelines will be followed if they are more restrictive than those in the wood turtle conservation strategy.

Goals and Conservation Measures (CM)

The following goals and strategies apply to perennial streams, seeps, riparian areas, and adjacent upland areas on the Forest (GW) within the range of the wood turtle. Currently, this range includes the North Fork Shenandoah and the South Fork of the South Branch of the Potomac River and the Cacapon River watersheds on the Lee and North River Ranger Districts.

Goal 1 Watersheds are managed to maintain or enhance the terrestrial summer foraging habitat of wood turtles.

CM 1.01 Maintain or create openings in riparian areas for turtle foraging and thermoregulation.

Goal 2 Watersheds are managed to maintain or enhance the nesting habitat of wood turtles.

CM 2.01 Manage and protect known existing nest sites.

CM 2.02 Create additional suitable nest sites where appropriate.

Goal 3 Watersheds are managed to maintain or enhance the overwintering aquatic habitat of wood turtles.

CM 3.01 Maintain or create in stream woody debris.

CM 3.02 Minimize sediment, pollutant, and pesticide loading to stream channels.

CM 3.03 Avoid stream channelization, artificial impoundments (i.e. dams), and bank stabilization that would decrease potential overwintering habitat.

CM 3.04 Allow beaver activities that create suitable habitat.

Goal 4 Human interactions, such as motorized vehicle use and recreation, are managed to minimize impacts to wood turtles.

CM 4.01 The Forest Service, working cooperatively with the Virginia Department of Game and Inland Fisheries and the West Virginia Division of Natural Resources, will identify hibernacula with significant turtle concentrations and/or other areas where there is a high potential for human interaction with wood turtles. They will evaluate the need for seasonal restrictions on road use or other activities to protect the turtle. The time that turtles are nesting or foraging away from the stream and most subject to terrestrial impact would be from April through October. In stream activities would be of greatest concern during the period of November through March.

CM 4.02 When mowing within 1000 feet (300 m) of a perennial stream, mowing decks will be raised a minimum of 8 inches (20 cm) above the ground between April 1 and November 15.

CM 4.03 Work with law enforcement to help identify law enforcement activities to curtail illegal collection activities (e.g. encourage wildlife road checks, increased law enforcement surveillance).

Goal 5 Manage riparian and aquatic habitats to protect water quality and enhance conditions for riparian dependent species.

CM 5.01 Riparian and aquatic habitat will be managed using the standards and guidelines in the Forest Plan.

Goal 6 Recognize the Paddy Run watershed on the Lee District as an emphasis area for wood turtle management; "Because of its relatively intact forest, remote location, position within the Cedar Creek watershed, connection to the Capon River watershed, and relatively protected status inside of the George Washington National Forest, Vance's Cove probably represents the best potential for long-term protection of a viable metapopulation of wood turtles" (Akre and Ernst, 2006).

The Paddy Run emphasis area includes National Forest land within the Paddy Run watershed, including Vance's Cove, starting at the National Forest boundary at Paddy Gap (see attached map). Long term desired future management direction for this area comes from the George Washington Forest Revised Land and Resource Management Plan. (Forest Plan). Project desired future conditions will be derived from management area designations 4, 9, 15, 18, 21, all of which are located within the emphasis area.

Within this emphasis area the following activities will be implemented:

CM 6.01 No logging activities allowed within 100 feet (30 m) of the edge of perennial streams and seeps, except to enhance habitat for wood turtles. No logging activities (including those for wood turtle enhancement) allowed within 300 feet (100 m) of the edge of perennial streams and seeps from April 1 to November 15. In coordination with VDGIF and Forest Service biologists, logging activity restrictions in the 300 ft buffer zone may be modified on a case-by-case basis. Regeneration harvest will be limited to no more than 6% of the watershed in a 10 year period.

CM 6.02 Forest Road 93 will be closed to the public at the end of spring gobbler season, established by VDGIF, until July 1 to reduce vehicular traffic during times of the year when the turtles are most active, especially nesting season.

CM 6.03 Create and/or maintaining openings with a mixture of grass, forbs and shrubs in the riparian corridor for turtle foraging areas.

CM 6.04 Create and/or maintain nest sites away from roads and trails as appropriate.

CM 6.05 Place LWD and root wads into the stream channel to provide over-wintering habitat as appropriate.

CM 6.06 Look for opportunities to reduce human-turtle interactions such as moving existing trails and roads away from riparian areas, and eliminating stocking from the upper reaches of Paddy Run.

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APPENDIX G1. AQUATIC HABITAT CLASSIFICATION PROCESS PAPER
George Washington National Forest

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January 16, 2007

A. Introduction

The George Washington National Forest (GWNF) developed an aquatic habitat classification to facilitate the Aquatic Ecological Sustainability Analysis. The methods used in this classification follow the basic structure of The Nature Conservancy (TNC) aquatic community classification, and the Virginia and West Virginia Wildlife Action Plans, yet habitat classifications were focused on land managed by the GWNF.

There were multiple goals in this effort. One was to provide a means to describe and catalog the diversity of aquatic habitats in the GWNF (coarse filter). The second was to provide a dataset that can be used to describe species-habitat associations for specific federally listed species, FS sensitive species, and locally rare species (fine filter). A determination could then be made regarding how much of a particular habitat is on National Forest, and whether or not it currently supports the associated species. This level of classification does not capture finer scale habitat attributes (i.e. pool/riffle composition depth, specific substrate composition, etc.) that may be important to refine the predictive habitat maps. However, it is useful in determining general patterns in species distributions, and may indicate areas to survey for a species, or areas in which to promote habitat restoration and private land conservation measures.

This habitat classification is hierarchical and is based on an understanding of how habitat influences the composition and distribution of biological communities. It is based on four assumptions (Higgins et al. 1998):

1. Physiographic and climatic patterns influence the distribution of organisms, and can be used to predict the expected range of biological community types (Jackson and Harvey 1989; Tonn 1990; Maxwell et al. 1995; Angermeier and Winston 1998; Burnett et al. 1998).
2. The physical structure of aquatic habitats (or ecosystems) can be used to predict the distribution of aquatic communities (Gorman and Karr 1978; Schlosser 1982).
3. Aquatic habitats are continuous; however, generalizations about discrete patterns in habitat use can be made (Vannote et al. 1980; Schlosser 1982).
4. Using a nested classification system, (i.e. stream reach habitat types within species ranges), we can account for community diversity that is difficult to observe or to measure (taxonomic, genetic, or ecological) (Frissell et al. 1986; Angermeier and Schollsser 1995).

B. Watersheds and Species Range

The Forest stratified GWNF habitat by an individual species known range on or near the Forest using hydrologic units or watersheds. Hydrologic units have been consistently developed across both Virginia and West Virginia, and cover the extent of the Forest land. Specifically, habitat was identified as potential habitat for a species only if it was within a watershed that was within the known range of the species. For example, potential habitat for the roughhead shiner was limited to the James River Drainage, since it is not known from the Potomac Drainage. This captured both the geographic and physiographic aspects of species distribution.

Angermeier and Winston (1999) found that physiography and drainage together described 27% of the variance in fish species composition. In addition, they found that fish community types described by the drainage-physiography combination were more distinct than those described by drainage or physiography alone. The Ecoregional Drainage Unit (EDU) is a spatial representation of this variable. The EDU concept was incorporated by TNC. They developed aggregations of 8-digit hydrologic units based on similarities in several variable including geology, flow characteristics, and topography (Smith et al. 2002). The TNC dataset included size-1

Aquatic Ecological Systems that were extensively explored by the Forest for use in this process. Above the Forest Service boundary, aquatic ecosystems were smaller than what was defined by TNC as a size-1 Aquatic Ecological System, and a portion of Forest land was not classified; therefore, the TNC classification was not used.

Virginia's Wildlife Action Plan defined a total of 34 EDUs in Virginia, compiling 14 drainages and six ecoregions. Since Virginia's dataset did not include the land that the GWNF manages in WV, and since a WV stream classification system has not been completed, the GWNF decided to use hydrologic units stratified by species range.

C. Stream Reach Classification

Streams and rivers display continuous changes in physical and chemical characteristics from headwaters to mouth, which may influence the structure and function of biological communities along this continuum (Vannote et al. 1980). Factors of elevation, watershed size, and geology are interrelated along the continuum. These factors in turn influence the distribution, abundance, and productivity of stream flora and fauna.

The lotic (stream and river) aquatic ecosystems of the George Washington National Forest were characterized in a GIS environment using combinations of watershed size, elevation, and geology.

Table G1-1. Habitat attributes assigned to each stream reach.

Attribute	Description	Data Source
Stream Size	Determined by watershed area	DEM, NHD
Elevation	Stream segments above or below 610 meters (2000 feet)	DEM
Geology	The geological class intersection of the stream segment	GIS coverage of USGS geologic maps

Stream Size

Most species occupy streams or stream reaches of particular size ranges, thus their distributions are longitudinally zoned. Species richness in stream reaches is related to longitudinal zonation. Headwaters nearly universally have fewer species than do medium and large streams in the same system.

Stream size is directly related to watershed area, and was determined using the watershed area. Stream size classes were assigned that are consistent with what was used in Virginia's Wildlife Action Plan.

Watershed area was derived in GIS from a 10 meter digital elevation model (DEM). The DEM was downloaded from: http://fsweb.clearinghouse.fs.fed.us/

Individual quads were merged in ArcMap to create a mosaic covering the GWNF. Watershed information was then extracted from the DEM using an ArcMap extension called HydroTools available from the following web site: http://www.crwr.utexas.edu/gis/archydrobook/ArcHydroTools/Tools.htm

The first step that ArcHydro Tools does is called "DEM Reconditioning". This step is unique to this extension and forces the DEM generated streams to coincide with the blue line stream locations. The extension creates a folder called "Layers" and generates a new DEM called AgreeDEM. Subsequent steps in Preprocessing that need to be done include Fill Sinks, Flow Direction, and Flow Accumulation. The Flow Accumulation grid is the useful product. The value in each grid expresses the number of grids that flow into it. In a 10 meter DEM each grid represents an area of 100 square meters (10m X 10m). Area in grids can be later translated into area in square miles or acres. The stream network can be extracted with the next ArcHydro Tools step of Stream Definition. This identifies flow accumulation cells greater than a specified number and gives each a value of one. A flow accumulation value of 500 represents 12.4 acres and approximates the drainage needed to support a channeled ephemeral stream in the Southeast. The resulting grid is labeled STR. Using the Map

Calculator in Spatial Analyst, the STR grid can be multiplied by the Flow Accumulation grid to create a gridded stream network with watershed area in grids at intervals equal to the size of the grid (10 meters). Spatial Analyst was used to convert the grid (raster) to features as a polyline shapefile with a field called GRIDCODE that represents the watershed area upstream from each line segment in number of grids. Fields were then added to the attribute table of the shapefile. Use the calculate function to populate the fields with area in square miles (for a 10 meter grid, multiply "gridcode" by 0.00003861022). This value converts 10 meter – square grids into square miles. Thus, each segment of the stream polyline will have an attribute of watershed area attached to it.

Elevation

Stream temperature has been identified as an important factor to predict species distributions. However, it is difficult to predict in a landscape scale classification. Since stream temperature decreases predictably with increasing elevation in mountains, largely due to the temperature lapse rate of the atmosphere, we have included reach elevation (in feet) as a surrogate attribute for temperature (Flebbe et al. 2006). A reach elevation of 2000 ft was used as the break point between cold water and cool/warm water habitat. This corresponds with findings by Meisner (1990), and was validated by reviewing the aquatic community in selected reaches. In addition, recent research by Owen (2006) found that the threshold for year-round temperatures sufficient to sustain trout in the Monongahela National Forest of West Virginia was at 2000 ft elevation.

The DEM was used to select stream segments as being above or below 610 meters (2000 feet) and attributed accordingly.

Geology

Geologic structure and rock type influence local substrate, slope, and longitudinal profiles of the streambed, as well as influencing water chemistry. These factors in turn influence the distribution, abundance, and productivity of stream flora and fauna.

The topographical features of the GWNF are the result of differential erosion of rocks of different resistance. Ridges are made up of more resistant quartzites and granites, and valleys are composed of less resistant shales and limestones (Hack 1957). Thus, the smaller headwater streams are associated with higher elevations and more resistant geology. Conversely, the larger river systems are more commonly found in the valleys at lower elevations and on less resistant shales and limestones. The size of the stream bed material (substrate) is determined by rock type and drainage area. Resistant quartzites and granites produce stream channels with boulders and large cobbles. Shales produce stream bed material dominated by gravel and small cobble. The size of the stream bed material and the drainage area of the watershed determine stream channel gradient (slope). Stream channels dominated by boulders are commonly found to have steeper gradients than those dominated by gravels.

Bedrock and surficial geology, including Soils, also strongly influence the flow regime and water quality of a stream.

The flow of a stream or river varies over time in response to precipitation events over its watershed. Different rocks and Soils have different water infiltration and storage capacities. Watersheds underlain by rocks and Soils with large storage capacity will have smaller flood peaks and higher low flows than will watersheds whose rocks and Soils lack storage capacity. Differences in storage capacity are reflected in differences in the watershed’s drainage density, expressed as the miles of stream channel per square mile or watershed. As storage capacity decreases, drainage density increases. As drainage density increase, flood peaks increase and low flows decrease.

Geology influences physical water quality of a stream because rock types decompose at different rates, and have different rates of denuation. Estimates of denudation rates for ridge-forming sandstones, and valley-forming shale for the Appalachians in Virginia are:

Sandstone	0.000078 inches per year	15 tons/sq. mile/year
Shale	0.00039 inches per year	75 tons/sq. mile/year

These translate into very different sediment yields. The annual sediment yield from shale is five times that of the sandstone. Similarly, turbidity (amount of solid particles suspended in water) differs by geology. Rock types that weather to produce colloidal size particles of silt and clay (ex. shales and impure limestone) will result in streams with greater potential turbidity. In contrast, sand and larger size particles will show little to no turbidity for the same or grater sediment concentrations.

Geology influences water chemistry as rocks are weathered and dissolved in water. The chemistry of the water can determine the heath or distribution of biota. For example, dissolved calcium can be a limiting factor in the distribution of many aquatic organisms, mollusks and crayfish in particular. Calcium levels would be highest in streams that flow through rocks that contain carbonate, such as limestone. Waters flowing through limestone also typically have high alkalinity and would be better able to buffer against dramatic changes in pH (such as from acid deposition). Waters flowing through granite and quartzite, typically have low alkalinity and poor buffering capacity.

Geology was obtained from the GWNF polygon GIS coverage created by manually digitizing available USGS geologic maps at scales of 1:24000 and 1:100,000.

Stream Types

Once the reaches were attributed, we divided the continuous variables into meaningful categories after some literature review and preliminary analyses of the data. We decided upon five categories for size, two categories for elevation, and five categories for geology (see Table G1-2).

Table G1-2. Aquatic habitat classification categories used for continuous variables

Stream Size:	Watershed area (sq. miles)	Class
Headwater	<2	100
Stream	2-10	200
Large stream	10-20	300
Small River	20-70	400
Large River	>70	500
Elevation (temperature regime):	Elevation (ft):	Class
Lower elevation (warm/cool water)	≤2000	10
Higher elevation (cold water)	>2000	20
Geology:	Rock Types:	Class
Sandstone/quartzite	Sandstone & quartzite	1
Limestone	limestone	2
Shale	shale	3
Granite	granite, metabasalt, proxene, gneiss	4
Charnokite/mylonite	charnikite & mylonite	5

The categories were concatenated by their assigned number to come up with a stream type for each reach that described the size, elevation, and geology (see Table G1-3).

Table G1-3. Miles of Lotic Habitat on GWNF by Stream Type.

Stream Type	Sum of Miles	Percent of Miles	Description	Example
111	153.41	13.02%	Headwater, lower elevation, sandstone/quartzite	Buck Lick Run, Rockingham Co.
112	50.38	4.27%	Headwater, lower elevation, limestone	Upper Kelly Run, Bath Co.
113	181.61	15.41%	Headwater, lower elevation, shale	Downy Branch, Allegheny Co.
114	18.44	1.56%	Headwater, lower elevation, granite	King Creek, Amherst Co.
115	8.08	0.69%	Headwater, lower elevation, charnokite/mylonite	Cedar Creek, Amherst Co.
121	240.60	20.41%	Headwater, higher elevation, sandstone/quartzite	Locust Spring Run, Highland Co.
122	24.93	2.11%	Headwater, higher elevation, limestone	Jordan Run, Bath Co.
123	47.98	4.07%	Headwater, higher elevation, shale	Upper Pitt Spring Run, Page Co.
124	12.93	1.10%	Headwater, higher elevation, granite	Crabtree Creek, Nelson Co.

Stream Type	Sum of Miles	Percent of Miles	Description	Example
125	3.85	0.33%	Headwater, higher elevation, charnokite/mylonite	Upp. N.F. Piney R., Nelson/Amherst
211	100.01	8.49%	Stream, lower elevation, sandstone/quartzite	Slate Lick Branch, Rockingham Co.
212	36.46	3.09%	Stream, lower elevation, limestone	Cub Run, Page Co.
213	74.76	6.34%	Stream, lower elevation, shale	Little Fork, Pendleton Co.
214	10.45	0.89%	Stream, lower elevation, granite	Shoe Creek, Nelson Co.
215	3.61	0.31%	Stream, lower elevation, charkonite/mylonite	Browns Creek, Amherst Co.
221	61.43	5.21%	Stream, higher elevation, sandstone/quartzite	Little Back Creek, Bath Co.
222	5.59	0.47%	Stream, higher elevation, limestone	Muddy Run, Bath Co.
223	9.06	0.77%	Stream, higher elevation, shale	Little Mill Creek, Bath Co.
224	5.39	0.46%	Stream, higher elevation, granite	S.F. Piney River, Amherst Co.
225	0.06	0.00%	Stream, higher elevation, charkonite/mylonite	Lower N.F. Piney R., Nelson/Amherst
311	12.52	1.06%	Large stream, lower elevation, sandstone/quartzite	Lower Cove Run, Hardy Co.
312	4.14	0.35%	Large stream, lower elevation, limestone	Smith Creek, Allegheny Co.
313	16.88	1.43%	Large stream, lower elevation, shale	Wilson Creek, Bath Co.
314	5.38	0.46%	Large stream, lower elevation, granite	Pedlar River, Amherst Co.
315	1.08	0.09%	Large stream, lower elevation, charnokite/mylonite	Piney River, Nelson/Amherst Co.
321	11.27	0.96%	Large stream, higher elevation, sandstone/quartzite	Skidmore Fork, Rockingham Co.
322	0.28	0.02%	Large stream, higher elevation, limestone	Dry Run, Bath Co.
323	0.03	0.00%	Large stream, higher elevation, shale	Shaws Fork, Highland Co.
411	21.21	1.80%	Small river, lower elevation, sandstone/quartzite	North River, Augusta Co.
412	2.04	0.17%	Small river, lower elevation, limestone	Trout Run, Hardy Co.
413	8.07	0.68%	Small river, lower elevation, shale	Dunlap Creek, Allegheny Co.
414	3.84	0.33%	Small river, lower elevation, granite	Pedlar River, Amherst Co.
415	2.30	0.19%	Small river, lower elevation, charnokite/mylonite	Tye River, Nelson Co.
421	3.86	0.33%	Small river, higher elevation, sandstone/quartzite	Laurel Fork, Highland Co.
423	0.14	0.01%	Small river, higher elevation, shale	Back Creek, Highland Co.
511	2.09	0.18%	Large river, lower elevation, sandstone/quartzite	Passage Creek, Shenandoah Co.
512	13.91	1.18%	Large river, lower elevation, limestone	Jackson River, Bath Co.
513	20.62	1.75%	Large river, lower elevation, shale	Cowpasture River, Bath Co.
	1178.66	100.00%		

D. Lake, Pond, and Wetland Classification

Lentic aquatic habitat has standing water and includes lakes, ponds, and swamps. It is primarily determined by slope (or gradient) and substrate or storage capacity. On the GWNF there are numerous small natural ponds and wetlands, in addition to human-built impoundments (reservoirs). Because they vary in size, depth, chemistry, hydro-period, and vegetation, there are often unique flora and fauna associated with these habitats.

Lentic habitat was identified on the George Washington National Forest using the National Land Cover Database (NLCD) for Virginia and West Virginia produced by the U.S. Geological Survey. This portion of the NLCD was created as part of land cover mapping activities for Federal Region III that includes the States of Maryland, Delaware, Pennsylvania, Virginia, West Virginia, and the District of Columbia. The NLCD classification contains 21 different land cover categories with a spatial resolution of 30 meters.

Citation_Information:
Originator: U.S. Geological Survey (USGS)
Publication_Date: 19990527
Title: Virginia Land Cover Data Set
Edition: 1
Geospatial_Data_Presentation_Form: raster digital data
Publication_Information:
Publication_Place: Sioux Falls, SD USA
Publisher: U.S. Geological Survey
http://erg.usgs.gov/isb/pubs/factsheets/fs10800.html

The NLCD layer has three lentic water cover classes, their definitions are below:

Open water (NLCD 11) – All areas of open water: typically 25% or greater cover of water (per pixel).

Woody Wetlands (NLCD 91) – Areas where forest or shrubland vegetation accounts for 25-100% of the cover and the Soil or substrate is periodically saturated with or covered with water.

Emergent Herbaceous Wetlands (NLCD 92) – Areas where perennial herbaceous vegetation accounts for 75-100% of the cover and the Soil or substrate is periodically saturated with or covered with water.

Open water was further stratified by size and connectivity to lotic ecosystems (flowing water). Waterbodies greater than 5 acres were classified as lakes. Waterbodies smaller than 5 acres were classified as ponds. Lakes and ponds that intersected the NHD streams layer in GIS were classified as "connected to stream". Those that did not intersect were classified as "not connected to stream".

Thus, six unique lentic aquatic habitats were differentiated. The number of features, acres, and percent of each and total acres of lentic aquatic habitat are summarized in Table G1-4.

Table G1-4. Acres of Lentic Habitat on GWNF by Category.

Category	Abbreviation	Number	Acres on GWNF	Percent
Lake connected to a stream	LCS	34	2830.6	87.7%
Lake not connected to a stream	LNCS	2	20.9	0.6%
Pond connected to a stream	PCS	29	36.0	1.1%
Pond not connected to a stream	PNCS	81	70.5	2.2%
Emergent herbaceous wetland	EHW	139	85.0	2.6%
Woody wetland	WW	189	185.7	5.8%
TOTALS		474	3228.7	100.0%

The category of “Lake connected to a stream” covered the greatest amount of acres on the Forest because this category included the 2,530 acre Lake Moomaw.

E. Species-Habitat Relationships

Species collection records were compiled from the Virginia Department of Game and Inland Fisheries (VDGIF) collections database, Virginia Department of Conservation and Recreation’s Division of Natural Heritage (VDNH) records, West Virginia Division of Natural Resources (WVDNR) records, and USFS records. Using ArcMap®, records of selected species were connected to the attributed stream reaches or lakes/wetlands, allowing for remote characterization of the species’ habitats.

Once the connections were complete, we exported the data to a Microsoft Excel® spreadsheet and compiled a list of habitat classifications for each species. A query was run using ArcMap® to identify all the associated habitat types on the GWNF for each species, within their known range. The habitat types were identified first, and then clipped to the size HUC watershed appropriate to their known distribution near the Forest. For example, based on known occurrences, the James River spinymussel was associated with habitat types 312, 313, 415, and 513 within the upper and middle James River watersheds.

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APPENDIX G2. DETAILED HABITAT OF AQUATIC SPECIES ON THE GWNF

Habitat Code	Stream (miles) or Lake (acres) Habitat	*Pleurobema collina* James spinymussel	*Scirpus ancistrochaetus* northeastern bulrush	*Helenium virginicum* Virginia sneezeweed	*Helonias bullata* swamp pink	*Notropis semperasper* Roughhead shiner	*Noturus gilberti* Orangefin madtom	*Hydraena maureenae* Maureen's shale stream beetle
111	Headwater, lower elevation, sandstone/quarzite				1.5			
112	Headwater, lower elevation, limestone							
113	Headwater, lower elevation, shale							150.9
114	Headwater, lower elevation, granitic							
115	Headwater, lower elevation, charnokite/mylonite							
121	Headwater, higher elevation, sandstone/quarzite				2.4			
122	Headwater, higher elevation, limestone							
123	Headwater, higher elevation, shale				0.1	37.6		
124	Headwater, higher elevation, granitic							
125	Headwater, higher elevation, charnokite/mylonite							
211	Stream, lower elevation, sandstone/quarzite				3.2			
212	Stream, lower elevation, limestone							
213	Stream, lower elevation, shale							
214	Stream, lower elevation, granitic							
215	Stream, lower elevation, charkonite/mylonite							
221	Stream, higher elevation, sandstone/quarzite				0.0			
222	Stream, higher elevation, limestone							
223	Stream, higher elevation, shale							
224	Stream, higher elevation, granitic							
225	Stream, higher elevation, charkonite/mylonite							
311	Large stream, lower elevation, sandstone/quarzite							
312	Large stream, lower elevation, limestone	0.2						
313	Large stream, lower elevation, shale	5.9						
314	Large stream, lower elevation, granitic							
315	Large stream, lower elevation, charnokite/mylonite							
321	Large stream, higher elevation, sandstone/quarzite							
322	Large stream, higher elevation, limestone							
323	Large stream, higher elevation, shale							
411	Small river, lower elevation, sandstone/quarzite							
412	Small river, lower elevation, limestone							
413	Small river, lower elevation, shale					5.1		
414	Small river, lower elevation, granitic							
415	Small river, lower elevation, charnokite/mylonite	1.6						
421	Small river, higher elevation, sandstone/quarzite							
423	Small river, higher elevation, shale					0.1		
511	Large river, lower elevation, sandstone/quarzite							
512	Large river, lower elevation, limestone					12.0	0.4	
513	Large river, lower elevation, shale	6.6				18.8	6.1	
TOTALS	Miles of stream habitat	14.3			7.3	73.7	6.5	150.9
WW	Woody wetland		1.1	0.22				
EHW	Emergent herbaceous wetland			1.56				
PNCS	Pond not connected to a stream			2.22				
PCS	Pond connected to a stream							
LNCS	Lake not connected to a stream							
LCS	Lake connected to a stream							
TOTALS	Acres of lake habitat		1.1	4				

Habitat Code	Stream (miles) or Lake (acres) Habitat	*Cicindela ancocisconensis* Tiger beetle	*Alasmidonta varicosa* Brook floater	*Elliptio lanceolata* Yellow lance	*Fusconaia masoni* Atlantic pigtoe	*Lasmigona subviridis* Green floater	*Villosa constricta* Notched Rainbow	*Ambystoma tigrinum* eastern tiger salamander
111	Headwater, lower elevation, sandstone/quarzite							
112	Headwater, lower elevation, limestone							
113	Headwater, lower elevation, shale							
114	Headwater, lower elevation, granitic							
115	Headwater, lower elevation, charnokite/mylonite							
121	Headwater, higher elevation, sandstone/quarzite							
122	Headwater, higher elevation, limestone							
123	Headwater, higher elevation, shale							
124	Headwater, higher elevation, granitic							
125	Headwater, higher elevation, charnokite/mylonite							
211	Stream, lower elevation, sandstone/quarzite							
212	Stream, lower elevation, limestone							
213	Stream, lower elevation, shale							
214	Stream, lower elevation, granitic							
215	Stream, lower elevation, charkonite/mylonite							
221	Stream, higher elevation, sandstone/quarzite							
222	Stream, higher elevation, limestone							
223	Stream, higher elevation, shale							
224	Stream, higher elevation, granitic							
225	Stream, higher elevation, charkonite/mylonite							
311	Large stream, lower elevation, sandstone/quarzite							
312	Large stream, lower elevation, limestone							
313	Large stream, lower elevation, shale				0.2			
314	Large stream, lower elevation, granitic							
315	Large stream, lower elevation, charnokite/mylonite							
321	Large stream, higher elevation, sandstone/quarzite							
322	Large stream, higher elevation, limestone							
323	Large stream, higher elevation, shale							
411	Small river, lower elevation, sandstone/quarzite							
412	Small river, lower elevation, limestone							
413	Small river, lower elevation, shale							
414	Small river, lower elevation, granitic							
415	Small river, lower elevation, charnokite/mylonite					2.3	2.3	
421	Small river, higher elevation, sandstone/quarzite							
423	Small river, higher elevation, shale							
511	Large river, lower elevation, sandstone/quarzite							
512	Large river, lower elevation, limestone			12.0			12.0	
513	Large river, lower elevation, shale	6.2	1.3	18.8		19.6	18.8	
TOTALS	Miles of stream habitat	6.2	1.3	30.8	0.2	21.9	33.1	
WW	Woody wetland							8
EHW	Emergent herbaceous wetland							26.02
PNCS	Pond not connected to a stream							5.12
PCS	Pond connected to a stream							
LNCS	Lake not connected to a stream							
LCS	Lake connected to a stream							
TOTALS	Acres of lake habitat							39.14

Habitat Code	Stream (miles) or Lake (acres) Habitat	*Empidonax alnorum* alder flycatcher	*Melospiza georgiana* swamp sparrow	*Seiurus noveboracensis* northern waterthrush	*Cambarus monongalensis* A Crayfish	*Salvelinus fontinalus* Brook trout	*Aeshna canadensis* Canada darner	*Aeshna tuberculifera* black-tipped darner	*Aeshna verticalis* green-striped darner
111	Headwater, lower elevation, sandstone/quarzite					153.4			
112	Headwater, lower elevation, limestone					50.4			
113	Headwater, lower elevation, shale					181.6			
114	Headwater, lower elevation, granitic					18.4			
115	Headwater, lower elevation, charnokite/mylonite					8.1			
121	Headwater, higher elevation, sandstone/quarzite				10.2	240.6			
122	Headwater, higher elevation, limestone					24.9			
123	Headwater, higher elevation, shale					48.0			
124	Headwater, higher elevation, granitic					12.9			
125	Headwater, higher elevation, charnokite/mylonite								
211	Stream, lower elevation, sandstone/quarzite					100.0			
212	Stream, lower elevation, limestone					36.5			
213	Stream, lower elevation, shale					74.8			
214	Stream, lower elevation, granitic					10.4			
215	Stream, lower elevation, charkonite/mylonite					3.6			
221	Stream, higher elevation, sandstone/quarzite				0.6	61.4			
222	Stream, higher elevation, limestone								
223	Stream, higher elevation, shale					9.1			
224	Stream, higher elevation, granitic					5.4			
225	Stream, higher elevation, charkonite/mylonite								
311	Large stream, lower elevation, sandstone/quarzite					12.5			
312	Large stream, lower elevation, limestone					4.1			
313	Large stream, lower elevation, shale								
314	Large stream, lower elevation, granitic					5.4			
315	Large stream, lower elevation, charnokite/mylonite								
321	Large stream, higher elevation, sandstone/quarzite				3.5	11.3			
322	Large stream, higher elevation, limestone								
323	Large stream, higher elevation, shale								
411	Small river, lower elevation, sandstone/quarzite				0.1	21.2			
412	Small river, lower elevation, limestone								
413	Small river, lower elevation, shale					8.1			
414	Small river, lower elevation, granitic								
415	Small river, lower elevation, charnokite/mylonite								
421	Small river, higher elevation, sandstone/quarzite				3.2	3.9			

423	Small river, higher elevation, shale								
511	Large river, lower elevation, sandstone/quarzite								
512	Large river, lower elevation, limestone					13.9			
513	Large river, lower elevation, shale								
TOTALS	Miles of stream habitat				17.6	1119.9			
WW	Woody wetland	185.7		185.7				26.47	
EHW	Emergent herbaceous wetland		84.95	84.95			26.47	35.81	26.47
PNCS	Pond not connected to a stream						3.56	9.12	3.56
PCS	Pond connected to a stream						4.67	12.68	4.67
LNCS	Lake not connected to a stream								
LCS	Lake connected to a stream							5.34	
TOTALS	Acres of lake habitat	185.7	84.95	270.65			34.7	89.42	34.7

Habitat Code	Stream (miles) or Lake (acres) Habitat	*Calopteryx amata* Superb jewelwing	*Calopteryx angustipennis* Appalachian jewelwing	*Celithemis martha* Martha's penant	*Cordulegaster diastatops* delta-spotted spiketail	*Enallagma annexum* northern bluet	*Epitheca canis* beaverpond baskettail	*Leucorrhinia hudsonica* Hudsonian whiteface
111	Headwater, lower elevation, sandstone/quarzite							
112	Headwater, lower elevation, limestone							
113	Headwater, lower elevation, shale							
114	Headwater, lower elevation, granitic							
115	Headwater, lower elevation, charnokite/mylonite							
121	Headwater, higher elevation, sandstone/quarzite	10.2			10.23			
122	Headwater, higher elevation, limestone							
123	Headwater, higher elevation, shale							
124	Headwater, higher elevation, granitic							
125	Headwater, higher elevation, charnokite/mylonite							
211	Stream, lower elevation, sandstone/quarzite							
212	Stream, lower elevation, limestone							
213	Stream, lower elevation, shale							
214	Stream, lower elevation, granitic							
215	Stream, lower elevation, charkonite/mylonite							
221	Stream, higher elevation, sandstone/quarzite	0.6						
222	Stream, higher elevation, limestone							
223	Stream, higher elevation, shale							
224	Stream, higher elevation, granitic							
225	Stream, higher elevation, charkonite/mylonite							
311	Large stream, lower elevation, sandstone/quarzite							
312	Large stream, lower elevation, limestone							
313	Large stream, lower elevation, shale							
314	Large stream, lower elevation, granitic							
315	Large stream, lower elevation, charnokite/mylonite							
321	Large stream, higher elevation, sandstone/quarzite	3.5						
322	Large stream, higher elevation, limestone							
323	Large stream, higher elevation, shale							
411	Small river, lower elevation, sandstone/quarzite	0.1						
412	Small river, lower elevation, limestone							
413	Small river, lower elevation, shale							
414	Small river, lower elevation, granitic							
415	Small river, lower elevation, charnokite/mylonite							
421	Small river, higher elevation, sandstone/quarzite	3.2						
423	Small river, higher elevation, shale							
511	Large river, lower elevation, sandstone/quarzite							
512	Large river, lower elevation, limestone							
513	Large river, lower elevation, shale		0.087					
TOTALS	Miles of stream habitat	17.6	0.1		10.2			
WW	Woody wetland			26.47				
EHW	Emergent herbaceous wetland			9.34		26.47	26.47	26.47
PNCS	Pond not connected to a stream			5.56		3.56	3.56	3.56
PCS	Pond connected to a stream			8.01		4.67	4.67	4.67
LNCS	Lake not connected to a stream							
LCS	Lake connected to a stream			5.34				
TOTALS	Acres of lake habitat			54.72		34.7	34.7	34.7

Habitat Code	Stream (miles) or Lake (acres) Habitat	*Gomphus adelphus* mustached clubtail	*Gomphus quadricolor* rapids clubtail	*Ladona julia* chalk-fronted corporal skimmer	*Lanthus parvulus* double-striped clubtail	*Lestes disjunctus* Northern spreadwing	*Nycticorax nyciticorax* Black-crowned night heron	*Nyctanassa violacea* Yellow-crowned night heron
111	Headwater, lower elevation, sandstone/quarzite				0.31			
112	Headwater, lower elevation, limestone				1.51			
113	Headwater, lower elevation, shale							
114	Headwater, lower elevation, granitic							
115	Headwater, lower elevation, charnokite/mylonite							
121	Headwater, higher elevation, sandstone/quarzite				10.84			
122	Headwater, higher elevation, limestone				0.11			
123	Headwater, higher elevation, shale				0.39			
124	Headwater, higher elevation, granitic							
125	Headwater, higher elevation, charnokite/mylonite							
211	Stream, lower elevation, sandstone/quarzite							
212	Stream, lower elevation, limestone							
213	Stream, lower elevation, shale							
214	Stream, lower elevation, granitic							
215	Stream, lower elevation, charkonite/mylonite							
221	Stream, higher elevation, sandstone/quarzite							
222	Stream, higher elevation, limestone							
223	Stream, higher elevation, shale							
224	Stream, higher elevation, granitic							
225	Stream, higher elevation, charkonite/mylonite							
311	Large stream, lower elevation, sandstone/quarzite							
312	Large stream, lower elevation, limestone							
313	Large stream, lower elevation, shale							
314	Large stream, lower elevation, granitic							
315	Large stream, lower elevation, charnokite/mylonite							
321	Large stream, higher elevation, sandstone/quarzite							
322	Large stream, higher elevation, limestone							
323	Large stream, higher elevation, shale							
411	Small river, lower elevation, sandstone/quarzite							
412	Small river, lower elevation, limestone							
413	Small river, lower elevation, shale	5.1	5.1					
414	Small river, lower elevation, granitic							
415	Small river, lower elevation, charnokite/mylonite							
421	Small river, higher elevation, sandstone/quarzite							
423	Small river, higher elevation, shale							
511	Large river, lower elevation, sandstone/quarzite						2.09	2.09
512	Large river, lower elevation, limestone						13.91	13.91
513	Large river, lower elevation, shale	18.8	18.8				20.62	20.62
TOTALS	Miles of stream habitat	23.9	23.9		13.2		36.6	36.6
WW	Woody wetland						185.7	185.7
EHW	Emergent herbaceous wetland			26.47		26.47		
PNCS	Pond not connected to a stream			3.56		3.56		
PCS	Pond connected to a stream			4.67		4.67		
LNCS	Lake not connected to a stream							
LCS	Lake connected to a stream							
TOTALS	Acres of lake habitat			34.7		34.7	185.7	185.7

Habitat Code	Stream (miles) or Lake (acres) Habitat	*Nehalennia irene* sedge sprite	*Neurocordulia yamaskanensis* stygian shadowdragon	*Rhionaeschna mutata* spatterdock darner	*Somatochlora elongata* Ski-tipped emerald	*Sympetrum obtrusum* white-faced meadowhawk	*Anas rubripes* Amer. Black duck
111	Headwater, lower elevation, sandstone/quarzite						
112	Headwater, lower elevation, limestone						
113	Headwater, lower elevation, shale						
114	Headwater, lower elevation, granitic						
115	Headwater, lower elevation, charnokite/mylonite						
121	Headwater, higher elevation, sandstone/quarzite						
122	Headwater, higher elevation, limestone						
123	Headwater, higher elevation, shale						
124	Headwater, higher elevation, granitic						
125	Headwater, higher elevation, charnokite/mylonite						
211	Stream, lower elevation, sandstone/quarzite						
212	Stream, lower elevation, limestone						
213	Stream, lower elevation, shale						
214	Stream, lower elevation, granitic						
215	Stream, lower elevation, charkonite/mylonite						
221	Stream, higher elevation, sandstone/quarzite						
222	Stream, higher elevation, limestone						
223	Stream, higher elevation, shale						
224	Stream, higher elevation, granitic						
225	Stream, higher elevation, charkonite/mylonite						
311	Large stream, lower elevation, sandstone/quarzite						
312	Large stream, lower elevation, limestone						
313	Large stream, lower elevation, shale						
314	Large stream, lower elevation, granitic						
315	Large stream, lower elevation, charnokite/mylonite						
321	Large stream, higher elevation, sandstone/quarzite						
322	Large stream, higher elevation, limestone						
323	Large stream, higher elevation, shale						
411	Small river, lower elevation, sandstone/quarzite						
412	Small river, lower elevation, limestone						
413	Small river, lower elevation, shale						
414	Small river, lower elevation, granitic						
415	Small river, lower elevation, charnokite/mylonite						
421	Small river, higher elevation, sandstone/quarzite						
423	Small river, higher elevation, shale						
511	Large river, lower elevation, sandstone/quarzite						2.09
512	Large river, lower elevation, limestone		13.9				13.91
513	Large river, lower elevation, shale		20.6				20.62
TOTALS	Miles of stream habitat		34.5				36.6
WW	Woody wetland			26.47			185.7
EHW	Emergent herbaceous wetland	26.47		9.34	26.47	26.47	
PNCS	Pond not connected to a stream	3.56		5.56	3.56	3.56	
PCS	Pond connected to a stream	4.67		8.01	4.67	4.67	
LNCS	Lake not connected to a stream						
LCS	Lake connected to a stream						
TOTALS	Acres of lake habitat	34.7		49.38	34.7	34.7	185.7

Habitat Code	Stream (miles) or Lake (acres) Habitat	*Isonychia hoffmani* Hoffman's Isonychia mayfly	*Nemotaulius hostilis* limnephilid caddisfly	*Sorex palustris punctulatus* southern water shrew	*Clemmys guttata* spotted turtle	*Glyptemys insculpta* wood turtle	*Anguilla rostrata* American eel	*Anax longipes* comet darner
111	Headwater, lower elevation, sandstone/quarzite					60.9		
112	Headwater, lower elevation, limestone					25.4		
113	Headwater, lower elevation, shale					29.0		
114	Headwater, lower elevation, granitic						15.5	
115	Headwater, lower elevation, charnokite/mylonite						8.1	
121	Headwater, higher elevation, sandstone/quarzite	10.2		6.8				
122	Headwater, higher elevation, limestone							
123	Headwater, higher elevation, shale					6.4		
124	Headwater, higher elevation, granitic							
125	Headwater, higher elevation, charnokite/mylonite							
211	Stream, lower elevation, sandstone/quarzite					38.3	64.8	
212	Stream, lower elevation, limestone					13.8	17.3	
213	Stream, lower elevation, shale					23.0		
214	Stream, lower elevation, granitic						9.7	
215	Stream, lower elevation, charkonite/mylonite						3.5	
221	Stream, higher elevation, sandstone/quarzite	0.6		0.6		6.3		
222	Stream, higher elevation, limestone							
223	Stream, higher elevation, shale							
224	Stream, higher elevation, granitic							
225	Stream, higher elevation, charkonite/mylonite							
311	Large stream, lower elevation, sandstone/quarzite					2.0		
312	Large stream, lower elevation, limestone					1.7		
313	Large stream, lower elevation, shale					4.0		
314	Large stream, lower elevation, granitic						4.0	
315	Large stream, lower elevation, charnokite/mylonite							
321	Large stream, higher elevation, sandstone/quarzite	3.5		2.7				
322	Large stream, higher elevation, limestone							
323	Large stream, higher elevation, shale							
411	Small river, lower elevation, sandstone/quarzite	0.1		0.1		2.5	15.7	
412	Small river, lower elevation, limestone					0.2		
413	Small river, lower elevation, shale					3.0	3.0	
414	Small river, lower elevation, granitic							
415	Small river, lower elevation, charnokite/mylonite						2.3	
421	Small river, higher elevation, sandstone/quarzite	3.2		3.3				
423	Small river, higher elevation, shale							
511	Large river, lower elevation, sandstone/quarzite							
512	Large river, lower elevation, limestone							
513	Large river, lower elevation, shale					1.3	1.8	
TOTALS	Miles of stream habitat	17.6		13.5		217.6	145.6	
WW	Woody wetland							26.47
EHW	Emergent herbaceous wetland		26.47		1.11			9.34
PNCS	Pond not connected to a stream		3.56		5.34			5.56
PCS	Pond connected to a stream		4.67					8.01
LNCS	Lake not connected to a stream							
LCS	Lake connected to a stream							
TOTALS	Acres of lake habitat		34.7		6.45			49.4

APPENDIX G3. AQUATIC SPECIES WITHIN GWNF SPECIAL BIOLOGICAL AREAS

Group	SCIENTIFIC NAME	COMMON NAME	Big Levels	Browns Pond	Coal Road	Dabney Lancaster Shale Barren	Loves Run Ponds	Maple Flats	Maple Springs	Peters Mill Run	Pines Chapel Pond	Potts Pond	Powells Fort Camp
amphib	*Ambystoma tigrinum*	eastern tiger salamander	X				X	X			X		
insect/ odonate	*Aeshna tuberculifera*	black-tipped darner						X				X	
insect/ odonate	*Celithemis martha*	Martha's penant						X					
plant	*Boltonia montana*	no common name						X					
plant	*Carex aquatilis*	water sedge	X										
plant	*Carex barrattii*	Barratt's sedge						X					
plant	*Carex buxbaumii*	Buxbaum's sedge						X					
plant	*Carex vesicaria*	inflated sedge		X									
plant	*Cypripedium reginae*	showy lady's-slipper								X			X
plant	*Eleocharis melanocarpa*	black-fruited spikerush					X	X					
plant	*Eleocharis robbinsii*	Robbins spikerush						X					

Group	SCIENTIFIC NAME	COMMON NAME	Big Levels	Browns Pond	Coal Road	Dabney Lancaster Shale Barren	Loves Run Ponds	Maple Flats	Maple Springs	Peters Mill Run	Pines Chapel Pond	Potts Pond	Powells Fort Camp
plant	*Eriocaulon aquaticum*	white buttons						X					
plant	*Helenium virginicum*	Virginia sneezeweed	X		X		X	X			X		
plant	*Helonias bullata*	swamp pink	X					X					
plant	*Hypericum boreale*	northern St. John's-wort					X	X					
plant	*Isoetes virginica*	Virginia quillwort						X					
plant	*Juncus brachycephalus*	small-head rush										X	
plant	*Liparis loeselii*	Loesel's twayblade								X			
plant	*Lycopodiella inundata*	northern bog clubmoss						X					
plant	*Panicum hemitomon*	maidencane						X					
plant	*Potamogeton oakesianus*	Oakes pondweed					X	X					
plant	*Sabatia campanulata*	slender marsh rose-pink						X					

Group	SCIENTIFIC NAME	COMMON NAME	Big Levels	Browns Pond	Coal Road	Dabney Lancaster Shale Barren	Loves Run Ponds	Maple Flats	Maple Springs	Peters Mill Run	Pines Chapel Pond	Potts Pond	Powells Fort Camp
plant	*Schoenoplectus subterminalis*	water bulrush						X					
plant	*Scirpus ancistrochaetus*	northeastern bulrush							X			X	
plant	*Vaccinium macrocarpon*	large cranberry	X					X					
plant	*Vitis rupestris*	sand grape				X							
plant	*Woodwardia virginica*	Virginia chainfern					X						
reptile	*Clemmys guttata*	spotted turtle						X					

APPENDIX G4. AQUATIC SPECIES WITHIN PROPOSED SPECIAL BIOLOGICAL AREAS

Group	SCIENTIFIC NAME	COMMON NAME	CAST STEEL POND	CELLAR MTN	COLD SPRINGS BRANCH	GRASSY POND	HIDDEN VALLEY	HUMPBACK MTN	INDIAN GRAVE RIDGE	JAMES RIVER GORGE	LAUREL FORK	MTN VIEW CHURCH	OVERALL RIVERSIDE	POND RUN POND	UPPER CRABTREE	UPPER ST. MARYS	WATERFALL MTN
amphib	*Ambystoma tigrinum*	eastern tiger salamander				X											
fish	*Notropis semperasper*	Roughhead shiner					X										
insect/ odonate	*Aeshna canadensis*	Canada darner									X						
insect/ odonate	*Aeshna tuberculifera*	black-tipped darner									X						
insect/ odonate	*Aeshna verticalis*	green-striped darner									X						
insect/ odonate	*Calopteryx amata*	Superb jewelwing									X						
insect/ odonate	*Cordulegaster diastatops*	delta-spotted spiketail									X						
insect/ odonate	*Enallagma annexum (AKA cyathigerum)*	northern bluet									X						
insect/ odonate	*Epitheca canis*	beaverpond baskettail									X						
insect/ odonate	*Ladona julia (AKA Libellula julia)*	chalk-fronted corporal skimmer									X						
insect/ odonate	*Lanthus parvulus*	double-striped clubtail									X						
insect/ odonate	*Lestes disjunctus*	northern spreadwing									X						
insect/ odonate	*Leucorrhinia hudsonica*	Hudsonian whiteface									X						
insect/ odonate	*Nehalennia irene*	sedge sprite									X						
insect/ odonate	*Rhionaeschna mutata (AKA Aeshna mutata)*	spatterdock darner				X					X						

Group	SCIENTIFIC NAME	COMMON NAME	CAST STEEL POND	CELLAR MTN	COLD SPRINGS BRANCH	GRASSY POND	HIDDEN VALLEY	HUMPBACK MTN	INDIAN GRAVE RIDGE	JAMES RIVER GORGE	LAUREL FORK	MTN VIEW CHURCH	OVERALL RIVERSIDE	POND RUN POND	UPPER CRABTREE	UPPER ST. MARYS	WATERFALL MTN
insect/ odonate	*Somatochlora elongata*	Ski-tipped emerald									X						
insect/ odonate	*Sympetrum obtrusum*	white-faced meadowhawk									X						
insect	*Isonychia hoffmani*	Hoffman's Isonychia mayfly									X						
mammal	*Sorex palustris punctulatus*	southern water shrew									X						
plant	*Eleocharis compressa*	flattened spikerush							X								
plant	*Epilobium leptophyllum*	linear-leaved willow-herb									X				X		
plant	*Glyceria grandis*	American manna-grass									X						
plant	*Helenium virginicum*	Virginia sneezeweed				X											
plant	*Helonias bullata*	swamp pink		X	X							X				X	
plant	*Juncus brevicaudatus*	narrow-panicled rush									X						
plant	*Liparis loeselii*	Loesel's twayblade															X
plant	*Muhlenbergia glomerata*	marsh muhly						X									
plant	*Polanisia dodecandra*	common clammy-weed								X							
plant	*Sagittaria calycina var calycina*	long-lobed arrowhead					X										

Group	SCIENTIFIC NAME	COMMON NAME	CAST STEEL POND	CELLAR MTN	COLD SPRINGS BRANCH	GRASSY POND	HIDDEN VALLEY	HUMPBACK MTN	INDIAN GRAVE RIDGE	JAMES RIVER GORGE	LAUREL FORK	MTN VIEW CHURCH	OVERALL RIVERSIDE	POND RUN POND	UPPER CRABTREE	UPPER ST. MARYS	WATERFALL MTN
plant	*Scirpus ancistrochaetus*	northeastern bulrush	X											X			
plant	*Solidago rupestris*	riverbank goldenrod							X				X				
plant	*Solidago uliginosa*	bog goldenrod									X						
plant	*Sparganium chlorocarpum*	narrow-leaf burreed									X						
plant	*Spartina pectinata*	freshwater cordgrass								X							
plant	*Sphagnum russowii*	Russow's peatmoss									X						
plant	*Spiranthes ochroleuca*	yellow nodding ladies'-tresses									X						

APPENDIX G5. WATERSHED ANALYSIS FOR GWNF PLAN REVISION

The introduction, purpose and need, objectives, methods, and watershed parameters in the following analysis (except for the species information) are derived from A Watershed Analysis For Forest Planning on the George Washington & Jefferson National Forests, January 17, 2002, George Washington and Jefferson National Forests, Roanoke, Virginia.

INTRODUCTION

At the direction of the Regional Forester, a team was assembled to develop a watershed analysis process that would pertain directly to the forests under revision in the Southern Region. Watershed analysis at this scale is a relatively new concept and few examples exist to emulate. The team relied on the publication, Ecosystem Analysis at the Watershed Scale: Federal Guide for Watershed Analysis (1995 Version 2.2, Regional Interagency Executive Committee, Portland, Oregon), Inland West Watershed Reconnaissance efforts, White River National Forest Watershed Analysis, Chattooga River Ecosystem Demonstration Project and procedures used in the Ozark-Ouachita Highland Assessment.

PURPOSE AND NEED

The Federal Guide for Watershed Analysis (1995) defines Watershed Analysis as:

> "A procedure to characterize the human, aquatic, riparian and terrestrial features, conditions, processes, and interactions within a watershed. It provides a systematic way to understand and organize ecosystem information. In doing so, watershed analysis enhances our ability to estimate direct, indirect and cumulative effects of our activities and guide the general type, location and sequence of appropriate management activities within a watershed."

The Forest Service has routinely debated and struggled to understand watershed condition, cumulative effects, and how management activities and human interactions impact aquatic resources. By approaching these issues spatially on a watershed scale it will add to our understanding of these processes and human interactions. Once we clearly understand the watershed processes and disturbances over time that creates the existing condition, we can then determine social needs and make better informed and science based management decisions for the future.

The Region 8 "Watershed Analysis Procedure" is a starting point for determining and ranking watershed health. The procedure follows a rapid characterization of 5th level Hydrologic Units, also referred to as watersheds in this document. Descriptive indicators of watershed condition and watershed vulnerability are used that are indicative of the relative health of a watershed. Watershed analysis must include complete watershed areas at the 5th field level. There the data represent private as well as public lands.

OBJECTIVES

The objective of the watershed analysis procedure is to provide an assessment of watershed health for 5th level watersheds containing portions of the George Washington and Jefferson National Forests. This assessment produces a comparison of watershed condition and watershed vulnerability among these watersheds. From this assessment the Forest Planning Team should be able to:

Incorporate watershed analysis into the Forest Plan revision process
Discuss desired future conditions at the watershed scale,
Facilitate discussion of effects of forest management activities at the watershed level,
Prioritize watershed restoration needs,
Determine riparian prescriptions based on watershed condition and vulnerability,

Recommend alternative management emphases based on watershed health and
Prioritize where subsequent finer detailed watershed assessments should occur. At the next lower scale.

A goal for watershed management in the East is to “save the best and restore the rest” where feasible. This assessment provides a basis for establishing management strategies that will help achieve this goal.

OVERVIEW OF THE PROCESS

The EWAP is a rapid characterization of 5th level Hydrologic Units that are termed watersheds in this document. The assessment process follows a logical sequence that provides the basis for describing the existing conditions within a watershed in an objective and credible format:

A. Develop set of watershed parameters based on core set and any supplemental parameters;
B. Assemble pertinent data (appropriate GIS coverages, aquatic information, etc.);
C. Build database of information for each watershed based on a set of parameters already developed;
D. Rank the parameter values among watersheds;
E. Summarize ranks to derive condition and vulnerability scores per watershed; and
F. Compile results (graphics, data, ranks) into an assessment report.

METHODS

Recognizing time constraints within the revision process, the proposed watershed analysis relies only on existing or readily derived data sets. The following guidelines were adopted for the development of the watershed analysis process to insure consistency between each forest:

1. The resolution of data would be at Forest Planning scale (usually 1:100,000). Finer resolution could be used if the data were available for all the watersheds within the area of interest.
2. The watershed boundaries would follow 5th level Hydrologic Units as defined by NRCS / Multi-agency Maps. The Forest may choose to redefine some Hydrologic Unit boundaries as long as the watershed retained the 5th level size (40,000 - 250,000 acres). Watersheds (5th level Hydrologic Units) where National Forest land was inconsequential (less than 1 percent of the watershed) were dropped from analysis.
3. The data for the analysis (excluding watershed boundaries) would already exist or be readily derived. The data would include non-Forest Service lands within the watershed.
4. Stream coverages would be represented by EPA RF3 stream reach streams.

The *Federal Guide* (referenced above) describes a six-step process for watershed analysis that sets the stage for subsequent decision-making. The information, organized by watershed, is to be used as a prelude to NEPA analysis and help prioritize ecological needs. Since the Southern Appalachian Forest Plan revision process is already well past issue identification and alternative development, the team decided to adapt the portions of the *Federal Guide* that would best fit the revision process. In brief, the watershed analysis process was based on parameters that described the existing physical and ecological conditions within a watershed as well as the parameters that are susceptible to change as a result of Forest Service management activities. Other parameters were used that reflected trends. These parameters formed the basis for ranking watersheds.

WATERSHED PARAMETERS

Core watershed parameters were identified (Table G5-1) that would be applicable on all forests. Further examination of the parameters revealed that the parameters grouped into two broad categories: condition and vulnerability. Condition parameters reflected natural and human factors that potentially affected watershed health. Vulnerability parameters denoted characteristics that could be changed (positive or negative) as a result of Forest Service management activities. The core parameters were grouped as shown in Table G5-1.

Road density and drainage density were derived data and the accuracy of information was recognized as being marginal at the 1; 100,000 scale. Both of these parameters were selected as core parameters since their information is very useful in comparison between watersheds and, together, they serve as an indirect measure of the density of road-stream crossings.

Table G5-1. Core Parameters for Watershed Analysis

Category	Watershed Parameter	Data Management	Data Source
Condition	National Forest ownership	Percent of national forest within the watershed	Forest Derived
	Road Density	Length of highway divided by watershed area expressed as a percentage	MAIA Data
	Forested Land Use	Percent of forest cover within the watershed	MAIA Data
	Mines	Number of mines found in the watershed	MAIA Data
	Agricultural land slopes > 3%	Spatial query of MAIA cropland or pasture land use and DEM slope coverage.	MAIA Derived
	Forested Riparian	Length of streams flowing through forested land cover divided by total length of streams in watershed	MAIA Data
	Road – riparian interaction	Percent of total stream length in each HUC that has road within 30 meters.	MAIA Derived
	Point sources of pollution	Sum of ricris, cercla, pcs, and ifd sites	EPA - Basins data
	Recreation pressure	A ranking by the forest recreation staff of recreation pressure.	Forest Derived
	Impoundments	Number of dams found in the watershed	EPA - Basins data
	Native Fish	Number of native fish species divided by total number of fish species expressed as a percentage.	Forest Derived
Vulnerability	Erodible Soils	Percent of area with (Soil erodibility factor X sq. root of max slope range) greater than 1.20	NRCS STATSGO
	State Impaired Waters	Total length of impaired streams divided by total stream length expressed as a percentage.	Forest Derived
	Acid Deposition Sensitivity	Percent of watershed with high acid deposition sensitivity	Forest Derived
	Number Aquatic TES Species	Number of species found in watershed	Forest Derived
	Occurrences of TES species	Number of occurrences of TES species by watershed	Forest Derived
	Endemic Fish	Number of species found in watershed	Forest Derived
	Public Water Supply Sources	Number of drinking water sources found in the watershed	EPA - Basins data
	Drainage Density	Length of streams divided by watershed area expressed as a percentage.	MAIA Data

ANALYSIS FOR AQUATIC ECOLOGICAL SUSTAINABILITY 2010

A subset of the above parameters was used to characterize the GWNF watersheds for the 2010 aquatic ecological sustainability analysis. In addition, the number of aquatic TE, S, and LR within each watershed was tabulated (see Table G5-2). Birds and non-TE plants were not included in this analysis because species occurrence locations were not readily available in GIS format. In order to assess the importance of Forest lands to the species from an eco-regional and planning area perspective, it was noted whether the species occurrence was only on National Forest, on both National Forest and private land, or only on private land within each watershed (see Table G5-3). The potential habitat on the GWNF for individual species is detailed in Appendix G2, and can be used to assess the importance of Forest lands to species habitat from a unit perspective.

Table G5-2. Characterization of the 5th level watersheds containing GWNF land

5TH LEVEL HUC WATERSHEDS (2002)	PERCENT GWNF	PERCENT FORESTED LAND USE	PERCENT RIPARIAN AREA IN FORESTED LAND USE	ROAD DENSITY	ROAD-RIPARIAN INTERACTION	POINT SOURCES OF POLLUTION	NO. DAMS	DRAINAGE DENSITY	PUBLIC WATER SUPPLY SOURCES	PERCENT IMPAIRED STREAMS	ACID DEPOSITION SENSITIVITY	TOTAL NO. TE/S/LR	NATIONAL FOREST TE/S/LR	NATIONAL FOREST & PRIVATE TE/S/LR	PRIVATE TE/S/LR
0207000102	5.2%	88.1%	82.1%	1.22	3.920	7	0	1.15	2	20.3%	0.80	20	17	3	0
0207000106	29.4%	87.9%	81.7%	1.37	4.762	11	23	1.53	2	20.9%	1.00	2	0	1	1
0207000301	19.9%	87.4%	83.4%	1.44	5.030	20	6	1.41	0	4.4%	1.00	3	0	2	1
0207000501	9.8%	38.7%	40.2%	2.72	5.296	60	4	1.40	2	19.7%	0.36	1	0	0	1
0207000502	59.1%	74.7%	71.0%	1.59	4.600	15	10	1.42	2	7.3%	0.71	5	3	1	1
0207000504	19.6%	62.8%	63.3%	2.57	3.356	53	15	1.44	2	12.3%	0.41	11	5	4	2
0207000505	9.5%	66.9%	64.1%	2.08	3.501	24	4	1.71	2	13.2%	0.45	5	1	1	3
0207000506	7.4%	70.3%	66.9%	2.52	4.249	59	4	1.61	6	11.8%	0.35	3	0	2	1
0207000601	52.5%	91.0%	86.4%	1.50	5.019	0	4	1.52	0	0.0%	1.00	3	1	2	0
0207000602	5.5%	39.5%	44.1%	2.62	3.946	41	1	1.54	12	17.4%	0.22	4	1	0	3
0207000603	27.9%	65.3%	65.6%	2.47	4.307	70	9	1.62	7	2.3%	0.73	7	1	2	4
0207000604	18.8%	73.2%	78.3%	1.77	3.154	16	4	1.48	0	0.1%	0.69	3	0	3	0
0208020102	41.5%	92.4%	86.0%	1.10	4.088	2	1	1.47	1	0.0%	1.00	2	0	1	1
0208020103	26.4%	92.4%	87.2%	1.16	3.236	1	1	1.73	3	0.0%	1.00	7	2	1	4
0208020104	41.2%	86.3%	73.7%	1.32	3.360	13	5	1.48	0	0.0%	0.98	5	0	3	2
0208020105	38.3%	89.0%	82.6%	1.90	2.573	34	4	1.52	7	7.5%	1.00	8	0	1	7
0208020106	58.6%	91.0%	85.5%	1.32	2.480	3	3	1.59	0	0.0%	1.00	11	1	4	6
0208020107	5.0%	74.0%	66.7%	1.81	3.057	7	0	1.76	2	4.0%	0.59	7	0	0	7
0208020108	0.8%	91.7%	87.5%	1.16	2.624	5	4	1.69	0	0.0%	1.00	11	0	1	10
0208020201	58.8%	91.5%	87.5%	1.32	3.094	2	2	1.65	0	0.0%	1.00	7	1	1	5
0208020202	29.5%	85.8%	80.6%	2.03	4.672	0	1	1.85	0	1.2%	1.00	1	0	1	0
0208020203	9.0%	58.6%	54.0%	2.32	3.971	26	2	1.49	4	10.7%	0.30	4	1	0	3
0208020204	33.9%	71.1%	72.2%	1.60	3.039	0	3	1.30	0	0.0%	0.41	2	1	1	0
0208020301	16.2%	79.7%	79.2%	2.98	2.775	130	30	1.73	15	7.4%	0.16	6	0	1	5
0208020303	16.9%	81.3%	76.7%	1.86	2.995	5	4	1.52	0	0.0%	0.13	3	0	2	1
0208020304	8.4%	78.7%	76.3%	2.08	2.442	5	8	1.59	5	1.0%	0.22	2	0	2	0
0208020306	0.9%	87.7%	80.3%	1.71	4.452	4	9	1.63	2	1.2%	0.21	2	0	1	1

Table G5-3. Species occurrence by watershed and land ownership (NF = on National Forest only, NFP = on both National Forest and private land, P = on private land only)

SCIENTIFIC NAME	COMMON NAME	0207000102	0207000106	0207000301	0207000501	0207000502	0207000504	0207000505	0207000506	207000601	0207000602	0207000603	0207000604	0208020102	0208020103	0208020104	0208020105	0208020106	0208020107	0208020108	0208020201	0208020202	0208020203	0208020204	0208020301	0208020303	0208020304	0208020306
Pleurobema collina	James spinymussel														P			P	P	P	P				P			
Helenium virginicum	Virginia sneezeweed						NF P	P																				
Helonias bullata	swamp pink						NF P																	NF				
Scirpus ancistrochaetus	northeastern bulrush					NF	P	P							NF	P												
Notropis semperasper	Roughhead shiner													P	P	NF P	P	NF P	P	P	P							
Noturus gilberti	Orangefin madtom																	P		P								
Hydraena maureenae	Maureen's shale stream beetle									NF							P	NF P		P	NF							
Cicindela ancocisconensis	a tiger beetle																P	NF P										
Sorex palustris punctulatus	southern water shrew	NF P														NF P												
Alasmidonta varicosa	Brook floater								P		P	P																
Elliptio lanceolata	Yellow lance																P	P	P	P			P		P			
Fusconaia masoni	Atlantic pigtoe																		P	P	P							
Lasmigona subviridis	Green floater											P													P	P		
Villosa constricta	Notched Rainbow														P			P	P	P			P		P			
Ambystoma tigrinum	eastern tiger salamander						NF P																					
Cambarus monongalensis	A Crayfish	NF																										
Anguilla rostrata	American eel				P	P	P	P	NF P		P	P	NF P							P					P	NF P	NF P	P
Salvelinus fontinalus	Brook trout	NF P	NF P	NF P		NF P	NF P	NF P	NF P	NF P	NF	NF P	NF P	NF P	NF P	NF P	NF P	NF P	P	NF P	NF P	NF P	NF	NF P	NF P	NF P	NF P	NF P
Aeshna canadensis	Canada darner	NF																										
Cottus cf. cognatus	Checkered sculpin			P																								
Aeshna tuberculifera	black-tipped darner	NF				NF	NF	NF							NF		P		P									
Aeshna verticalis	green-striped darner	NF																										
Anax longipes	comet darner						NF																					
Calopteryx amata	Superb jewelwing	NF																										
Calopteryx angustipennis	Appalachian jewelwing											NF						NF		P			P					

SCIENTIFIC NAME	COMMON NAME	0207000102	0207000106	0207000301	0207000501	0207000502	0207000504	0207000505	0207000506	207000601	0207000602	0207000603	0207000604	0208020102	0208020103	0208020104	0208020105	0208020106	0208020107	0208020108	0208020201	0208020202	0208020203	0208020204	0208020301	0208020303	0208020304	0208020306
Celithemis martha	Martha's penant						NF																					
Cordulegaster diastatops	delta-spotted spiketail	NF																										
Enallagma annexum (AKA cyathigerum)	northern bluet	NF																										
Epitheca canis	beaverpond baskettail	NF																										
Gomphus adelphus	mustached clubtail																	P			P							
Gomphus quadricolor	rapids clubtail																	P		P	P							
Ladona julia (AKA Libellula julia)	chalk-fronted corporal skimmer	NF																										
Lanthus parvulus	double-striped clubtail	NF P																										
Lestes disjunctus	northern spreadwing	NF														P	P											
Leucorrhinia hudsonica	Hudsonian whiteface	NF																										
Nehalennia irene	sedge sprite	NF																										
Neurocordulia yamaskanensis	stygian shadowdrago n											P					P											
Rhionaeschna mutata (AKA Aeshna mutata)	spatterdock darner	NF													P													
Somatochlora elongata	Ski-tipped emerald	NF																										
Sympetrum obtrusum	white-faced meadowhawk	NF																										
Isonychia hoffmani	Hoffman's Isonychia mayfly	NF																										
Nemotaulius hostilis	a limnephilid caddisfly	NF																										
Clemmys guttata	spotted turtle						NF																					
Glyptemys insculpta	wood turtle		P	NF P						NF P	P	NF P	NF P															

APPENDIX G6. AQUATIC SPECIES DROPPED FROM FURTHER CONSIDERATION

Species Name	Common Name	Taxa	Forest	NatureServe Global Rank	Virginia DNH Rank	West Virginia NHP Rank	Va State Con Concern Plan (WAP)	West Va State Con Concern Plan (WAP)	Hunted or Public Interest (Y or N)	Known occurrences on Forest?	Final Plan Species Categories	Rationale
Ixobrychus exilis exilis	least bittern	Bird	?	G5	S2B/S3N	S1B	Y		N	?	DROP	not known from FS
Rallus elegans	King rail	Bird	GWJ	G4	S2B/S3N	S1B	Y	Y	N	?	DROP	not known from FS
Cottus cognatus	slimy sculpin	Fish	GW	G5	S2	S1	Y	Y	N	N	DROP	LR, Not on FS. In Virginia known from cold, alkaline spring-fed brooks with strong flows. These are found mainly in valley bottoms. (from Jenkins' Fishes of Virginia). South Branch Potomac, South Fork Shenandoah.
Cottus girardi	Potomac sculpin	Fish	GW	G4	S3	S3	N	Y	N	Y	DROP	LR, Not S1 or S2, or VASOC
Margariscus margarita	pearl dace	Fish	GW	G5	S3S4	S3S4	Y	Y	N	N	DROP	LR, not on FS, not S1 or S2
Percina rex	Roanoke logperch	Fish	J	G1G2	S1S2		Y	N	N	N	DROP	NOT ON THE GWNF (only on the Jeff)!
Hansonoperla appalachia	Appalachian stonefly	Insect	GWJ	G3	S1S3	S2	Y	Y	N	N	DROP	LR not known from FS, not a lot of info
Isonychia tusculanensis	a mayfly	Insect	J	G4	S2		Y	N	N	N	DROP	Not on GW
Leuctra mitchellensis	Mitchell needlefly	Insect	?	G3	S1S2		Y	N	N	N	DROP	LR not known from FS, not a lot of info
Leuctra monticola	montane needlefly	Insect	J	G1Q	S1		Y	N	N	N	DROP	Not on GW
Megaleuctra flinti	Shenandoah needlefly	Insect	GW	G2	S2	S1	Y	Y	N	N	DROP	LR not known from FS, not a lot of info
Paragnetina ishusa	widecollar stonefly	Insect	GW	G3G4	S1S3		Y	N	N	N	DROP	LR not known from FS, not a lot of info
Paraleptophlebia jeanae	a mayfly	Insect	?	G3G4	S1S3		Y	N	N	N	DROP	LR not known from FS, not a lot of info
Perlesta frisoni	Blue Ridge stonefly	Insect	GWJ	G3G4	S1S2		Y	N	N	N	DROP	LR not known from FS, not a lot of info
Alasmidonta undulata	triangle floater	Mollusk	GW	G4	S3S4	S1	Y	Y	N	N	DROP	LR, not on FS

Species Name	Common Name	Taxa	Forest	NatureServe Global Rank	Virginia DNH Rank	West Virginia NHP Rank	Va State Con Concern Plan (WAP)	West Va State Con Concern Plan (WAP)	Hunted or Public Interest (Y or N)	Known occurrences on Forest?	Final Plan Species Categories	Rationale
Lampsilis cariosa	yellow lampmussel	Mollusk	GW	G3	S2	S1	Y	Y	N	N	DROP	LR, not on FS
Arigomphus furcifer	lilypad clubtail	Odonata	GW	G5	SH		Y	N	N	N	DROP	LR, possibly extirpated
Gomphus borealis	beaverpond clubtail	Odonata	GW	G4	SH		Y	N	N	N	DROP	LR, possibly extirpated
Gomphus descriptus	harpoon clubtail	Odonata	GW	G4	S1	S3	Y	Y	N	N	DROP	LR, not on FS
Leucorrhinia frigida	frosted whiteface	Odonata	GW	G5	SH		Y	N	N	N	DROP	LR, possibly extirpated
Somatochlora williamsoni	Williamson's emerald	Odonata	GW	G5	SH		Y	N	N	N	DROP	LR, possibly extirpated
Gomphus viridifrons	green-faced clubtail	Odonata	GW	G3	S2	S3	Y	Y	N	N	DROP	Dropped on 2/3/2009 as per 12/2/2008 Roble comments that it is not on the GWNF
Cordulia shurtleffi	American emerald	Odonata	GW	G5	S3	S3	N	N	N	Y	DROP	Dropped on 2/3/2009 as per 12/2/2008 Roble comments that it is S3 and should be deleted from LR list
Enallagma hageni	Hagen's bluet	Odonata	GW	G5	S3	S3S4	N	N	N	Y	DROP	Dropped on 2/3/2009 as per 12/2/2008 Roble comments that it is S3 and should be deleted from LR list
Leucorrhinia intacta	dot-tailed whiteface	Odonata	GW	G5	S3	S3	N	N	N	Y	DROP	Dropped on 2/3/2009 as per 12/2/2008 Roble comments that it is S3 and should be deleted from LR list
Nehalennia integricollis	southern sprite	Odonata	GW	G5	S3	-	N	N	N	Y	DROP	Dropped on 2/3/2009 as per 12/2/2008 Roble comments that it is S3 and should be deleted from LR list
Tramea onusta	red-mantled glider	Odonata	GW	G5	S1	-	Y	N	N	Y	DROP	Dropped on 2/3/2009 as per 12/2/2008 Roble comment that this spp. Is probably just a casual visitor to VA, and should be deleted from list.

APPENDIX H – TERRESTRIAL AND AQUATIC SPECIES VIABILITY TABLES

Table H-1. Terrestrial Species Priority and Species Groups

Element Name	Common Name	G Rank	Unit Rank	Species Group 1	Species Group 2	Species Group 3	Species Group 4	Species Group 5	Species Group 6
Apochthonius holsingeri	A cave pseudoscorpion	G1	U1	Caves					
Boltonia montana	Dolls'-daisy	G1G2	U1	Riparian	Special Biologic Area				
Corallorhiza bentleyi	Bentley's coalroot	G1G2	U1	Occurrence Protection					
Helicodiscus diadema	Shaggy coil	G1	U1	Calciphiles	Occurrence Protection				
Kleptochthonius anophthalmus	A cave pseudoscorpion	G1	U1	Caves					
Nampabius turbator	Cave centipede	G1	U1	Calciphiles	Caves				
Nannaria shenandoah	Shenandoah Mountain xystodesmid	G1	U1	Occurrence Protection					
Pygmarrhopalites sacer	Cave springtail	G1	U1	Calciphiles	Caves				
Pygmarrhopalites caedus	A cave springtail	G1	U1	Caves	Occurrence Protection				
Pyrgus wyandot	Appalachian grizzled skipper	G1	U1	Fire Dependent/ Enhanced	Lepidopterans	Open Woodlands	Sensitive to Over-Collection	Shale barrens	Special Biologic Area
Iliamna remota	Kankakee globe-mallow	G1Q	UP	Riparian					
Leuctra monticola	montane needlefly	G1	UP	Riparian					
Pseudanophthalmus avernus	Avernus cave beetle	G1	UP	Calciphiles	Caves				
Pseudanophthalmus intersectus	Crossroads cave beetle	G1	UP	Calciphiles	Caves				
Pseudanophthalmus nelsoni	Nelson's cave beetle	G1	UP	Calciphiles	Caves				

Element Name	Common Name	G Rank	Unit Rank	Species Group 1	Species Group 2	Species Group 3	Species Group 4	Species Group 5	Species Group 6
Pseudanophthalmus petrunkevitchi	Petrunkevitch's cave beetle	G1	UP	Calciphiles	Caves				
Pseudotremia princeps	South Branch Valley cave millipede	G1	UP	Calciphiles	Caves				
Stygobromus hoffmani	Alleghany County cave amphipod	G1	UP	Calciphiles	Caves				
Buckleya distichophylla	Piratebush	G3	U1	Fire Dependent/ Enhanced	Occurrence Protection				
Carex roanensis	Roan Mountain sedge	G2G3	U1	Occurrence Protection	Special Biologic Area				
Echinacea laevigata	smooth coneflower	G2G3	U1	Calciphiles	Fire Dependent/ Enhanced	Open Woodlands	Special Biologic Area		
Glaucomys sabrinus fuscus	Virginia northern flying squirrel	G2	U1	Area Sensitive Mature Forest	High Elevation Forests	Riparian	Special Biologic Area		
Glyphyalinia raderi	Maryland glyph	G2	U1	Calciphiles	Occurrence Protection				
Helicodiscus triodus	Talus coil	G2	U1	Calciphiles	Occurrence Protection				
Myotis sodalis	Indiana bat	G2	U1	Area Sensitive Mature Forest	Caves	Cavity, Den, Snags	Occurrence Protection	Open Woodlands	Riparian
Plethodon sherando	Big levels salamander	G2	U1	Open Woodlands	Special Biologic Area				
Potamogeton tennesseensis	Tennessee pondweed	G2	U1	Riparian					
Pycnanthemum torreyi	Torrey's mountain-mint	G2	U1	Calciphiles	Mafic rocks	Open Woodlands			
Pygmarrhopalites carolynae	Cave springtail	G2	U1	Calciphiles	Caves				
Stygobromus mundus	Bath County cave amphipod	G2	U1	Calciphiles	Caves				
Trillium pusillum var. virginianum	mountain least trillium	GG3T2	U1	High Elevation Forests	Special Biologic Area				
Arabis serotina	shale barren rockcress	GG3	U2	Fire Dependent/ Enhanced	Shale barrens	Special Biologic Area			
Clematis viticaulis	Millboro leatherflower	G2	U2	Shale barrens	Special Biologic Area				

Element Name	Common Name	G Rank	Unit Rank	Species Group 1	Species Group 2	Species Group 3	Species Group 4	Species Group 5	Species Group 6
Heuchera alba	white alumroot	G2Q	U2	High Elevation Forests	Occurrence Protection	Special Biologic Area			
Hydraena maureenae	Maureen's shale stream beetle	G2	U2	Riparian					
Phlox buckleyi	sword-leaved phlox	G2	U2	Fire Dependent/ Enhanced	Occurrence Protection	Ruderal	Special Biologic Area		
Plethodon virginia	Shenandoah Mt. salamander	G2	U2	Area Sensitive Mature Forest	High Elevation Forests	Late Successional Hardwood	Special Biologic Area	Cliff, Talus, outcrops	
Stygobromus sp. 7	Sherando spinosid amphipod	G2	U2	Calciphiles	Caves				
Stygobromus sp. nov.	Massanutten Spring Amphipod	G2	U2	Calciphiles	Caves				
Thryomanes bewickii altus	Appalachian Bewick's wren	G2	UH	High Elevation Openings	Cavity, Den, Snags	Grasslands	Shrublands		
Megaleuctra flinti	Shenandoah needlefly	G2	UP	Riparian					
Paxistima canbyi	Canby's mountain lover	G2	UP	Calciphiles	Cliff, Talus, outcrops				
Stygobromus morrisoni	Morrison's cave amphipod	G2	UP	Calciphiles	Caves				
Erora laeta	Early hairstreak	GU	U1	Lepidopterans	Occurrence Protection				
Callophrys irus	Frosted elfin	G3	U1	Fire Dependent/ Enhanced	Lepidopterans	Occurrence Protection	Open Woodlands		
Cicindela ancocisconensis	a tiger beetle	G3	U1	Riparian					
Cicindela patruela	Barrens tiger beetle	G3	U1	Ruderal	Sandstone glades and barrens	Special Biologic Area			
Clematis coactilis	Virginia white-haired leatherflower	G3	U1	Shale barrens					
Hypericum mitchellianum	Blue Ridge St. John's-wort	G3	U1	High Elevation Forests	High Elevation Openings	Occurrence Protection	Special Biologic Area		
Microtus chrotorrhinus carolinensis	Southern rock vole	G3	U1	High Elevation Forests	Riparian				
Myotis leibii	eastern small-footed bat	G3	U1	Caves	Cliff, Talus, outcrops	Occurrence Protection			

Element Name	Common Name	G Rank	Unit Rank	Species Group 1	Species Group 2	Species Group 3	Species Group 4	Species Group 5	Species Group 6
Poa paludigena	bog bluegrass	G3	U1	Riparian					
Scirpus ancistrochaetus	northeastern bulrush	G3	U1	Riparian	Special Biologic Area				
Sorex palustris punctulatus	southern water shrew	G3	U1	High Elevation Forests	Riparian	Special Biologic Area			
Stygobromus gracilipes	Shenandoah Valley cave amphipod	G3	U1	Calciphiles	Caves				
Vitis rupestris	sand grape	G3	U1	Special Biologic Area	Riparian				
Arabis patens	Spreading rockcress	G3	U2	Shale barrens					
Carex polymorpha	variable sedge	G3	U2	Fire Dependent/ Enhanced	Occurrence Protection	Special Biologic Area			
Gaylussacia brachycera	box huckleberry	G3	U2	Fire Dependent/ Enhanced	Occurrence Protection	Special Biologic Area			
Gymnocarpium appalachianum	Appalachian oak fern	G3	U2	High Elevation Forests	Occurrence Protection	Special Biologic Area			
Helenium virginicum	Virginia sneezeweed	G3	U2	Riparian	Special Biologic Area				
Helonias bullata	swamp-pink	G3	U2	Special Biologic Area	Riparian				
Plethodon punctatus	Cow Knob salamander	G3	U2	Area Sensitive Mature Forest	High Elevation Forests	Late Successional Hardwood	Special Biologic Area	Cliff, Talus, outcrops	
Speyeria diana	Diana fritillary	G3	U2	Lepidopterans	Open Woodlands	Sensitive to Over-Collection			
Triphora trianthophora	nodding pogonia	G3	U2	Special Biologic Area	Occurrence Protection				
Zygonopus weyeriensis	Grand Caverns blind cave millipede	G3	U2	Calciphiles	Caves				
Juglans cinerea	butternut	GG4	U3	Occurrence Protection					
Liatris helleri	shale -barren blazing star	G3	U3	Shale barrens					
Miktoniscus racovitzai	Racovitza's terrestrial cave isopod	G3	U3	Caves					
Monotropsis odorata	sweet pinesap	G3	U3	Occurrence Protection	Special Biologic Area				
Neotoma magister	Alleghany woodrat	G3	U3	Caves	Cliff, Talus, outcrops	Late Successional Hardwood			

Element Name	Common Name	G Rank	Unit Rank	Species Group 1	Species Group 2	Species Group 3	Species Group 4	Species Group 5	Species Group 6
Oenothera argillicola	Shale-barren evening primrose	G3	U3	Shale barrens					
Panax quinquefolius	American Ginseng	G3G4	U3	Cove forests	Sensitive to Over-Collection				
Ruellia purshiana	Pursh's wild petunia	G3	U3	Alkaline glades and barrens	Calciphiles	Fire Dependent/ Enhanced	Mafic rocks		
Scutellaria saxatilis	Rock skullcap	G3	U3	Cliff, Talus, outcrops	Open Woodlands				
Taenidia montana	Virginia mountain pimpernel	G3	U3	Shale barrens					
Trifolium virginicum	Kate's mountain clover	G3	U3	Special Biologic Area	Shale barrens				
Peltigera hydrothyria	Waterfan	G3	U4	Riparian					
Erynnis martialis	Mottled duskywing	G3	UH	Area Sensitive Shrubland and Open Woodlands	Fire Dependent/ Enhanced	Lepidopterans	Occurrence Protection	Special Biologic Area	
Speyeria idalia	Regal fritillary	G3	UH	Area Sensitive Grasslands.	Lepidopterans	Sensitive to Over-Collection			
Virginia valeriae pulchra	mountain earth snake	G3	UH	Grasslands	Open Woodlands	Shrublands			
Carex schweinitzii	Schweinitz's sedge	G3G4	UP	Riparian					
Catocala herodias gerhardi	Herodias underwing	G3	UP	Lepidopterans	Occurrence Protection	Open Woodlands			
Catocala marmorata	Marbled underwing	G3	UP	Lepidopterans	Occurrence Protection	Riparian			
Delphinium exaltatum	tall larkspur	G3	UP	Calciphiles	Fire Dependent/ Enhanced	Open Woodlands			
Euphorbia purpurea	glade spurge	G3	UP	Calciphiles	Riparian				
Hansonoperla appalachia	Appalachian stonefly	G3	UP	Riparian					
Leuctra mitchellensis	Mitchell needlefly	G3	UP	Riparian					

Element Name	Common Name	G Rank	Unit Rank	Species Group 1	Species Group 2	Species Group 3	Species Group 4	Species Group 5	Species Group 6
Paragnetina ishusa	widecollar stonefly	G3	UP	Riparian					
Paraleptophlebia jeanae	a mayfly	G3	UP	Riparian					
Parnassia grandifolia	Large-leaved grass-of-parnassus	G3	UP	Riparian					
Perlesta frisoni	Blue Ridge stonefly	G3	UP	Riparian					
Phlox amplifolia	Broadleaf phlox	G3G5	UP	Calciphiles	Occurrence Protection				
Semionellus placidus	Millipede	G3	UP	Late Successional Hardwood	Occurrence Protection				
Sida hermaphrodita	Virginia mallow	G3	UP	Riparian					
Triodopsis picea	Spruce Knob threetooth	G3	UP	Occurrence Protection					
Zygonopus whitei	Luray Caverns blind cave millipede	G3	UP	Calciphiles	Caves				
Adlumia fungosa	Climbing fumatory	G4	U1	Occurrence Protection					
Arnoglossom muehlenbergii	great Indian-plantain	G4	U1	Fire Dependent/ Enhanced	Grasslands	Occurrence Protection	Riparian	Ruderal	
Carex barrattii	Barratt's sedge	G4	U1	Riparian	Special Biologic Area				
Corynorhinus townsendii virginianus	Virginia big-eared bat	G4	U1	Area Sensitive Mature Forest	Caves	Occurrence Protection			
Cuscuta rostrata	beaked dodder	G4	U1	High Elevation Openings	Occurrence Protection	Special Biologic Area			
Cypripedium reginae	showy lady's-slipper	G4	U1	Occurrence Protection	Riparian	Sensitive to Over-Collection	Special Biologic Area		
Eleocharis compressa	flat-stemmed spikerush	G4	U1	Riparian					
Eleocharis melanocarpa	black-fruited spikerush	G4	U1	Riparian	Special Biologic Area				
Eleocharis robbinsii	Robbins spikerush	G4G5	U1	Riparian	Special Biologic Area				
Euchloe olympia	Olympia marble	G4	U1	Lepidopterans	Open Woodlands	Shale barrens			

Element Name	Common Name	G Rank	Unit Rank	Species Group 1	Species Group 2	Species Group 3	Species Group 4	Species Group 5	Species Group 6
Lanius ludovicianus	loggerhead shrike	G4	U1	Area Sensitive Grasslands.	Grasslands	Shrublands			
Paronychia argyrocoma	Silver Nail-wort	G4	U1	Shale barrens					
Potamogeton oakesianus	Oakes pondweed	G4	U1	Riparian	Special Biologic Area				
Schoenoplectus subterminalis	water bulrush	G4G5	U1	Riparian	Special Biologic Area				
Scutellaria parvula var. parvula	small skullcap	G4T4?	U1	Calciphiles	Cliff, Talus, outcrops	Open Woodlands			
Solidago randii = S. simplex var. randii	Rand's goldenrod	G4	U1	Special Biologic Area	Mafic rocks				
Solidago rupestris	riverbank goldenrod	G4?	U1	Special Biologic Area	Riparian				
Solidago uliginosa	bog goldenrod	G4G5	U1	Special Biologic Area	Riparian				
Spiranthes ochroleuca	yellow nodding ladies'-tresses	G4	U1	Riparian	Open Woodlands	Special Biologic Area			
Vaccinium macrocarpon	large cranberry	G4	U1	Special Biologic Area	Riparian				
Autochton cellus	Golden-banded skipper	G4	U2	Lepidopterans	Riparian				
Clematis albicoma	White-haired Leatherflower	G4	U2	Shale barrens					
Polygonia progne	Gray comma	G4	U2	Grasslands & Shrublands	Lepidopterans	Riparian	Open Woodlands	Ruderal	Special Biologic Area
Prunus alleghaniensis	Alleghany sloe	G4	U2	Fire Dependent/ Enhanced	Open Woodlands	Shale barrens			
Satyrium favonius ontario	Northern Hairstreak	G4	U2	Lepidopterans	Occurrence Protection	Open Woodlands			
Sylvilagus obscurus	Appalachian Cottontail	G4	U2	High Elevation Forests	High Elevation Openings	Riparian			

Element Name	Common Name	G Rank	Unit Rank	Species Group 1	Species Group 2	Species Group 3	Species Group 4	Species Group 5	Species Group 6
Vermivora chrysoptera	golden winged warbler	G4	U2	Area Sensitive Grassland, Shrubland, Open Woodlands	High Elevation Openings	Fire Dependent/ Enhanced	Grasslands & Shrublands	Riparian	Open Woodlands
Crotalus horridus	Timber rattlesnake	G4	U3	Cliff, Talus, outcrops	Sensitive to Over-Collection				
Dendroica cerulea	cerulean warbler	G4	U3	Area Sensitive Mature Forest	Late Successional Hardwood	Riparian			
Eriogonum allenii	Yellow Buckwheat	G4	U3	Shale barrens					
Glyptemys insculpta	wood turtle	G3	U3	Late Successional Hardwood	Riparian	Open Woodlands	Sensitive to Over-Collection	Shrublands	Grasslands
Solidago arguta var. harrisii	Shale Barren Goldenrod	G4T4	U3	Shale barrens					
Contopus borealis	olive-sided flycatcher	G4	UH	High Elevation Forests	High Elevation Openings	Riparian	Special Biologic Area	Cavity, Den, Snags	
Falco peregrinus	peregrine falcon	G4	UH	Cliff, Talus, outcrops	Occurrence Protection	Open Woodlands			
Phyciodes batesii	Tawny crescent	G4	UH	Lepidopterans	Occurrence Protection				
Pituophis melanoleucus	northern pinesnake	G4	UH	Fire Dependent/ Enhanced	Occurrence Protection	Open Woodlands			
Houstonia canadensis	Canada bluets	G4G5	UNP	Alkaline glades and barrens	Calciphiles	Special Biologic Area			
Ammodramus henslowii	Henslow's sparrow	G4	UP	Area Sensitive Grasslands.	Occurrence Protection				
Cyperus dentatus	toothed flatsedge	G4	UP	Riparian					
Helianthemum propinquum	low frostweed	G4	UP	Open Woodlands					
Huperzia appalachiana	Appalachian fir clubmoss	G5	UP	High Elevation Forests	Riparian				
Isonychia tusculanensis	a mayfly	G4	UP	Riparian					
Linum lewisii	prairie flax	G4	UP	Calciphiles	Cliff, Talus, outcrops	Open Woodlands			
Onosmodium virginianum	Virginia false-gromwell	G4	UP	Fire Dependent/ Enhanced	Open Woodlands	Calciphiles			

Element Name	Common Name	G Rank	Unit Rank	Species Group 1	Species Group 2	Species Group 3	Species Group 4	Species Group 5	Species Group 6
Paronychia virginica	yellow nailwort	G4	UP	Calciphiles	Cliff, Talus, outcrops	Shale barrens			
Prunus nigra	Canada plum	G4G5	UP	Ruderal	Shrublands				
Zigadenus elegans ssp. glaucus = Anticlea glauca	white camas	G4	UP	Cliff, Talus, outcrops	Open Woodlands	Calciphiles			
Aegolius acadicus	northern saw-whet owl	G5	U1	Area Sensitive Mature Forest	High Elevation Forests	Cavity, Den, Snags	Riparian	Special Biologic Area	
Alnus incana ssp. rugosa	speckled alder	G5T5	U1	Riparian					
Ambystoma tigrinum	Eastern tiger salamander	G5	U1	Late Successional Hardwood	Riparian	Special Biologic Area			
Anaphalis margaritacea	pearly everlasting	G5	U1	Fire Dependent/ Enhanced	Grasslands	Shrublands	Special Biologic Area		
Bromus kalmii	wild chess	G5	U1	Fire Dependent/ Enhanced	Shale barrens	Special Biologic Area			
Campanula rotundifolia	American harebell	G5	U1	Calciphiles	Cliff, Talus, outcrops	Special Biologic Area			
Caprimulgus carolinensis	chuck-will's widow	G5	U1	Area Sensitive Grassland, Shrubland, Open Woodlands	Fire Dependent/ Enhanced	Open Woodlands	Regenerating Forests		
Carex aquatilis	water sedge	G5	U1	Riparian	Special Biologic Area				
Carex arctata	black sedge	G5	U1	Riparian	Special Biologic Area				
Carex buxbaumii	Buxbaum's sedge	G5	U1	Riparian	Special Biologic Area				
Carex lasiocarpa var. americana	slender sedge	G5T5	U1	Riparian	Special Biologic Area				
Carex vesicaria	inflated sedge	G5	U1	Riparian	Special Biologic Area				
Carpodacus purpureus	purple finch	G5	U1	High Elevation Openings	High Elevation Forests	Special Biologic Area			
Catharus guttatus	hermit thrush	G5	U1	Area Sensitive Mature Forest	High Elevation Forests	High Elevation Openings	Special Biologic Area		
Cheilanthes eatonii	chestnut lipfern	G5?	U1	Cliff, Talus, outcrops	Shale barrens	Special Biologic Area			

Element Name	Common Name	G Rank	Unit Rank	Species Group 1	Species Group 2	Species Group 3	Species Group 4	Species Group 5	Species Group 6
Cirsium altissimum	tall thistle	G5	U1	Ruderal	Special Biologic Area				
Clemmys guttata	spotted turtle	G5	U1	Riparian	Special Biologic Area				
Colias interior	Pink-edged sulphur	G5	U1	Lepidopterans	Riparian	Special Biologic Area			
Colinus virginianus	northern bobwhite	G5	U1	Area Sensitive Grassland, Shrubland, Open Woodlands	Fire Dependent/ Enhanced	Grasslands	Open Woodlands	Shrublands	
Cornus canadensis	bunchberry	G5	U1	High Elevation Forests	Occurrence Protection	Special Biologic Area			
Cornus rugosa	roundleaf dogwood	G5	U1	Occurrence Protection	Special Biologic Area				
Crataegus pruinosa	prunose hawthorn	G5	U1	Fire Dependent/ Enhanced	Occurrence Protection	Special Biologic Area			
Cuscuta coryli	hazel dodder	G5?	U1	Cliff, Talus, outcrops	Occurrence Protection				
Cystopteris fragilis	fragile fern	G5	U1	Cliff, Talus, outcrops	Special Biologic Area				
Dendroica fusca	blackburnian warbler	G5	U1	Area Sensitive Mature Forest	High Elevation Forests	Special Biologic Area			
Dendroica magnolia	magnolia warbler	G5	U1	High Elevation Forests	Regenerating Forests	Special Biologic Area	Riparian		
Elymus trachycaulus	slender wheatgrass	G5	U1	Fire Dependent/ Enhanced	Shale barrens	Special Biologic Area			
Epilobium leptophyllum	linear-leaved willow-herb	G5	U1	Riparian	Special Biologic Area				
Equisetum sylvaticum	woodland horsetail	G5	U1	Special Biologic Area	Riparian				
Eriocaulon aquaticum	white buttons	G5	U1	Riparian	Special Biologic Area				
Erynnis persius	Persius duskywing	G5	U1	Grasslands	Lepidopterans	Riparian	Shrublands		
Erysimum capitatum	western wallflower	G5	U1	Open Woodlands	Shale barrens	Special Biologic Area			
Glyceria grandis	American manna-grass	G5	U1	Riparian	Special Biologic Area				
Gnaphalium uliginosum	low cudweed	G5	U1	High Elevation Openings	Riparian	Ruderal	Special Biologic Area		

Element Name	Common Name	G Rank	Unit Rank	Species Group 1	Species Group 2	Species Group 3	Species Group 4	Species Group 5	Species Group 6
Haliaeetus leucocephalus	bald eagle	G5	U1	Occurrence Protection	Riparian				
Helianthemum bicknellii	plains frostweed	G5	U1	Cliff, Talus, outcrops	Open Woodlands	Sandstone glades and barrens	Special Biologic Area		
Hypericum boreale	northern St. John's-wort	G5	U1	Riparian					
Incisalia polia	Hoary elfin	G5	U1	Grasslands	Lepidopterans	Sandstone glades and barrens	Shrublands		
Isoetes lacustris	lake quillwort	G5	U1	Riparian	Special Biologic Area				
Juncus brachycephalus	small-head rush	G5	U1	Special Biologic Area	Riparian				
Juncus brevicaudatus	narrow-panicled rush	G5	U1	Special Biologic Area	Riparian				
Juniperus communis var depressa	ground juniper	G5T5	U1	High Elevation Openings	Special Biologic Area	Calciphiles			
Lepus americanus	snowshoe hare	G5	U1	High Elevation Forests	High Elevation Openings	Regenerating Forests	Special Biologic Area		
Leucothoe fontanesiana	highland dog-hobble	G5	U1	Cove forests	Occurrence Protection	Special Biologic Area			
Liparis loeselii	Loesel's twayblade	G5	U1	Riparian	Special Biologic Area				
Lonicera canadensis	American fly-honeysuckle	G5	U1	High Elevation Forests	Riparian				
Loxia curvirostra	red crossbill	G5	U1	Area Sensitive Mature Forest	High Elevation Forests	Special Biologic Area			
Martes pennanti	fisher	G5	U1	Area Sensitive Mature Forest	High Elevation Forests	Special Biologic Area			
Melospiza georgiana	swamp sparrow	G5	U1	High Elevation Openings	Riparian				
Minuartia groenlandica	mountain sandwort	G5	U1	Cliff, Talus, outcrops	Sensitive to Recreation Traffic	Special Biologic Area			
Muhlenbergia glomerata	marsh muhly	G5	U1	Mafic rocks	Special Biologic Area	Riparian			
Oligoneuron rigidum	stiff goldenrod	G5	U1	Calciphiles	Open Woodlands	Special Biologic Area			

Element Name	Common Name	G Rank	Unit Rank	Species Group 1	Species Group 2	Species Group 3	Species Group 4	Species Group 5	Species Group 6
Oporornis philadelphia	mourning warbler	G5	U1	High Elevation Forests	High Elevation Openings	Regenerating Forests	Fire Dependent/ Enhanced		
Oryzopsis asperifolia	white-grained mtn-ricegrass	G5	U1	Open Woodlands	Shrublands	Special Biologic Area			
Osmundaastrum cinnamomeum var. glandulosum	glandular cinnamon fern	G5TNR	U1	Special Biologic Area	Riparian				
Panax trifolius	Dwarf ginseng	G5	U1	Cove forests	Sensitive to Over-Collection				
Panicum hemitomon	maidencane	G5?	U1	Riparian	Special Biologic Area				
Platanthera grandiflora	large purple fringed orchid	G5	U1	Riparian	Sensitive to Over-Collection	Special Biologic Area			
Platanthera peramoena	purple fringeless orchid	G5	U1	Riparian	Sensitive to Over-Collection				
Poa palustris	fowl bluegrass	G5	U1	Riparian	Special Biologic Area				
Potentilla arguta	tall cinquefoil	G5	U1	Mafic rocks	Special Biologic Area				
Pyrola elliptica	shinleaf	G5	U1	High Elevation Forests	Occurrence Protection	Special Biologic Area			
Regulus satrapa	golden-crowned kinglet	G5	U1	High Elevation Forests	Special Biologic Area				
Ribes americanum	wild black currant	G5	U1	Special Biologic Area	Riparian				
Rubus idaeus ssp. strigosus	American red raspberry	G5T5	U1	High Elevation Openings	Special Biologic Area				
Sabatia campanulata	slender marsh rose-pink	G5	U1	Special Biologic Area	Riparian				
Sagittaria calycina var calycina	long-lobed arrowhead	G5T5?	U1	Special Biologic Area	Riparian				
Schizachne purpurascens	purple oatgrass	G5	U1	High Elevation Forests	Special Biologic Area	Riparian			
Seiurus noveboracensis	northern waterthrush	G5	U1	Area Sensitive Mature Forest	High Elevation Forests	Special Biologic Area	Riparian		
Sibbaldiopsis tridentata	three-toothed cinquefoil	G5	U1	Cliff, Talus, outcrops	Sensitive to Recreation Traffic	Special Biologic Area			

Element Name	Common Name	G Rank	Unit Rank	Species Group 1	Species Group 2	Species Group 3	Species Group 4	Species Group 5	Species Group 6
Sitta canadensis	red-breasted nuthatch	G5	U1	Cavity, Den, Snags	High Elevation Forests	Special Biologic Area			
Speyeria atlantis	Atlantis fritillary	G5	U1	Lepidopterans	Special Biologic Area	Riparian			
Sphagnum russowii	Russow's peatmoss	G5	U1	Special Biologic Area	Riparian				
Symphoricarpos albus	snowberry	G5	U1	Calciphiles	Cliff, Talus, outcrops	Special Biologic Area			
Thuja occidentalis	northern white cedar	G5	U1	Cliff, Talus, outcrops	Special Biologic Area	Calciphiles			
Triantha racemosa	coastal false-asphodel	G5	U1	Riparian	Special Biologic Area				
Trichostema setaceum	narrow-leaved blue curls	G5	U1	Open Woodlands	Shale barrens	Special Biologic Area			
Troglodytes troglodytes	winter wren	G5	U1	High Elevation Forests	Special Biologic Area	Riparian	Cavity, Den, Snags		
Viola pedatifida	prairie violet	G5	U1	Special Biologic Area	Shale barrens				
Woodwardia virginica	Virginia chainfern	G5	U1	Special Biologic Area	Riparian				
Aralia hispida	Bristly Sarsaparilla	G5	U2	Cliff, Talus, outcrops	Fire Dependent/ Enhanced	Special Biologic Area			
Betula cordifolia	mountain paper birch	G5	U2	Cliff, Talus, outcrops	Fire Dependent/ Enhanced	Special Biologic Area			
Boloria selene	Silver-bordered fritillary	G5	U2	Lepidopterans	Riparian	Special Biologic Area			
Certhia americana	brown creeper	G5	U2	Area Sensitive Mature Forest	High Elevation Forests	Cavity, Den, Snags	Riparian	Special Biologic Area	
Coccyzus erythropthalmus	black-billed cuckoo	G5	U2	High Elevation Forests	High Elevation Openings	Riparian			
Empidonax alnorum	alder flycatcher	G5	U2	High Elevation Forests	Riparian	Special Biologic Area	Riparian		
Eumeces anthracinus	coal skink	G5	U2	Occurrence Protection	Open Woodlands	Ruderal	Shrublands		
Glyceria acutiflora	sharp-scaled manna-grass	G5	U2	Riparian					

Element Name	Common Name	G Rank	Unit Rank	Species Group 1	Species Group 2	Species Group 3	Species Group 4	Species Group 5	Species Group 6
Liochlorophis vernalis	Smooth green snake	G5	U2	High Elevation Openings	Open Woodlands	Grasslands	Fire Dependent/ Enhanced		
Mustela nivalis	least weasel	G5	U2	Grasslands	Shrublands				
Phyciodes cocyta	Northern crescent	G5	U2	Lepidopterans					
Poa saltuensis	drooping bluegrass	G5	U2	Mafic rocks	Open Woodlands	Special Biologic Area			
Saxifraga pensylvanica	swamp saxifrage	G5	U2	Riparian					
Scolopax minor	American woodcock	G5	U2	Grasslands	Riparian				
Sparganium chlorocarpum = S. emersum	narrow-leaf burreed	G5	U2	Special Biologic Area	Riparian				
Sphyrapicus varius	yellow-bellied sapsucker	G5	U2	High Elevation Forests	High Elevation Openings	Riparian	Cavity, Den, Snags		
Spilogale putorius	Spotted Skunk	G5	U2	Late Successional Hardwood	Shrublands	Cliff, Talus, outcrops			
Tyto alba	barn owl	G5	U2	Area Sensitive Grasslands.	Cavity, Den, Snags	Grasslands			
Caprimulgus vociferus	whip-poor-will	G5	U3	Area Sensitive Grassland, Shrubland, Open Woodlands	Fire Dependent/ Enhanced	Open Woodlands	Regenerating Forests		
Castor canadensis	Beaver	G5	U3	Riparian	Special Biologic Area				
Lontra canadensis	North American river otter	G5	U3	Riparian					
Aquila chrysaetos	golden eagle	G5	U4	Area Sensitive Mature Forest					
Dendroica discolor	prairie warbler	G5	U4	Area Sensitive Grassland, Shrubland, Open Woodlands	Fire Dependent/ Enhanced	Regenerating Forests			
Empidonax virescens	acadian flycatcher	G5	U4	Area Sensitive Mature Forest	Riparian				
Echinodorus tenellus	dwarf burhead	G5?	UH	Riparian	Special Biologic Area	Riparian			
Eurybia radula	rough-leaved aster	G5	UP	Riparian					

Element Name	Common Name	G Rank	Unit Rank	Species Group 1	Species Group 2	Species Group 3	Species Group 4	Species Group 5	Species Group 6
Astragalus distortus	bent milkvetch	G5	UP	Shale barrens					
Bartramia longicauda	upland sandpiper	G5	UP	Area Sensitive Grasslands.	Fire Dependent/ Enhanced	Occurrence Protection			
Bromus ciliatus	fringed brome grass	G5	UP	Riparian					
Calopogon tuberosus	Grass pink	G5	UP	Riparian					
Circus cyaneus	northern harrier	G5	UP	Area Sensitive Grasslands.	Occurrence Protection				
Clematis occidentalis	purple clematis	G5	UP	Mafic rocks					
Crataegus calpodendron	pear hawthorn	G5	UP	Occurrence Protection					
Desmodium canadense	showy tick-trefoil	G5	UP	Riparian					
Desmodium cuspidatum	toothed tick-trefoil	G5	UP	Calciphiles	Occurrence Protection	Ruderal	Special Biologic Area		
Desmodium sessilifolium	sessile-leaf tick-trefoil	G5	UP	Open Woodlands	Riparian				
Elymus canadensis	nodding wild rye	G5	UP	Riparian					
Epilobium ciliatum	Hair willow-herb	G5	UP	Riparian					
Eupatorium maculatum	spotted joe-pye weed	G5	UP	Riparian					
Geranium robertianum	herb-robert	G5	UP	Cliff, Talus, outcrops					
Goodyera repens	dwarf rattlesnake plantain	G5	UP	Occurrence Protection	Riparian				
Linum sulcatum	grooved yellow flax	G5	UP	Calciphiles	Cliff, Talus, outcrops	Open Woodlands			
Lycopodiella inundata	northern bog clubmoss	G5	UP	Riparian					
Lythrum alatum	winged loosestrife	G5	UP	Riparian					
Maianthemum stellatum	stary false Solomon's-seal	G5	UP	Riparian					
Melica nitens	Three-flowered melic grass	G5	UP	Calciphiles	Open Woodlands	Shale barrens			

Element Name	Common Name	G Rank	Unit Rank	Species Group 1	Species Group 2	Species Group 3	Species Group 4	Species Group 5	Species Group 6
Nemotaulius hostilis	a limnephilid caddisfly	G5	UP	Riparian					
Polanisia dodecandra	common clammy-weed	G5	UP	Riparian					
Pseudognaphalium macounii	Winged cudweed	G5	UP	Caves					
Rosa setigera	prairie rose	G5	UP	Calciphiles	Open Woodlands	Shale barrens			
Sagittaria rigida	sessile-fruited arrowhead	G5	UP	Riparian					
Scirpus torreyi	Torrey's bulrush	G5?	UP	Riparian					
Spartina pectinata	freshwater cordgrass	G5	UP	Riparian					
Spiranthes lucida	shining ladies'-tresses	G5	UP	Riparian					
Sporobolus neglectus	small dropseed	G5	UP	Cliff, Talus, outcrops	Shale barrens	Calciphiles			
Triadenum fraseri	Fraser's marsh St. John's-wort	G5	UP	Riparian	Special Biologic Area				
Verbena scabra	sandpaper vervain	G5	UP	Riparian					
Veronica scutellata	marsh speedwell	G5	UP	Riparian					
Viburnum lentago	nannyberry	G5	UP	Riparian					
Vicia americana	American purple vetch	G5	UP	Riparian	Ruderal				
Bonasa umbellus	ruffed grouse	G5	UNA	Fire Dependent/ Enhanced	Grasslands & Shrublands	Regenerating Forests & Hard and Soft Mast Dependent	Late Successional Hardwood	Riparian	Open Woodlands
Meleagris gallopavo	wild turkey	G5	UNA	Fire Dependent/ Enhanced	Grasslands	Hard and Soft Mast Dependent	Late Successional Hardwood	Open Woodlands	Shrublands
Odocoileus virginianus	white-tailed deer	G5	UNA	Fire Dependent/ Enhanced	Grasslands & Shrublands	Hard and Soft Mast Dependent	Late Successional Hardwood	Open Woodlands	Regenerating Forests
Sciurus carolinensis	gray squirrel	G5	UNA	Late Successional Hardwood	Hard and Soft Mast Dependent	Cavity, Den, Snags	Riparian		

Element Name	Common Name	G Rank	Unit Rank	Species Group 1	Species Group 2	Species Group 3	Species Group 4	Species Group 5	Species Group 6
Sciurus niger	Eastern fox squirrel	G5	UNA	Area Sensitive Grassland, Shrubland, Open Woodlands	Cavity, Den, Snags	Fire Dependent/ Enhanced	Hard and Soft Mast Dependent		
Ursus americanus	black bear	G5	UNA	Regenerating Forests & Hard and Soft Mast Dependent	Late Successional Hardwood	Area Sensitive Mature Forest	Grasslands & Shrublands	Cavity, Den, Snags	Open Woodlands

Shaded Cells are species groups affected by direction requiring additional protection
Unshaded cells are species groups affected be levels of habitat management activities
G-Rank is the Global Conservation Rank
G1 – Critically Imperiled
G2- Imperiled
G3- Vulnerable
G4- Apparently Secure
G5 – Secure

Unit Rank	Unit Rank Description
U1	Critically Imperiled—Critically imperiled on the unit because of extreme rarity (often 5 or fewer occurrences) or because of some factor(s) such as very steep declines making it especially vulnerable to extirpation from the unit.
U2	Imperiled—Imperiled on the unit because of rarity due to very restricted range, very few populations (often 20 or fewer), steep declines, or other factors making it very vulnerable to extirpation from the unit.
U3	Vulnerable—Vulnerable on the unit due to a restricted range, relatively few populations (often 80 or fewer), recent and widespread declines, or other factors making it vulnerable to extirpation on the unit.
U4	Apparently Secure—Uncommon but not rare; some cause for long-term concern due to declines or other factors.
U5	Secure—Common, widespread, and abundant on the unit.
UH	Possibly Extirpated (Historical)—Species or system occurred historically in unit, and there is some possibility that it may be rediscovered. Its presence may not have been verified in the past 20-40 years. A species or system could become UH without such
UP	Possibly Present--There are no known current or historical occurrences, but the unit is within the range of the species or system and there is some chance it may occur.
UNA	Not Applicable—A unit rank is not applicable because rarity or vulnerability is not the conservation issue for the species or system (e.g., cowbirds or invasive species).

Table H-2. Priority Species and Comparison of Alternative Effects on Habitat Management for the Species

Element Name	Common Name	G Rank	Unit Rank	Habitat Management Effects Compared to Current Condition: Alt A	Alt B	Alt C	Alt D	Alt E	Alt F	Alts G, H and I	Species Protection Plan Direction: Alts B - I
Apochthonius holsingeri	A cave pseudoscorpion	G1	U1								+
Boltonia montana	Dolls'-daisy	G1	U1								+
Corallorhiza bentleyi	Bentley's coalroot	G1	U1								+
Helicodiscus diadema	Shaggy coil	G1	U1								+
Kleptochthonius anophthalmus	A cave pseudoscorpion	G1	U1								+
Nampabius turbator	Cave centipede	G1	U1								+
Nannaria shenandoah	Shenandoah Mountain xystodesmid	G1	U1								+
Pygmarrhopalites sacer	Cave springtail	G1	U1								+
Pygmarrhopalites caedus	A cave springtail	G1	U1								+
Pyrgus wyandot	Appalachian grizzled skipper	G1	U1		++	-	+	++	++	++	+
Iliamna remota	Kankakee globe-mallow	G1	UP								+
Leuctra monticola	montane needlefly	G1	UP								+
Pseudanophthalmus avernus	Avernus cave beetle	G1	UP								+
Pseudanophthalmus intersectus	Crossroads cave beetle	G1	UP								+
Pseudanophthalmus nelsoni	Nelson's cave beetle	G1	UP								+
Pseudanophthalmus petrunkevitchi	Petrunkevitch's cave beetle	G1	UP								+
Pseudotremia princeps	South Branch Valley cave millipede	G1	UP								+
Stygobromus hoffmani	Alleghany County cave amphipod	G1	UP								+
Buckleya distichophylla	Piratebush	G2	U1		++	-	+	++	++	++	+
Carex roanensis	Roan Mountain sedge	G2	U1								+
Echinacea laevigata	smooth coneflower	G2	U1		++	-	+	++	++	++	+
Glaucomys sabrinus fuscus	Virginia northern flying squirrel	G2	U1		=	-	=	=	=	=	+
Glyphyalinia raderi	Maryland glyph	G2	U1								+
Helicodiscus triodus	Talus coil	G2	U1								+
Myotis sodalis	Indiana bat	G2	U1		+	-	+	+	+	+	+
Plethodon sherando	Big levels salamander	G2	U1		++	-	+	++	++	++	+
Potamogeton tennesseensis	Tennessee pondweed	G2	U1								+
Pycnanthemum torreyi	Torrey's mountain-mint	G2	U1		++	-	+	++	++	++	+
Pygmarrhopalites carolynae	Cave springtail	G2	U1								+
Stygobromus mundus	Bath County cave amphipod	G2	U1								+

Element Name	Common Name	G Rank	Unit Rank	Habitat Management Effects Compared to Current Condition: Alt A	Alt B	Alt C	Alt D	Alt E	Alt F	Alts G, H and I	Species Protection Plan Direction: Alts B - I
Trillium pusillum var. virginianum	mountain least trillium	G2	U1								+
Arabis serotina	shale barren rockcress	G2	U2		++	-	+	++	++	++	+
Clematis viticaulis	Millboro leatherflower	G2	U2								+
Heuchera alba	white alumroot	G2	U2								+
Hydraena maureenae	Maureen's shale stream beetle	G2	U2								+
Phlox buckleyi	sword-leaved phlox	G2	U2		++	-	+	++	++	++	+
Plethodon virginia	Shenandoah Mt. salamander	G2	U2		=	=	=	=	=	=	+
Stygobromus sp. 7	Sherando spinosid amphipod	G2	U2								+
Stygobromus sp. nov.	Massanutten Spring Amphipod	G2	U2								+
Thryomanes bewickii altus	Appalachian Bewick's wren	G2	UH		+	-	+	=	-	+	+
Megaleuctra flinti	Shenandoah needlefly	G2	UP								+
Paxistima canbyi	Canby's mountain lover	G2	UP								+
Stygobromus morrisoni	Morrison's cave amphipod	G2	UP								+
Erora laeta	Early hairstreak	GU	U1								+
Callophrys irus	Frosted elfin	G3	U1		++	-	+	++	++	++	+
Cicindela ancocisconensis	a tiger beetle	G3	U1								+
Cicindela patruela	Barrens tiger beetle	G3	U1								+
Clematis coactilis	Virginia white-haired leatherflower	G3	U1								+
Hypericum mitchellianum	Blue Ridge St. John's-wort	G3	U1		+	-	+	=	-	+	+
Microtus chrotorrhinus carolinensis	Southern rock vole	G3	U1								+
Myotis leibii	eastern small-footed bat	G3	U1								+
Poa paludigena	bog bluegrass	G3	U1								+
Scirpus ancistrochaetus	northeastern bulrush	G3	U1								+
Sorex palustris punctulatus	southern water shrew	G3	U1								+
Stygobromus gracilipes	Shenandoah Valley cave amphipod	G3	U1								+
Vitis rupestris	sand grape	G3	U1								+
Arabis patens	Spreading rockcress	G3	U2								+
Carex polymorpha	variable sedge	G3	U2		++	-	+	++	++	++	+
Gaylussacia brachycera	box huckleberry	G3	U2		++	-	+	++	++	++	+
Gymnocarpium appalachianum	Appalachian oak fern	G3	U2								+
Helenium virginicum	Virginia sneezeweed	G3	U2								+
Helonias bullata	swamp-pink	G3	U2								+

				Habitat Management Effects Compared to Current Condition							Species Protection Plan Direction
Element Name	Common Name	G Rank	Unit Rank	Alt A	Alt B	Alt C	Alt D	Alt E	Alt F	Alts G, H and I	Alts B - I
Plethodon punctatus	Cow Knob salamander	G3	U2		=	=	=	=	=	=	+
Speyeria diana	Diana fritillary	G3	U2		++	-	+	++	++	++	+
Triphora trianthophora	nodding pogonia	G3	U2								+
Zygonopus weyeriensis	Grand Caverns blind cave millipede	G3	U2								+
Juglans cinerea	butternut	G3	U3								+
Liatris helleri	shale -barren blazing star	G3	U3								+
Miktoniscus racovitzai	Racovitza's terrestrial cave isopod	G3	U3								+
Monotropsis odorata	sweet pinesap	G3	U3								+
Neotoma magister	Alleghany woodrat	G3	U3		-	+	-	-	-	-	+
Oenothera argillicola	Shale-barren evening primrose	G3	U3								+
Panax quinquefolius	Ginseng	G3	U3		+	-	+	=	+	+	+
Ruellia purshiana	Pursh's wild petunia	G3	U3		++	-	+	++	++	++	+
Scutellaria saxatilis	Rock skullcap	G3	U3		++	-	+	++	++	++	+
Taenidia montana	Virginia mountain pimpernel	G3	U3								+
Trifolium virginicum	Kate's mountain clover	G3	U3								+
Peltigera hydrothyria	Waterfan	G3	U4								+
Erynnis martialis	Mottled duskywing	G3	UH		++	-	+	++	++	++	+
Speyeria idalia	Regal fritillary	G3	UH		=	=	=	=	=	=	+
Virginia valeriae pulchra	mountain earth snake	G3	UH		++	-	+	++	++	++	
Carex schweinitzii	Schweinitz's sedge	G3	UP								+
Catocala herodias gerhardi	Herodias underwing	G3	UP		++	-	+	++	++	++	+
Catocala marmorata	Marbled underwing	G3	UP								+
Delphinium exaltatum	tall larkspur	G3	UP		++	-	+	++	++	++	+
Euphorbia purpurea	glade spurge	G3	UP								+
Hansonoperla appalachia	Appalachian stonefly	G3	UP								+
Leuctra mitchellensis	Mitchell needlefly	G3	UP								+
Paragnetina ishusa	widecollar stonefly	G3	UP								+
Paraleptophlebia jeanae	a mayfly	G3	UP								+
Parnassia grandifolia	Large-leaved grass-of-parnassus	G3	UP								+
Perlesta frisoni	Blue Ridge stonefly	G3	UP								+
Phlox amplifolia	Broadleaf phlox	G3	UP								+
Semionellus placidus	Millipede	G3	UP		-	+	-	-	-	-	+
Sida hermaphrodita	Virginia mallow	G3	UP								+
Triodopsis picea	Spruce Knob threetooth	G3	UP								+
Zygonopus whitei	Luray Caverns blind cave millipede	G3	UP								+
Adlumia fungosa	Climbing fumatory	G4	U1								+
Arnoglossom muehlenbergii	great Indian-plantain	G4	U1		++	-	+	++	++	++	+

Element Name	Common Name	G Rank	Unit Rank	Habitat Management Effects Compared to Current Condition							Species Protection Plan Direction
				Alt A	Alt B	Alt C	Alt D	Alt E	Alt F	Alts G, H and I	Alts B - I
Carex barrattii	Barratt's sedge	G4	U1								+
Corynorhinus townsendii virginianus	Virginia big-eared bat	G4	U1		=	=	=	=	=	=	+
Cuscuta rostrata	beaked dodder	G4	U1		+	-	+	=	-	+	+
Cypripedium reginae	showy lady's-slipper	G4	U1								+
Eleocharis compressa	flat-stemmed spikerush	G4	U1								+
Eleocharis melanocarpa	black-fruited spikerush	G4	U1								+
Eleocharis robbinsii	Robbins spikerush	G4	U1								+
Euchloe olympia	Olympia marble	G4	U1		++	-	+	++	++	++	+
Lanius ludovicianus	loggerhead shrike	G4	U1		+	-	+	+	+	+	
Paronychia argyrocoma	Silver Nail-wort	G4	U1								+
Potamogeton oakesianus	Oakes pondweed	G4	U1								+
Schoenoplectus subterminalis	water bulrush	G4	U1								+
Scutellaria parvula var. parvula	small skullcap	G4	U1		++	-	+	++	++	++	+
Solidago randii = S. simplex var. randii	Rand's goldenrod	G4	U1								+
Solidago rupestris	riverbank goldenrod	G4	U1								+
Solidago uliginosa	bog goldenrod	G4	U1								+
Spiranthes ochroleuca	yellow nodding ladies'-tresses	G4	U1		++	-	+	++	++	++	+
Vaccinium macrocarpon	large cranberry	G4	U1								+
Autochton cellus	Golden-banded skipper	G4	U2								+
Clematis albicoma	White-haired Leatherflower	G4	U2								+
Polygonia progne	Gray comma	G4	U2		++	-	+	++	++	++	+
Prunus alleghaniensis	Alleghany sloe	G4	U2		++	-	+	++	++	++	+
Satyrium favonius ontario	Northern Hairstreak	G4	U2		++	-	+	++	++	++	+
Sylvilagus obscurus	Appalachian Cottontail	G4	U2		+	-	+	=	-	+	+
Vermivora chrysoptera	golden winged warbler	G4	U2		++	-	+	++	+	++	+
Crotalus horridus	Timber rattlesnake	G4	U3								+
Dendroica cerulea	cerulean warbler	G4	U3		=	=	=	=	=	=	+
Eriogonum allenii	Yellow Buckwheat	G4	U3								+
Glyptemys insculpta	wood turtle	G4	U3		+	-	+	+	+	+	+
Solidago arguta var. harrisii	Shale Barren Goldenrod	G4	U3								+
Contopus borealis	olive-sided flycatcher	G4	UH		+	-	+	=	-	+	+
Falco peregrinus	peregrine falcon	G4	UH		++	-	+	++	++	++	+
Phyciodes batesii	Tawny crescent	G4	UH								+
Pituophis melanoleucus	northern pinesnake	G4	UH		++	-	+	++	++	++	+
Houstonia canadensis	Canada bluets	G4	UNP								+

Element Name	Common Name	G Rank	Unit Rank	Habitat Management Effects Compared to Current Condition							Species Protection Plan Direction
				Alt A	Alt B	Alt C	Alt D	Alt E	Alt F	Alts G, H and I	Alts B - I
Ammodramus henslowii	Henslow's sparrow	G4	UP		=	=	=	=	=	=	+
Cyperus dentatus	toothed flatsedge	G4	UP								+
Helianthemum propinquum	low frostweed	G4	UP		++	-	+	++	++	++	
Huperzia appalachiana	Appalachian fir clubmoss	G4	UP								+
Isonychia tusculanensis	a mayfly	G4	UP								+
Linum lewisii	prairie flax	G4	UP		++	-	+	++	++	++	+
Onosmodium virginianum	Virginia false-gromwell	G4	UP		++	-	+	++	++	++	+
Paronychia virginica	yellow nailwort	G4	UP								+
Prunus nigra	Canada plum	G4	UP		+	-	+	+	=	+	+
Zigadenus elegans ssp. glaucus = Anticlea glauca	white camas	G4	UP		++	-	+	++	++	++	+
Aegolius acadicus	northern saw-whet owl	G5	U1		=	=	=	=	=	=	+
Alnus incana ssp. rugosa	speckled alder	G5	U1								+
Ambystoma tigrinum	Eastern tiger salamander	G5	U1		-	+	-	-	-	-	+
Anaphalis margaritacea	pearly everlasting	G5	U1		++	-	+	++	++	++	+
Bromus kalmii	wild chess	G5	U1		++	-	+	++	++	++	+
Campanula rotundifolia	American harebell	G5	U1								+
Caprimulgus carolinensis	chuck-will's widow	G5	U1		++	-	+	++	++	++	
Carex aquatilis	water sedge	G5	U1								+
Carex arctata	black sedge	G5	U1								+
Carex buxbaumii	Buxbaum's sedge	G5	U1								+
Carex lasiocarpa var. americana	slender sedge	G5	U1								+
Carex vesicaria		G5	U1								+
Carpodacus purpureus	purple finch	G5	U1		+	-	+	=	-	+	+
Catharus guttatus	hermit thrush	G5	U1		+	-	+	+	+	+	+
Cheilanthes eatonii	chestnut lipfern	G5	U1								+
Cirsium altissimum	tall thistle	G5	U1								+
Clemmys guttata	spotted turtle	G5	U1								+
Colias interior	Pink-edged sulphur	G5	U1								+
Colinus virginianus	northern bobwhite	G5	U1		++	-	+	++	+	++	
Cornus canadensis	bunchberry	G5	U1								+
Cornus rugosa	roundleaf dogwood	G5	U1								+
Crataegus pruinosa	prunose hawthorn	G5	U1		++	-	+	++	++	++	+
Cuscuta coryli	hazel dodder	G5	U1								+
Cystopteris fragilis	fragile fern	G5	U1								+
Dendroica fusca	blackburnian warbler	G5	U1		=	=	=	=	=	=	+
Dendroica magnolia	magnolia warbler	G5	U1		+	-	++	+	=	+	+
Elymus trachycaulus	slender wheatgrass	G5	U1		++	-	+	++	++	++	+

Element Name	Common Name	G Rank	Unit Rank	Habitat Management Effects Compared to Current Condition							Species Protection Plan Direction
				Alt A	Alt B	Alt C	Alt D	Alt E	Alt F	Alts G, H and I	Alts B - I
Epilobium leptophyllum	linear-leaved willow-herb	G5	U1								+
Equisetum sylvaticum	woodland horsetail	G5	U1								+
Eriocaulon aquaticum	white buttons	G5	U1								+
Erynnis persius	Persius duskywing	G5	U1		+	-	+	+	+	+	+
Erysimum capitatum	western wallflower	G5	U1		++	-	+	++	++	++	+
Glyceria grandis	American manna-grass	G5	U1								+
Gnaphalium uliginosum	low cudweed	G5	U1		+	-	+	=	-	+	+
Haliaeetus leucocephalus	bald eagle	G5	U1								+
Helianthemum bicknellii	plains frostweed	G5	U1		++	-	+	++	++	++	+
Hypericum boreale	northern St. John's-wort	G5	U1								+
Incisalia polia	Hoary elfin	G5	U1		+	-	+	+	+	+	+
Isoetes lacustris	lake quillwort	G5	U1								+
Juncus brachycephalus	small-head rush	G5	U1								+
Juncus brevicaudatus	narrow-panicled rush	G5	U1								+
Juniperus communis var depressa	ground juniper	G5	U1		+	-	+	=	-	+	+
Lepus americanus	snowshoe hare	G5	U1		+	-	++	+	=	+	+
Leucothoe fontanesiana	highland dog-hobble	G5	U1		+	-	+	=	+	+	+
Liparis loeselii	Loesel's twayblade	G5	U1								+
Lonicera canadensis	American fly-honeysuckle	G5	U1								+
Loxia curvirostra	red crossbill	G5	U1		=	=	=	=	=	=	+
Martes pennanti	fisher	G5	U1		=	=	=	=	=	=	+
Melospiza georgiana	swamp sparrow	G5	U1		+	-	+	=	-	+	+
Minuartia groenlandica	mountain sandwort	G5	U1								+
Muhlenbergia glomerata	marsh muhly	G5	U1								+
Oligoneuron rigidum	stiff goldenrod	G5	U1		++	-	+	++	++	++	+
Oporornis philadelphia	mourning warbler	G5	U1		++	-	+	++	++	++	+
Oryzopsis asperifolia	white-grained mtn-ricegrass	G5	U1		++	-	+	++	++	++	+
Osmunda cinnamomea var. glandulosa	glandular cinnamon fern	G5	U1								+
Panax trifolius	Dwarf ginseng	G5	U1		+	-	+	=	+	+	+
Panicum hemitomon	maidencane	G5	U1								+
Platanthera grandiflora	large purple fringed orchid	G5	U1								+
Platanthera peramoena	purple fringeless orchid	G5	U1								+
Poa palustris	fowl bluegrass	G5	U1								+
Potentilla arguta	tall cinquefoil	G5	U1								+
Pyrola elliptica	shinleaf	G5	U1								+
Regulus satrapa	golden-crowned kinglet	G5	U1								+
Ribes americanum	wild black currant	G5	U1								+

Element Name	Common Name	G Rank	Unit Rank	Habitat Management Effects Compared to Current Condition							Species Protection Plan Direction
				Alt A	Alt B	Alt C	Alt D	Alt E	Alt F	Alts G, H and I	Alts B - I
Rubus idaeus ssp. strigosus	American red raspberry	G5	U1		+	-	+	=	-	+	+
Sabatia campanulata	slender marsh rose-pink	G5	U1								+
Sagittaria calycina var calycina	long-lobed arrowhead	G5	U1								+
Schizachne purpurascens	purple oat-grass	G5	U1								+
Seiurus noveboracensis	northern waterthrush	G5	U1		=	=	=	=	=	=	+
Sibbaldiopsis tridentata	three-toothed cinquefoil	G5	U1								+
Sitta canadensis	red-breasted nuthatch	G5	U1								+
Speyeria atlantis	Atlantis fritillary	G5	U1								+
Sphagnum russowii	Russow's peatmoss	G5	U1								+
Symphoricarpos albus	snowberry	G5	U1								+
Thuja occidentalis	northern white cedar	G5	U1								+
Triantha racemosa	coastal false-asphodel	G5	U1								+
Trichostema setaceum	narrow-leaved blue curls	G5	U1		++	-	+	++	++	++	+
Troglodytes troglodytes	winter wren	G5	U1								+
Viola pedatifida	prairie violet	G5	U1								+
Woodwardia virginica	Virginia chainfern	G5	U1								+
Aralia hispida	Bristly Sarsaparilla	G5	U2		++	-	+	++	++	++	+
Betula cordifolia	mountain paper birch	G5	U2		++	-	+	++	++	++	+
Boloria selene	Silver-bordered fritillary	G5	U2								+
Certhia americana	brown creeper	G5	U2		=	=	=	=	=	=	+
Coccyzus erythropthalmus	black-billed cuckoo	G5	U2		+	-	+	=	-	+	+
Empidonax alnorum	alder flycatcher	G5	U2								+
Eumeces anthracinus	coal skink	G5	U2		++	-	+	++	++	++	+
Glyceria acutiflora	sharp-scaled manna-grass	G5	U2								+
Liochlorophis vernalis	Smooth green snake	G5	U2		++	-	+	++	++	++	
Mustela nivalis	least weasel	G5	U2		+	-	+	+	+	+	
Phyciodes cocyta	Northern crescent	G5	U2								+
Poa saltuensis	drooping bluegrass	G5	U2		++	-	+	++	++	++	+
Saxifraga pensylvanica	swamp saxifrage	G5	U2								+
Scolopax minor	American woodcock	G5	U2		+	-	+	+	+	+	+
Sparganium chlorocarpum = S. emersum	narrow-leaf burreed	G5	U2								+
Sphyrapicus varius	yellow-bellied sapsucker	G5	U2		+	-	+	=	-	+	+
Spilogale putorius	Spotted Skunk	G5	U2		+	-	+	+	+	+	+
Tyto alba	barn owl	G5	U2		+	-	+	+	+	+	+
Caprimulgus vociferus	whip-poor-will	G5	U3		++	-	+	++	++	++	
Castor canadensis	Beaver	G5	U3								+
Lontra canadensis		G5	U3								+
Aquila chrysaetos	golden eagle	G5	U4		=	=	=	=	=	=	

Element Name	Common Name	G Rank	Unit Rank	Habitat Management Effects Compared to Current Condition							Species Protection Plan Direction
				Alt A	Alt B	Alt C	Alt D	Alt E	Alt F	Alts G, H and I	Alts B - I
Dendroica discolor	prairie warbler	G5	U4		++	-	+	++	++	++	
Empidonax virescens	acadian flycatcher	G5	U4		=	=	=	=	=	=	+
Echinodorus tenellus	dwarf burhead	G5	UH								+
Aster radula	rough-leaved aster	G5	UP								+
Astragalus distortus	bent milkvetch	G5	UP								+
Bartramia longicauda	upland sandpiper	G5	UP		++	-	+	++	++	++	+
Bromus ciliatus	fringed brome grass	G5	UP								+
Calopogon tuberosus	Grass pink	G5	UP								+
Circus cyaneus	northern harrier	G5	UP		=	=	=	=	=	=	+
Clematis occidentalis	purple clematis	G5	UP								+
Crataegus calpodendron	pear hawthorn	G5	UP								+
Desmodium canadense	showy tick-trefoil	G5	UP								+
Desmodium cuspidatum	toothed tick-trefoil	G5	UP								+
Desmodium sessilifolium	sessile-leaf tick-trefoil	G5	UP		++	-	+	++	++	++	+
Elymus canadensis	nodding wild rye	G5	UP								+
Epilobium ciliatum	Hair willow-herb	G5	UP								+
Eupatorium maculatum	spotted joe-pye weed	G5	UP								+
Geranium robertianum	herb-robert	G5	UP								+
Goodyera repens	dwarf rattlesnake plantain	G5	UP								+
Linum sulcatum	grooved yellow flax	G5	UP		++	-	+	++	++	++	+
Lycopodiella inundata	northern bog clubmoss	G5	UP								+
Lythrum alatum	winged loosestrife	G5	UP								+
Maianthemum stellatum	stary false Solomon's-seal	G5	UP								+
Melica nitens	Three-flowered melic grass	G5	UP		++	-	+	++	++	++	+
Nemotaulius hostilis	a limnephilid caddisfly	G5	UP								+
Polanisia dodecandra	common clammy-weed	G5	UP								+
Pseudognaphalium macounii	Winged cudweed	G5	UP								+
Rosa setigera	prairie rose	G5	UP		++	-	+	++	++	++	+
Sagittaria rigida	sessile-fruited arrowhead	G5	UP								+
Scirpus torreyi		G5	UP								+
Spartina pectinata	freshwater cordgrass	G5	UP								+
Spiranthes lucida	shining ladies'-tresses	G5	UP								+
Sporobolus neglectus	small dropseed	G5	UP								+
Triadenum fraseri	Fraser's marsh St. John's-wort	G5	UP								+
Verbena scabra	sandpaper vervain	G5	UP								+
Veronica scutellata	marsh speedwell	G5	UP								+
Viburnum lentago	nannyberry	G5	UP								+
Vicia americana	American purple vetch	G5	UP								+
Bonasa umbellus	ruffed grouse	G5	UNA		++	-	+	++	+	++	+
Meleagris gallopavo	wild turkey	G5	UNA		++	-	+	++	+	++	

Element Name	Common Name	G Rank	Unit Rank	Habitat Management Effects Compared to Current Condition							Species Protection Plan Direction
				Alt A	Alt B	Alt C	Alt D	Alt E	Alt F	Alts G, H and I	Alts B - I
Odocoileus virginianus	white-tailed deer	G5	UNA		++	-	+	++	+	++	
Sciurus carolinensis	gray squirrel	G5	UNA		+	-	+	+	=	+	+
Sciurus niger	Eastern fox squirrel	G5	UNA		+	-	+	+	=	+	+
Ursus americanus	black bear	G5	UNA		++	-	+	++	+	++	+

+ means small improvement in habitat
++ means improvement in habitat
= means habitat remains the same
- means small decrease in habitat
Blank means no difference in habitat among the alternatives

Table H-3. Current/Existing Situation Viability Outcomes by Species and Watershed
(Shaded columns indicate species sensitivity)

Scientific Name	Common Name	Watershed	National Forest (NF) or Private (P) occurrence	% GWNF	% High Erosion Potential	% Forested Riparian	% High Acid Sensitivity	Road Density (miles/sq.mi.)	Viability Outcome *
Pleurobema collina	James spinymussel	Potts Creek	P	26%	71%	87%	100%	1.16	C
		Cowpasture River	P	59%	85%	86%	100%	1.32	C
		Catawba Creek-James River	P	5%	53%	67%	59%	1.81	E
		Craig Creek	P	<1%	76%	88%	100%	1.16	C
		Calfpasture River	P	59%	78%	88%	100%	1.32	C
		Pedlar River-James River	P	16%	25%	79%	16%	2.98	C
Helenium virginicum	Virginia sneezeweed	Back Creek-South River	NFP	20%	36%	63%	41%	2.57	B
		Naked Creek-South Fork Shenandoah River	P	10%	58%	64%	45%	2.08	C
Helonias bullata	swamp pink	Back Creek-South River	NFP	20%	36%	63%	41%	2.57	B
		Irish Creek-South River	NF	34%	53%	72%	41%	1.60	B
Scirpus ancistrochaetus	northeastern bulrush	Dry River-North River	NF	59%	66%	71%	71%	1.59	D
		Back Creek-South River	P	20%	36%	63%	41%	2.57	E
		Naked Creek-South Fork Shenandoah River	P	10%	58%	64%	45%	2.08	E
		Potts Creek	NF	26%	71%	87%	100%	1.16	D
		Back Creek-Jackson River	P	41%	84%	74%	98%	1.32	E
Notropis semperasper	Roughhead shiner	Dunlap Creek	P	42%	83%	86%	100%	1.10	C
		Potts Creek	P	26%	71%	87%	100%	1.16	C
		Back Creek-Jackson River	NFP	41%	84%	74%	98%	1.32	B
		Wilson Creek-Jackson River	P	38%	86%	83%	100%	1.90	C
		Cowpasture River	NFP	59%	85%	86%	100%	1.32	B
		Catawba Creek-James River	P	5%	53%	67%	59%	1.81	C
		Craig Creek	P	<1%	76%	88%	100%	1.16	C
		Calfpasture River	P	59%	78%	88%	100%	1.32	C
Noturus gilberti	Orangefin madtom	Cowpasture River	P	59%	85%	86%	100%	1.32	C

Scientific Name	Common Name	Watershed	National Forest (NF) or Private (P) occurrence	% GWNF	% High Erosion Potential	% Forested Riparian	% High Acid Sensitivity	Road Density (miles/sq.mi.)	Viability Outcome *
		Craig Creek	P	<1%	76%	88%	100%	1.16	C
Hydraena maureenae	Maureen's shale stream beetle	Shoemaker River-North Fork Shenandoah River	NF	53%	88%	86%	100%	1.50	D
		Wilson Creek-Jackson River	P	38%	86%	83%	100%	1.90	E
		Cowpasture River	NFP	59%	85%	86%	100%	1.32	B
		Craig Creek	P	<1%	76%	88%	100%	1.16	E
		Calfpasture River	NF	59%	78%	88%	100%	1.32	D
Cicindela ancocisconensis	Appalachian tiger beetle	Wilson Creek-Jackson River	P	38%	86%	83%	100%	1.90	E
		Cowpasture River	NFP	59%	85%	86%	100%	1.32	D
Sorex palustris punctulatus	southern water shrew	North Fork South Branch Potomac River	NFP	5%	92%	82%	80%	1.22	D
		Back Creek-Jackson River	NFP	41%	84%	74%	98%	1.32	D
Alasmidonta varicosa	Brook floater	Gooney Run-South Fork Shenandoah River	P	7%	60%	67%	35%	2.52	E
		Smith Creek-North Fork Shenandoah River	P	6%	46%	44%	22%	2.62	E
		Stony Creek-North Fork Shenandoah River	P	28%	61%	66%	73%	2.47	E
Elliptio lanceolata	Yellow lance	Wilson Creek-Jackson River	P	38%	86%	83%	100%	1.90	C
		Cowpasture River	P	59%	85%	86%	100%	1.32	C
		Catawba Creek-James River	P	5%	53%	67%	59%	1.81	E
		Craig Creek	P	<1%	76%	88%	100%	1.16	C
		Maury River	P	9%	32%	54%	30%	2.32	C
		Pedlar River-James River	P	16%	25%	79%	16%	2.98	C
Fusconaia masoni	Atlantic pigtoe	Catawba Creek-James River	P	5%	53%	67%	59%	1.81	E
		Craig Creek	P	<1%	76%	88%	100%	1.16	C
		Calfpasture River	P	59%	78%	88%	100%	1.32	E
Lasmigona subviridis	Green floater	Stony Creek-North Fork Shenandoah River	P	28%	61%	66%	73%	2.47	C
		Pedlar River-James River	P	16%	25%	79%	16%	2.98	C

Scientific Name	Common Name	Watershed	National Forest (NF) or Private (P) occurrence	% GWNF	% High Erosion Potential	% Forested Riparian	% High Acid Sensitivity	Road Density (miles/sq.mi.)	Viability Outcome *
		Tye River	P	17%	33%	77%	13%	1.86	C
Villosa constricta	Notched Rainbow	Potts Creek	P	26%	71%	87%	100%	1.16	C
		Cowpasture River	P	59%	85%	86%	100%	1.32	C
		Catawba Creek-James River	P	5%	53%	67%	59%	1.81	C
		Craig Creek	P	<1%	76%	88%	100%	1.16	C
		Maury River	P	9%	32%	54%	30%	2.32	C
		Pedlar River-James River	P	16%	25%	79%	16%	2.98	C
Peltigera hydrothyria	waterfan	North Fork South Branch Potomac River	NF	5%	92%	82%	80%	1.22	B
		Middle River	NF	10%	37%	40%	36%	2.72	B
		Stony Creek-North Fork Shenandoah River	NF	28%	61%	66%	73%	2.47	B
		Cowpasture River	NF	59%	85%	86%	100%	1.32	B
		Irish Creek-South River	NFP	34%	53%	72%	41%	1.60	A
		Tye River	NFP	17%	33%	77%	13%	1.86	A
		Buffalo River	NFP	8%	28%	76%	22%	2.08	A
Ambystoma tigrinum	eastern tiger salamander	Back Creek-South River	NFP	20%	36%	63%	41%	2.57	B
Cambarus monongalensis	A Crayfish	North Fork South Branch Potomac River	NF	5%	92%	82%	80%	1.22	B
Anguilla rostrata	American eel	Middle River	P	10%	37%	40%	36%	2.72	C
		Dry River-North River	P	59%	66%	71%	71%	1.59	C
		Back Creek-South River	P	20%	36%	63%	41%	2.57	C
		Naked Creek-South Fork Shenandoah River	P	10%	58%	64%	45%	2.08	C
		Gooney Run-south Fork Shenandoah River	NFP	7%	60%	67%	35%	2.52	B
		Smith Creek-North Fork Shenandoah River	P	6%	46%	44%	22%	2.62	C
		Stony Creek-North Fork Shenandoah River	P	28%	61%	66%	73%	2.47	C
		Cedar Creek	NFP	19%	34%	78%	69%	1.77	A
		Craig Creek	P	<1%	76%	88%	100%	1.16	E
		Pedlar River-James River	P	16%	25%	79%	16%	2.98	C
		Tye River	NFP	17%	33%	77%	13%	1.86	A
		Buffalo River	NFP	8%	28%	76%	22%	2.08	A

Scientific Name	Common Name	Watershed	National Forest (NF) or Private (P) occurrence	% GWNF	% High Erosion Potential	% Forested Riparian	% High Acid Sensitivity	Road Density (miles/sq.mi.)	Viability Outcome *
		Rockfish River	P	1%	21%	80%	21%	1.71	C
Salvelinus fontinalus	Brook trout	North Fork South Branch Potomac River	NFP	5%	92%	82%	80%	1.22	B
		South Fork South Branch Potomac River	NFP	29%	86%	82%	100%	1.37	B
		Cacapon River	NFP	20%	79%	83%	100%	1.44	B
		Dry River-North River	NFP	59%	66%	71%	71%	1.59	A
		Back Creek-South River	NFP	20%	36%	63%	41%	2.57	B
		Naked Creek-South Fork Shenandoah River	NFP	10%	58%	64%	45%	2.08	B
		Gooney Run-south Fork Shenandoah River	NFP	7%	60%	67%	35%	2.52	B
		Shoemaker River-North Fork Shenandoah River	NFP	53%	88%	86%	100%	1.50	B
		Smith Creek-North Fork Shenandoah River	NF	6%	46%	44%	22%	2.62	B
		Stony Creek-North Fork Shenandoah River	NFP	28%	61%	66%	73%	2.47	A
		Cedar Creek	NFP	19%	34%	78%	69%	1.77	B
		Dunlap Creek	NFP	42%	83%	86%	100%	1.10	B
		Potts Creek	NFP	26%	71%	87%	100%	1.16	B
		Back Creek-Jackson River	NFP	41%	84%	74%	98%	1.32	A
		Wilson Creek-Jackson River	NFP	38%	86%	83%	100%	1.90	A
		Cowpasture River	NFP	59%	85%	86%	100%	1.32	A
		Catawba Creek-James River	P	5%	53%	67%	59%	1.81	C
		Craig Creek	NFP	<1%	76%	88%	100%	1.16	B
		Calfpasture River	NFP	59%	78%	88%	100%	1.32	A
		Little Calfpasture River	NFP	30%	75%	81%	100%	2.03	B
		Maury River	NF	9%	32%	54%	30%	2.32	B
		Irish Creek-South River	NFP	34%	53%	72%	41%	1.60	A
		Pedlar River-James River	NFP	16%	25%	79%	16%	2.98	B
		Tye River	NFP	17%	33%	77%	13%	1.86	A
		Buffalo River	NFP	8%	28%	76%	22%	2.08	B
		Rockfish River	NFP	1%	21%	80%	21%	1.71	B
Cottus cf. cognatus	Checkered sculpin	Cacapon River	P	20%	79%	83%	100%	1.44	C
Aeshna canadensis	Canada darner	North Fork South Branch Potomac River	NF	5%	92%	82%	80%	1.22	D

Scientific Name	Common Name	Watershed	National Forest (NF) or Private (P) occurrence	% GWNF	% High Erosion Potential	% Forested Riparian	% High Acid Sensitivity	Road Density (miles/sq.mi.)	Viability Outcome *
Aeshna tuberculifera	black-tipped darner	North Fork South Branch Potomac River	NF	5%	92%	82%	80%	1.22	D
		Dry River-North River	NF	59%	66%	71%	71%	1.59	B
		Back Creek-South River	NF	20%	36%	63%	41%	2.57	B
		Naked Creek-South Fork Shenandoah River	NF	10%	58%	64%	45%	2.08	D
		Potts Creek	NF	26%	71%	87%	100%	1.16	B
		Wilson Creek-Jackson River	P	38%	86%	83%	100%	1.90	C
		Catawba Creek-James River	P	5%	53%	67%	59%	1.81	E
Aeshna verticalis	green-striped darner	North Fork South Branch Potomac River	NF	5%	92%	82%	80%	1.22	D
Anax longipes	comet darner	Back Creek-South River	NF	20%	36%	63%	41%	2.57	B
Calopteryx amata	Superb jewelwing	North Fork South Branch Potomac River	NF	5%	92%	82%	80%	1.22	D
Calopteryx angustipennis	Appalachian jewelwing	Stony Creek-North Fork Shenandoah River	NF	28%	61%	66%	73%	2.47	B
		Cowpasture River	NF	59%	85%	86%	100%	1.32	B
		Craig Creek	P	<1%	76%	88%	100%	1.16	C
		Maury River	P	9%	32%	54%	30%	2.32	C
Celithemis martha	Martha's penant	Back Creek-South River	NF	20%	36%	63%	41%	2.57	B
Cordulegaster diastatops	delta-spotted spiketail	North Fork South Branch Potomac River	NF	5%	92%	82%	80%	1.22	B
Enallagma annexum (AKA cyathigerum)	northern bluet	North Fork South Branch Potomac River	NF	5%	92%	82%	80%	1.22	D
Epitheca canis	beaverpond baskettail	North Fork South Branch Potomac River	NF	5%	92%	82%	80%	1.22	D
Gomphus adelphus	mustached clubtail	Cowpasture River	P	59%	85%	86%	100%	1.32	C
		Calfpasture River	P	59%	78%	88%	100%	1.32	C
Gomphus quadricolor	rapids clubtail	Cowpasture River	P	59%	85%	86%	100%	1.32	C
		Craig Creek	P	<1%	76%	88%	100%	1.16	C

Scientific Name	Common Name	Watershed	National Forest (NF) or Private (P) occurrence	% GWNF	% High Erosion Potential	% Forested Riparian	% High Acid Sensitivity	Road Density (miles/sq.mi.)	Viability Outcome *
		Calfpasture River	P	59%	78%	88%	100%	1.32	C
Ladona julia (AKA Libellula julia)	chalk-fronted corporal skimmer	North Fork South Branch Potomac River	NF	5%	92%	82%	80%	1.22	D
Lanthus parvulus	double-striped clubtail	North Fork South Branch Potomac River	NFP	5%	92%	82%	80%	1.22	B
Lestes disjunctus	northern spreadwing	North Fork South Branch Potomac River	NF	5%	92%	82%	80%	1.22	D
		Back Creek-Jackson River	P	41%	84%	74%	98%	1.32	C
		Wilson Creek-Jackson River	P	38%	86%	83%	100%	1.90	C
Leucorrhinia hudsonica	Hudsonian whiteface	North Fork South Branch Potomac River	NF	5%	92%	82%	80%	1.22	D
Nehalennia irene	sedge sprite	North Fork South Branch Potomac River	NF	5%	92%	82%	80%	1.22	D
Neurocordulia yamaskanensis	stygian shadowdragon	Stony Creek-North Fork Shenandoah River	P	28%	61%	66%	73%	2.47	C
		Wilson Creek-Jackson River	P	38%	86%	83%	100%	1.90	C
Rhionaeschna mutata (AKA Aeshna mutata)	spatterdock darner	North Fork South Branch Potomac River	NF	5%	92%	82%	80%	1.22	D
		Potts Creek	P	26%	71%	87%	100%	1.16	C
Somatochlora elongata	Ski-tipped emerald	North Fork South Branch Potomac River	NF	5%	92%	82%	80%	1.22	D
Sympetrum obtrusum	white-faced meadowhawk	North Fork South Branch Potomac River	NF	5%	92%	82%	80%	1.22	D
Isonychia hoffmani	Hoffman's Isonychia mayfly	North Fork South Branch Potomac River	NF	5%	92%	82%	80%	1.22	B
Nemotaulius hostilis	a limnephilid caddisfly	North Fork South Branch Potomac River	NF	5%	92%	82%	80%	1.22	D
Clemmys guttata	spotted turtle	Back Creek-South River	NF	20%	36%	63%	41%	2.57	D
Glyptemys insculpta	wood turtle	South Fork South Branch Potomac River	P	29%	86%	82%	100%	1.37	C
		Cacapon River	NFP	20%	79%	83%	100%	1.44	B

Scientific Name	Common Name	Watershed	National Forest (NF) or Private (P) occurrence	% GWNF	% High Erosion Potential	% Forested Riparian	% High Acid Sensitivity	Road Density (miles/sq.mi.)	Viability Outcome *
		Shoemaker River-North Fork Shenandoah River	NFP	53%	88%	86%	100%	1.50	B
		Smith Creek-North Fork Shenandoah River	P	6%	46%	44%	22%	2.62	C
		Stony Creek-North Fork Shenandoah River	NFP	28%	61%	66%	73%	2.47	B
		Cedar Creek	NFP	19%	34%	78%	69%	1.77	B

*Outcome A. Species is well distributed and abundant within watershed. Forest Service may influence conditions in the watershed to keep it well distributed. Likelihood of maintaining viability is high.

Outcome B. Species is potentially at risk in the watershed; however, the extent and location of NFS lands with respect to the species is conducive to positively influence the sustainability of the species within this watershed. Therefore, likelihood of maintaining viability is moderate.

Outcome C. Species is potentially at risk within the watershed; however, the extent and location of NFS lands with respect to the species is NOT conducive to positively influence the sustainability of the species within this watershed. Therefore, species viability in the watershed may be at risk.

Outcome D. The species is so rare within the watershed (population is at very low density and/or at only a few local sites) that stochastic events (accidents, weather events, etc.) may place persistence of the species within the watershed at risk; however, the extent and location of NFS lands with respect to the species is conducive to positively influence the sustainability of the species within this watershed. Therefore, likelihood of maintaining viability is moderate.

Outcome E. The species is so rare within the watershed (population is at very low density and/or at only a few local sites) that stochastic events (accidents, weather events, etc.) may place persistence of the species within the watershed at risk. Forest Service ability to influence the species is limited. Therefore species viability in the watershed may be at risk.

**Birds and non-TE plants and mammals were not included in this analysis because species occurrence locations were not readily available in GIS format. See Terrestrial Ecological Analysis.

Table H-4. Species Habitat on GWNF, Rank* and Sensitivity Factor**

Species			Habitat and Ranking								Species Sensitivity Factor				
GROUP	SCIENTIFIC NAME	COMMON NAME	G-RANK	S-RANK VA	S-RANK WV	STATUS	POTENTIAL HABITAT ON FS	UNIT RANK	GLOBAL CONSERVATION IMPORTANCE RATING	REGIONAL CONSERVATION IMPORTANCE RATING	SEDIMENT	HABITAT COMPLEXITY	TEMP.	ACID DEPOSITION	PASSAGE
mussel	*Pleurobema collina*	James spinymussel	G1	S1	S1	FE	14.3 mi	U1	4	3	x	x		x	
plant	*Helenium virginicum*	Virginia sneezeweed	G3	S2		FT	4.0 ac	U2	1	1		x			
plant	*Helonias bullata*	swamp pink	G3	S2S3		FT	7.3 mi	U2	1	1	x			x	
plant	*Scirpus ancistrochaetus*	northeastern bulrush	G3	S2	S1	FE	1.1 ac	U1	2	2		x			
fish	*Notropis semperasper*	Roughhead shiner	G2G3	S2S3	_	S	73.7 mi	U3	3	2	x	x		x	
fish	*Noturus gilberti*	Orangefin madtom	G2	S2	_	S	6.5 mi	UP	4	4	x	x		x	
insect	*Hydraena maureenae*	Maureen's shale stream beetle	G1G3	S1S3	_	S	150.9 mi	U2	1	3	x			x	
insect	*Cicindela ancocisconensis*	Appalachian tiger beetle	G3	S2	S3	S	6.20 mi	U1	3	2	x				
mammal	*Sorex palustris punctulatus*	southern water shrew	G5T3	S1S2	S1	S	13.5 mi	U1	2	2		x	x	x	
mussel	*Alasmidonta varicosa*	Brook floater	G3	S1	S1	S	1.3 mi	UP	4	4	x	x		x	
mussel	*Elliptio lanceolata*	Yellow lance	G2G3	S2S3	_	S	30.8 mi	UP	4	3	x	x		x	
mussel	*Fusconaia masoni*	Atlantic pigtoe	G2	S2	_	S	0.2 mi	UP	4	4	x	x		x	
mussel	*Lasmigona subviridis*	Green floater	G3	S2	S2	S	21.9 mi	UP	4	3	x	x		x	
bird	*Haliaeetus leucocephalus*	Bald eagle	G5	S23B /S3N	S2B/ S3N	S	Riparian	U1	4	3					
plant	*Boltonia montana*	Doll's daisy	G1G2	S1	_	S	Riparian	U1	1	1					
plant	*Iliamna remota*	Kankakee globe-mallow	G1Q	S1	_	S	Riparian	UP	4	4					

Species			Habitat and Ranking								Species Sensitivity Factor				
GROUP	SCIENTIFIC NAME	COMMON NAME	G-RANK	S-RANK VA	S-RANK WV	STATUS	POTENTIAL HABITAT ON FS	UNIT RANK	GLOBAL CONSERVATION IMPORTANCE RATING	REGIONAL CONSERVATION IMPORTANCE RATING	SEDIMENT	HABITAT COMPLEXITY	TEMP.	ACID DEPOSITION	PASSAGE
plant	*Isoetes virginica*	Virginia quillwort	G1	S1?	_	S	Riparian	UP	5	5					
plant	*Peltigera hydrothyria*	waterfan	G4	S1	_	S	515.0 mi	U4	3	2	x		x	x	
plant	*Poa paludigena*	bog bluegrass	G3	S2	S1	S	Riparian	U1	3	2					
plant	*Potamogeton hillii*	Hill's pondweed	G3	S1	_	S	Riparian	UP	5	5					
plant	*Potamogeton tennesseensis*	Tennessee pondweed	G2	S1	S2	S	Riparian	U1	3	3					
plant	*Sida hermaphrodita*	Virginia mallow	G3	S1	S2	S	Riparian	UP	4	4					
plant	*Vitis rupestris*	sand grape	G3	S1?	S2	S	Riparian	U1	4	3					
amphib	*Ambystoma tigrinum*	eastern tiger salamander	G5	S1		LR	39.1 ac	U1	4	2				x	
bird	*Anas rubripes*	Amer. black duck	G5	S4	S2B/ S4N	LR	36.6 mi & 3,228.7 ac	UP	4	3					
bird	*Empidonax alnorum*	alder flycatcher	G5	S1B	S3B/ S4N	LR	185.7 ac	U2	4	2					
bird	*Empidonax virescens*	Acadian flycatcher	G5	S5	S5B	MIS	Riparian	U4	4	3					
bird	*Melospiza georgiana*	swamp sparrow	G5	S1B/ S4S5 N	S3B/ S4N	LR	85.0 ac	U1	4	3					
bird	*Nycticorax nycticorax*	black-crowned night-heron	G5	S3B/ S4N	SHB	LR	36.6 mi & 3,228.7 ac	UP	4	3					
bird	*Nyctanassa violacea*	yellow-crowned night-heron	G5	S2S3 B/S3 N	S1N	LR	36.6 mi & 3,228.7 ac	UP	4	3				x	
bird	*Seiurus noveboracensis*	northern waterthrush	G5	S1B	S2B	LR	270.7 ac	U1	4	2					

Species			Habitat and Ranking								Species Sensitivity Factor				
GROUP	SCIENTIFIC NAME	COMMON NAME	G-RANK	S-RANK VA	S-RANK WV	STATUS	POTENTIAL HABITAT ON FS	UNIT RANK	GLOBAL CONSERVATION IMPORTANCE RATING	REGIONAL CONSERVATION IMPORTANCE RATING	SEDIMENT	HABITAT COMPLEXITY	TEMP.	ACID DEPOSITION	PASSAGE
crayfish	*Cambarus monongalensis*	A Crayfish	G5	S1?	S3	LR	17.6 mi	U1	4	3	x	x	x	x	
fish	*Anguilla rostrata*	American eel	G4	S5	S2	SMC	145.6 mi	U4	4	3	x	x		x	x
fish	*Cottus cf. cognatus*	Checkered sculpin	G4Q	-	-	LR	Riparian	U3	4	4	x	X	x	x	x
fish	*Salvelinus fontinalus*	Brook trout	G5	S4	S5	MIS	1,119.9 mi	U5	3	1	x	x	x	x	x
insect/	*Aeshna canadensis*	Canada darner	G5	S1	S1	LR	34.7 ac	U1	4	2			x		
insect/	*Aeshna tuberculifera*	black-tipped darner	G4	S2S3	S2	LR	89.4 ac	U2	4	2			x		
insect/	*Aeshna verticalis*	green-striped darner	G5	S1	S2	LR	34.7 ac	U1	4	2			x		
insect/	*Anax longipes*	comet darner	G5	S3	S1	LR	49.4 ac	U1	4	2			x		
insect/	*Calopteryx amata*	Superb jewelwing	G4	S1	-	LR	17.6 mi	U1	4	2	x	x	x		
insect/	*Calopteryx angustipennis*	Appalachian jewelwing	G4	S2	S2	LR	.09 mi	U1	4	3	x	x	x	x	
insect/	*Celithemis martha*	Martha's penant	G4	S2	_	LR	54.7 ac	U1	4	2			x		
insect/	*Cordulegaster diastatops*	delta-spotted spiketail	G5	S1	S2	LR	10.23 mi	U1	4	2	x	x	x	x	
insect/	*Enallagma annexum (AKA cyathigerum)*	northern bluet	G5	S1	S2	LR	34.7 ac	U1	4	2			x		
insect/	*Epitheca canis*	beaverpond baskettail	G5	S1	S1S2	LR	34.7 ac	U1	4	2			x		
insect/	*Gomphus adelphus*	mustached clubtail	G4	S1	S2	LR	23.9 mi	UP	4	4	x	x			
insect/	*Gomphus quadricolor*	rapids clubtail	G3/G4	S2	S2S3	LR	23.9 mi	UP	4	4	x	x			
insect/	*Ladona julia (AKA Libellula julia)*	chalk-fronted corporal skimmer	G5	S1	S2	LR	34.7 ac	U1	4	2			x		

Species			Habitat and Ranking									Species Sensitivity Factor				
GROUP	SCIENTIFIC NAME	COMMON NAME	G-RANK	S-RANK VA	S-RANK WV	STATUS	POTENTIAL HABITAT ON FS	UNIT RANK	GLOBAL CONSERVATION IMPORTANCE RATING	REGIONAL CONSERVATION IMPORTANCE RATING	SEDIMENT	HABITAT COMPLEXITY	TEMP.	ACID DEPOSITION	PASSAGE
insect/	*Lanthus parvulus*	double-striped clubtail	G4	S2	S2	LR	13.2 mi	U1	4	2	x	x	x	x	
insect/	*Lestes disjunctus*	northern spreadwing	G5	S2	S2S3	LR	34.7 ac	U1	4	3			x		
insect/	*Leucorrhinia ihudsonica*	Hudsonian whiteface	G5	S1	S1	LR	34.7 ac	U1	4	2			x		
insect/	*Nehalennia irene*	sedge sprite	G5	S1	S3	LR	34.7 ac	U1	4	2			x		
insect/	*Neurocordulia yamaskanensis*	stygian shadowdragon	G5	S2	S2	LR	34.5 mi	UP	4	4	x	x	x		
insect/	*Rhionaeschna mutata (AKA Aeshna mutata)*	spatterdock darner	G3G4	S2	S1	LR	49.4 ac	U1	4	3			x		
insect/	*Somatochlora elongata*	Ski-tipped emerald	G5	S1S2	S2	LR	34.7 ac	U1	4	2			x		
insect/	*Sympetrum obtrusum*	white-faced meadowhawk	G5	S1	S2	LR	34.7 ac	U1	4	2			x		
insect	*Autochton cellus*	Golden banded skipper	G5	S3	S1S2	LR	Riparian	U2	3	2					
insect	*Boloria selene*	Silver-bordered fritillary	G5	S2	S3	LR	Riparian	U2	2	1					
insect	*Colias interior*	Pink-edged sulphur	G5	S1S2	S2	LR	Riparian	U1	4	3					
insect	*Isonychia hoffmani*	Hoffman's Isonychia mayfly	G1/G3	S1	-	LR	17.6 mi	U1	2	1	x	x	x	x	
insect	*Nemotaulius hostilis*	a limnephilid caddisfly	G5	S1	SNR	LR	34.7 ac	U1	4	2			x		
insect	*Speyeria atlantis*	Atlantis fritillary	G5	S2	S3	LR	Riparian	U1	3	2					
mammal	*Castor canandensis*	beaver	G5	S5	S5	SMC	Riparian	U3	4	4					
mammal	*Lontra canadensis*	river otter	G5	S4	S1	LR	Riparian	U3	4	3					
mussel	*Villosa constricta*	Notched Rainbow	G3	S3	_	LR	33.1 mi	UP	4	3	x	x		x	
reptile	*Clemmys guttata*	spotted turtle	G5	S4	S1	LR	6.45 ac	U1	4	4					

Species			Habitat and Ranking								Species Sensitivity Factor				
GROUP	SCIENTIFIC NAME	COMMON NAME	G-RANK	S-RANK VA	S-RANK WV	STATUS	POTENTIAL HABITAT ON FS	UNIT RANK	GLOBAL CONSERVATION IMPORTANCE RATING	REGIONAL CONSERVATION IMPORTANCE RATING	SEDIMENT	HABITAT COMPLEXITY	TEMP.	ACID DEPOSITION	PASSAGE
reptile	*Glyptemys insculpta*	wood turtle	G4	S2	S2	LR	217.6 mi	U2	4	2	x	x	x	x	
plant	*Alnus incana ssp. rugosa*	speckled alder	G5T5	S2	S4	LR	Riparian	U1	4	4					
plant	*Arethusa bulbosa*	Dragon's mouth	G4	SSH	-	LR	Riparian	UH	5	5					
plant	*Eurybia radula*	rough-leaved aster	G5	S1	S4	LR	Riparian	UP	4	4					
plant	*Bromus ciliatus*	fringed brome grass	G5	S1	S4	LR	Riparian	UP	4	4					
plant	*Calopogon tuberosus*	tuberous grass pink	G5	S2	S1	LR	Riparian	UP	4	3					
plant	*Carex aquatilis*	water sedge	G5	S1	S1	LR	Riparian	U1	4	2					
plant	*Carex arctata*	*Black sedge*	G5	S1	S1	*LR*	Riparian	U1	4	2					
plant	*Carex barrattii*	Barratt's sedge	G4	S2	_	LR	Riparian	U1	3	2					
plant	*Carex buxbaumii*	Buxbaum's sedge	G5	S2	S2	LR	Riparian	U1	4	3					
plant	*Carex conoidea*	field sedge	G5	S1S2	S1	LR	Riparian	UP	4	2					
plant	*Carex cristatella*	crested sedge	G5	S2	S4	LR	Riparian	UP	4	3					
plant	*Carex interior*	inland sedge	G5	S1	S1	LR	Riparian	UP	4	4					
plant	*Carex lasiocarpa var. americana*	slender sedge	G5T5	S1	S1	LR	Riparian	U1	4	3					
plant	*Carex schweinitzii*	Schweinitz's sedge	G3G4	S1	_	LR	Riparian	UP	4	4					
plant	*Carex vesicaria*	inflated sedge	G5	S1S2	S2	LR	Riparian	U1	4	3					
plant	*Cyperus dentatus*	toothed flatsedge	G4	S1	SNR	LR	Riparian	UP	4	4					
plant	*Cypripedium reginae*	showy lady's-slipper	G4	S1	S1	LR	Riparian	U1	4	3					

Species			Habitat and Ranking								Species Sensitivity Factor				
GROUP	SCIENTIFIC NAME	COMMON NAME	G-RANK	S-RANK VA	S-RANK WV	STATUS	POTENTIAL HABITAT ON FS	UNIT RANK	GLOBAL CONSERVATION IMPORTANCE RATING	REGIONAL CONSERVATION IMPORTANCE RATING	SEDIMENT	HABITAT COMPLEXITY	TEMP.	ACID DEPOSITION	PASSAGE
plant	*Echinodorus tenellus*	dwarf burhead	G5?	S1	–	LR	Riparian	UH	4	4					
plant	*Eleocharis compressa*	flattened spikerush	G4	S2	S2	LR	Riparian	U1	4	2					
plant	*Eleocharis melanocarpa*	black-fruited spikerush	G4	S2	_	LR	Riparian	U1	3	2					
plant	*Eleocharis robbinsii*	Robbins spikerush	G4G5	S1	_	LR	Riparian	U1	4	3					
plant	*Elymus canadensis*	nodding wild rye	G5	S2?	S5	LR	Riparian	UP	4	4					
plant	*Epilobium leptophyllum*	linear-leaved willow-herb	G5	S2	S3	LR	Riparian	U1	4	3					
plant	*Equisetum sylvaticum*	Woodland horsetail	G5	S1	S1	LR	Riparian	U1	4	4					
plant	*Eriocaulon aquaticum*	white buttons	G5	S1	_	LR	Riparian	U1	4	3					
plant	*Eupatorium maculatum*	spotted joe-pye weed	G5	S2	S1	LR	Riparian	UP	4	4					
plant	*Glyceria acutiflora*	sharp-scaled manna-grass	G5	S3	S2	LR	Riparian	U2	4	3					
plant	*Glyceria grandis*	American manna-grass	G5	S1	S2	LR	Riparian	U1	4	3					
plant	*Huperzia appalachiana*	Appalachian fir clubmoss	G5	S2	_	LR	Riparian	UP	4	4					
plant	*Hypericum boreale*	northern St. John's-wort	G5	S2	SH	LR	Riparian	U1	4	4					
plant	*Hypericum ellipticum*	pale St. John's-wort	G5	SH	S4	LR	Riparian	UNP	5	5					
plant	*Isoetes lacustris*	lake quillwort	G5	S1?	_	LR	Riparian	U1	4	4					
plant	*Juncus brachycephalus*	small-head rush	G5	S2	_	LR	Riparian	U1	4	3					
plant	*Juncus brevicaudatus*	narrow-panicled rush	G5	S2	S4	LR	Riparian	U1	4	4					

Species			Habitat and Ranking								Species Sensitivity Factor				
GROUP	SCIENTIFIC NAME	COMMON NAME	G-RANK	S-RANK VA	S-RANK WV	STATUS	POTENTIAL HABITAT ON FS	UNIT RANK	GLOBAL CONSERVATION IMPORTANCE RATING	REGIONAL CONSERVATION IMPORTANCE RATING	SEDIMENT	HABITAT COMPLEXITY	TEMP.	ACID DEPOSITION	PASSAGE
plant	*Lachnanthes caroliniana*	Carolina redroot	G4	SH	_	LR	Riparian	UH	5	5					
plant	*Liparis loeselii*	Loesel's twayblade	G5	S2	S3	LR	Riparian	U1	4	3					
plant	*Lycopodiella inundata*	northern bog clubmoss	G5	S1	S2?	LR	Riparian	UP	4	4					
plant	*Lythrum alatum*	winged loosestrife	G5	S2	S2	LR	Riparian	UP	4	4					
plant	*Muhlenbergia glomerata*	marsh muhly	G5	S2	SNR	LR	Riparian	U1	4	4					
plant	*Osmunda cinnamomea var. glandulosa*	glandular cinnamon fern	G5TNR	SNR	SNR	LR	Riparian	U1	3	2					
plant	*Panicum hemitomon*	maidencane	G5?	S2	_	LR	Riparian	U1	4	3					
plant	*Parnassia grandiflora*	Large-leaved grass-of-parnassus	G3	S2	S1	LR	Riparian	UP	4	4					
plant	*Platanthera grandiflora*	large purple fringed orchid	G5	S1	S4	LR	Riparian	U1	4	4					
plant	*Platanthera peramoena*	purple fringeless orchis	G5	S2	S4	LR	Riparian	U1	4	3					
plant	*Poa palustris*	fowl bluegrass	G5	S1S2	S4	LR	Riparian	U1	4	4					
plant	*Polanisia dodecandra*	common clammy-weed	G5	S1	SNA	LR	Riparian	UP	4	4					
plant	*Potamogeton amplifolius*	Large leaf pondweed	G5	S1S2	S4	LR	Riparian	U2	4	4					
plant	*Potamogeton oakesianus*	Oakes pondweed	G4	S2	SH	LR	Riparian	U1	4	3					
plant	*Ribes americanum*	Wild black currant	G5	S1	S4	LR	Riparian	U1	4	4					
plant	*Sabatia campanulata*	slender marsh rose-pink	G5	S2	_	LR	Riparian	U1	3	3					

Species			Habitat and Ranking								Species Sensitivity Factor				
GROUP	SCIENTIFIC NAME	COMMON NAME	G-RANK	S-RANK VA	S-RANK WV	STATUS	POTENTIAL HABITAT ON FS	UNIT RANK	GLOBAL CONSERVATION IMPORTANCE RATING	REGIONAL CONSERVATION IMPORTANCE RATING	SEDIMENT	HABITAT COMPLEXITY	TEMP.	ACID DEPOSITION	PASSAGE
plant	*Sagittaria calycina var calycina*	long-lobed arrowhead	G5T5?	S1	S2	LR	Riparian	U1	4	2					
plant	*Sagittaria rigida*	sessile-fruited arrowhead	G5	S1	SNA	LR	Riparian	UP	4	3					
plant	*Schoenoplectus subterminalis*	water bulrush	G4G5	S1S2	_	LR	Riparian	U1	4	4					
plant	*Scirpus torreyi*	Torrey's bulrush	G5?	S1	S1	LR	Riparian	UP	4	3					
plant	*Solidago rupestris*	riverbank goldenrod	G4?	S1	_	LR	Riparian	U1	4	2					
plant	*Solidago uliginosa*	bog goldenrod	G4G5	S2	S4	LR	Riparian	U1	4	3					
plant	*Sparganium chlorocarpum*	narrow-leaf burreed	G5	S1		LR	Riparian	U2	4	3					
plant	*Spartina pectinata*	freshwater cordgrass	G5	S2	S4	LR	Riparian	UP	4	4					
plant	*Sphagnum russowii*	Russow's peatmoss	G5	S1S2	-	LR	Riparian	U2	4	3					
plant	*Spiranthes lucida*	shining ladies'-tresses	G5	S1	S1S2	LR	Riparian	UP	4	4					
plant	*Spiranthes ochroleuca*	yellow nodding ladies'-tresses	G4	S1	S5	LR	Riparian	U1	3	3					
plant	*Triadenum fraseri (Hypericum v.)*	Fraser's marsh St. John's-wort	G5	S1	S4	LR	Riparian	UP	4	4					
plant	*Triantha racemosa*	coastal false-asphodel	G5	S1	_	LR	Riparian	U1	4	4					
plant	*Vaccinium macrocarpon*	large cranberry	G4	S2	S2	LR	Riparian	U1	4	3					
plant	*Verbena scabra*	sandpaper vervain	G5	S2	S1	LR	Riparian	UP	4	4					
plant	*Veronica scutellata*	marsh speedwell	G5	S1	S2	LR	Riparian	UP	4	4					

Species			Habitat and Ranking								Species Sensitivity Factor				
GROUP	SCIENTIFIC NAME	COMMON NAME	G-RANK	S-RANK VA	S-RANK WV	STATUS	POTENTIAL HABITAT ON FS	UNIT RANK	GLOBAL CONSERVATION IMPORTANCE RATING	REGIONAL CONSERVATION IMPORTANCE RATING	SEDIMENT	HABITAT COMPLEXITY	TEMP.	ACID DEPOSITION	PASSAGE
plant	*Viburnum lentago*	nannyberry	G5	S1	S1S2	LR	Riparian	UP	4	4					
plant	*Vicia americana*	American purple vetch	G5	S1S2	S4	LR	Riparian	UP	4	4					
plant	*Woodwardia virginica*	Virginia chainfern	G5	S5	SNR	LR	Riparian	U1	4	4					

*G-Rank = global rank; S-Rank VA= State rank in Virginia; S-Rank WV=State rank in West Virginian; Unit Rank=Rank of rarity on the GWNF (U1=critically imperiled, U2=imperiled, U3=vulnerable, U4=apparently secure, U5=secure, UU=unrankable, UH=historical, UX=presumed extirpated, UP=possibly present, UNP=not present, UNR=not ranked, UNA=not applicable)

**Sensitivity factors were not assigned to those species with "riparian" as potential habitat.

Table H-5. Changes* to Viability by Forest Plan Alternative**

Scientific Name	Common Name	Watershed	Viability outcome from Table H-3	Alt. A	Alt. B	Alt. C	Alt. D	Alt. E	Alt. F	Alt. G	Alts. H and I
Pleurobema collina	James spinymussel	Potts Creek	C	o	+	+	+	+	+	+	+
		Cowpasture River	C	o	+	+	+	+	+	+	+
		Catawba Creek-James River	E	o	+	+	+	+	+	+	+
		Craig Creek	C	o	+	+	+	+	+	+	+
		Calfpasture River	C	o	+	+	+	+	+	+	+
		Pedlar River-James River	C	o	+	+	+	+	+	+	+
Helenium virginicum	Virginia sneezeweed	Back Creek-South River	B	o	+	+	o	+	+	+	+
		Naked Creek-South Fork Shenandoah River	C	o	+	+	o	+	+	+	+
Helonias bullata	swamp pink	Back Creek-South River	B	o	+	+	o	+	+	+	+
		Irish Creek-South River	B	o	+	+	o	+	+	+	+
Scirpus ancistrochaetus	northeastern bulrush	Dry River-North River	D	o	+	+	o	+	+	+	+
		Back Creek-South River	E	o	+	+	o	+	+	+	+
		Naked Creek-South Fork Shenandoah River	E	o	+	+	o	+	+	+	+
		Potts Creek	D	o	+	+	o	+	+	+	+
		Back Creek-Jackson River	E	o	+	+	o	+	+	+	+
Notropis semperasper	Roughhead shiner	Dunlap Creek	C	o	+	+	o	+	+	+	+
		Potts Creek	C	o	+	+	o	+	+	+	+
		Back Creek-Jackson River	B	o	+	+	o	+	+	+	+
		Wilson Creek-Jackson River	C	o	+	+	o	+	+	+	+
		Cowpasture River	B	o	+	+	o	+	+	+	+
		Catawba Creek-James River	C	o	+	+	o	+	+	+	+
		Craig Creek	C	o	+	+	o	+	+	+	+
		Calfpasture River	C	o	+	+	o	+	+	+	+
Noturus gilberti	Orangefin madtom	Cowpasture River	C	o	+	+	o	+	+	+	+
		Craig Creek	C	o	+	+	o	+	+	+	+
Hydraena maureenae	Maureen's shale stream beetle	Shoemaker River-North Fork Shenandoah River	D	o	+	+	o	+	+	+	+
		Wilson Creek-Jackson River	E	o	+	+	o	+	+	+	+

Scientific Name	Common Name	Watershed	Viability outcome from Table H-3	Alt. A	Alt. B	Alt. C	Alt. D	Alt. E	Alt. F	Alt. G	Alts. H and I
		Cowpasture River	B	o	+	+	o	+	+	+	+
		Craig Creek	E	o	+	+	o	+	+	+	+
		Calfpasture River	D	o	+	+	o	+	+	+	+
Cicindela ancocisconensis	Appalachian tiger beetle	Wilson Creek-Jackson River	E	o	+	+	o	+	+	+	+
		Cowpasture River	D	o	+	+	o	+	+	+	+
Sorex palustris punctulatus	southern water shrew	North Fork South Branch Potomac River	D	o	+	+	o	+	+	+	+
		Back Creek-Jackson River	D	o	+	+	o	+	+	+	+
Alasmidonta varicosa	Brook floater	Gooney Run-South Fork Shenandoah River	E	o	+	+	o	+	+	+	+
		Smith Creek-North Fork Shenandoah River	E	o	+	+	o	+	+	+	+
		Stony Creek-North Fork Shenandoah River	E	o	+	+	o	+	+	+	+
Elliptio lanceolata	Yellow lance	Wilson Creek-Jackson River	C	o	+	+	o	+	+	+	+
		Cowpasture River	C	o	+	+	o	+	+	+	+
		Catawba Creek-James River	E	o	+	+	o	+	+	+	+
		Craig Creek	C	o	+	+	o	+	+	+	+
		Maury River	C	o	+	+	o	+	+	+	+
		Pedlar River-James River	C	o	+	+	o	+	+	+	+
Fusconaia masoni	Atlantic pigtoe	Catawba Creek-James River	E	o	+	+	+	+	+	+	+
		Craig Creek	C	o	+	+	+	+	+	+	+
		Calfpasture River	E	o	+	+	+	+	+	+	+
Lasmigona subviridis	Green floater	Stony Creek-North Fork Shenandoah River	C	o	+	+	o	+	+	+	+
		Pedlar River-James River	C	o	+	+	o	+	+	+	+
		Tye River	C	o	+	+	o	+	+	+	+
Villosa constricta	Notched Rainbow	Potts Creek	C	o	+	+	o	+	+	+	+
		Cowpasture River	C	o	+	+	o	+	+	+	+
		Catawba Creek-James River	C	o	+	+	o	+	+	+	+
		Craig Creek	C	o	+	+	o	+	+	+	+

Scientific Name	Common Name	Watershed	Viability outcome from Table H-3	Alt. A	Alt. B	Alt. C	Alt. D	Alt. E	Alt. F	Alt. G	Alts. H and I
		Maury River	C	o	+	+	o	+	+	+	+
		Pedlar River-James River	C	o	+	+	o	+	+	+	+
Peltigera hydrothyria	waterfan	North Fork South Branch Potomac River	B	o	+	+	o	+	+	+	+
		Middle River	B	o	+	+	o	+	+	+	+
		Stony Creek-North Fork Shenandoah River	B	o	+	+	o	+	+	+	+
		Cowpasture River	B	o	+	+	o	+	+	+	+
		Irish Creek-South River	A	o	+	+	o	+	+	+	+
		Tye River	A	o	+	+	o	+	+	+	+
		Buffalo River	A	o	+	+	o	+	+	+	+
Ambystoma tigrinum	eastern tiger salamander	Back Creek-South River	B	o	+	+	o	+	+	+	+
Cambarus monongalensis	A Crayfish	North Fork South Branch Potomac River	B	o	+	+	o	+	+	+	+
Anguilla rostrata	American eel	Middle River	C	o	+	+	o	+	+	+	+
		Dry River-North River	C	o	+	+	o	+	+	+	+
		Back Creek-South River	C	o	+	+	o	+	+	+	+
		Naked Creek-South Fork Shenandoah River	C	o	+	+	o	+	+	+	+
		Gooney Run-south Fork Shenandoah River	B	o	+	+	o	+	+	+	+
		Smith Creek-North Fork Shenandoah River	C	o	+	+	o	+	+	+	+
		Stony Creek-North Fork Shenandoah River	C	o	+	+	o	+	+	+	+
		Cedar Creek	A	o	+	+	o	+	+	+	+
		Craig Creek	E	o	+	+	o	+	+	+	+
		Pedlar River-James River	C	o	+	+	o	+	+	+	+
		Tye River	A	o	+	+	o	+	+	+	+
		Buffalo River	A	o	+	+	o	+	+	+	+
		Rockfish River	C	o	+	+	o	+	+	+	+
Salvelinus fontinalus	Brook trout	North Fork South Branch Potomac River	B	o	+	+	o	+	+	+	+
		South Fork South Branch Potomac River	B	o	+	-	o	+	+	+	+
		Cacapon River	B	o	+	-	o	+	+	+	+
		Dry River-North River	A	o	+	-	o	+	+	+	+
		Back Creek-South River	B	o	+	-	o	+	+	+	+
		Naked Creek-South Fork Shenandoah River	B	o	+	+	o	+	+	+	+

Scientific Name	Common Name	Watershed	Viability outcome from Table H-3	Alt. A	Alt. B	Alt. C	Alt. D	Alt. E	Alt. F	Alt. G	Alts. H and I
		Gooney Run-south Fork Shenandoah River	B	o	+	+	o	+	+	+	+
		Shoemaker River-North Fork Shenandoah River	B	o	+	-	o	+	+	+	+
		Smith Creek-North Fork Shenandoah River	B	o	+	-	o	+	+	+	+
		Stony Creek-North Fork Shenandoah River	A	o	+	-	o	+	+	+	+
		Cedar Creek	B	o	+	-	o	+	+	+	+
		Dunlap Creek	B	o	+	-	o	+	+	+	+
		Potts Creek	B	o	+	-	o	+	+	+	+
		Back Creek-Jackson River	A	o	+	-	o	+	+	+	+
		Wilson Creek-Jackson River	A	o	+	-	o	+	+	+	+
		Cowpasture River	A	o	+	-	o	+	+	+	+
		Catawba Creek-James River	C	o	+	-	o	+	+	+	+
		Craig Creek	B	o	+	-	o	+	+	+	+
		Calfpasture River	A	o	+	-	o	+	+	+	+
		Little Calfpasture River	B	o	+	-	o	+	+	+	+
		Maury River	B	o	+	+	o	+	+	+	+
		Irish Creek-South River	A	o	+	-	o	+	+	+	+
		Pedlar River-James River	B	o	+	+	o	+	+	+	+
		Tye River	A	o	+	+	o	+	+	+	+
		Buffalo River	B	o	+	+	o	+	+	+	+
		Rockfish River	B	o	+	+	o	+	+	+	+
Cottus cf. cognatus	Checkered sculpin	Cacapon River	C	o	+	-	o	+	+	+	+
Aeshna canadensis	Canada darner	North Fork South Branch Potomac River	D	o	+	+	o	+	+	+	+
Aeshna tuberculifera	black-tipped darner	North Fork South Branch Potomac River	D	o	+	+	o	+	+	+	+
		Dry River-North River	B	o	+	+	o	+	+	+	+
		Back Creek-South River	B	o	+	+	o	+	+	+	+
		Naked Creek-South Fork Shenandoah River	D	o	+	+	o	+	+	+	+
		Potts Creek	B	o	+	+	o	+	+	+	+
		Wilson Creek-Jackson River	C	o	+	+	o	+	+	+	+
		Catawba Creek-James River	E	o	+	+	o	+	+	+	+
Aeshna verticalis	green-striped darner	North Fork South Branch Potomac River	D	o	+	+	o	+	+	+	+

Scientific Name	Common Name	Watershed	Viability outcome from Table H-3	Alt. A	Alt. B	Alt. C	Alt. D	Alt. E	Alt. F	Alt. G	Alts. H and I
Anax longipes	comet darner	Back Creek-South River	B	o	+	+	o	+	+	+	+
Calopteryx amata	Superb jewelwing	North Fork South Branch Potomac River	D	o	+	+	o	+	+	+	+
Calopteryx angustipennis	Appalachian jewelwing	Stony Creek-North Fork Shenandoah River	B	o	+	+	o	+	+	+	+
		Cowpasture River	B	o	+	+	o	+	+	+	+
		Craig Creek	C	o	+	+	o	+	+	+	+
		Maury River	C	o	+	+	o	+	+	+	+
Celithemis martha	Martha's penant	Back Creek-South River	B	o	+	+	o	+	+	+	+
Cordulegaster diastatops	delta-spotted spiketail	North Fork South Branch Potomac River	B	o	+	+	o	+	+	+	+
Enallagma annexum (AKA cyathigerum)	northern bluet	North Fork South Branch Potomac River	D	o	+	+	o	+	+	+	+
Epitheca canis	beaverpond baskettail	North Fork South Branch Potomac River	D	o	+	+	o	+	+	+	+
Gomphus adelphus	mustached clubtail	Cowpasture River	C	o	+	+	o	+	+	+	+
		Calfpasture River	C	o	+	+	o	+	+	+	+
Gomphus quadricolor	rapids clubtail	Cowpasture River	C	o	+	+	o	+	+	+	+
		Craig Creek	C	o	+	+	o	+	+	+	+
		Calfpasture River	C	o	+	+	o	+	+	+	+
Ladona julia (AKA Libellula julia)	chalk-fronted corporal skimmer	North Fork South Branch Potomac River	D	o	+	+	o	+	+	+	+
Lanthus parvulus	double-striped clubtail	North Fork South Branch Potomac River	B	o	+	+	o	+	+	+	+
Lestes disjunctus	northern spreadwing	North Fork South Branch Potomac River	D	o	+	+	o	+	+	+	+
		Back Creek-Jackson River	C	o	+	+	o	+	+	+	+
		Wilson Creek-Jackson River	C	o	+	+	o	+	+	+	+

Scientific Name	Common Name	Watershed	Viability outcome from Table H-3	Alt. A	Alt. B	Alt. C	Alt. D	Alt. E	Alt. F	Alt. G	Alts. H and I
Leucorrhinia hudsonica	Hudsonian whiteface	North Fork South Branch Potomac River	D	o	+	+	o	+	+	+	+
Nehalennia irene	sedge sprite	North Fork South Branch Potomac River	D	o	+	+	o	+	+	+	+
Neurocordulia yamaskanensis	stygian shadowdragon	Stony Creek-North Fork Shenandoah River	C	o	+	+	o	+	+	+	+
		Wilson Creek-Jackson River	C	o	+	+	o	+	+	+	+
Rhionaeschna mutata (AKA Aeshna mutata)	spatterdock darner	North Fork South Branch Potomac River	D	o	+	+	o	+	+	+	+
		Potts Creek	C	o	+	+	o	+	+	+	+
Somatochlora elongata	Ski-tipped emerald	North Fork South Branch Potomac River	D	o	+	+	o	+	+	+	+
Sympetrum obtrusum	white-faced meadowhawk	North Fork South Branch Potomac River	D	o	+	+	o	+	+	+	+
Isonychia hoffmani	Hoffman's Isonychia mayfly	North Fork South Branch Potomac River	B	o	+	+	o	+	+	+	+
Nemotaulius hostilis	a limnephilid caddisfly	North Fork South Branch Potomac River	D	o	+	+	o	+	+	+	+
Clemmys guttata	spotted turtle	Back Creek-South River	D	o	+	+	o	+	+	+	+
Glyptemys insculpta	wood turtle	South Fork South Branch Potomac River	C	o	+	+	o	+	+	+	+
		Cacapon River	B	o	+	+	o	+	+	+	+
		Shoemaker River-North Fork Shenandoah River	B	o	+	+	o	+	+	+	+
		Smith Creek-North Fork Shenandoah River	C	o	+	+	o	+	+	+	+
		Stony Creek-North Fork Shenandoah River	B	o	+	+	o	+	+	+	+
		Cedar Creek	B	o	+	+	o	+	+	+	+

* +, increased protection for aquatic and riparian habitat from current plan over the planning period
-, decreased protection for aquatic and riparian habitat from current plan over the planning period
o, no change in protection for aquatic and riparian habitat from current plan over the planning period

**Birds and non-TE plants and mammals were not included in this analysis because species occurrence locations were not readily available in GIS format. See Terrestrial Ecological Analysis.

APPENDIX I – ANALYSIS OF CONCERNS AND RISKS OF HORIZONTAL DRILLING AND HYDRAULIC FRACTURING

This Appendix contains two documents used in the analysis of the availability of gas leasing. The first document is "*Specific Concerns with Gas Development and Actions to Address the Concerns.*" The second document is "*A Review of the Concerns and Risks of Improper Implementation of Mitigation Measures for Horizontal Drilling and Hydraulic Fracturing*."

PART I: SPECIFIC CONCERNS WITH GAS DEVELOPMENT AND ACTIONS TO ADDRESS THE CONCERNS

The Forest Interdisciplinary Team reviewed public comments and information on gas drilling to develop a specific list of potential impacts and actions that can be used to reduce the potential for those impacts to occur.

1. Effects of water withdrawals on surface and groundwater supplies and on wetlands

Flow reduction in streams and aquifers can impact water quality (for example: temperature, dissolved oxygen, chemistry).

Flow reduction in streams and aquifers can impact water quantity available for aquatic organism habitat, especially during summer and fall when flows are generally low.

Water withdrawal structures can result in entrainment and impingement of aquatic organisms.

Transporting water can transfer invasive species from one waterbody to another via trucks, hoses, pipelines, and other equipment.

Aquifer depletion from either surface or groundwater pumping.

Aquifer depletion leading to decline in groundwater level and effect on nearby streams, rivers, and wetlands that are connected to groundwater.

Hydrologic changes to wetlands can negatively affect wetland plants and animals.

Actions needed to address the concern:

a. Modify standard11-043 under Riparian Corridors as follows:

The riparian corridors are suitable for federal oil and gas leasing with a controlled surface use stipulation to protect riparian resources and values. *Roads, pipelines, and utilities associated with access to lease operations may be allowed to cross riparian areas. Well pads and associated well development infrastructure are not allowed in riparian areas.* Other Federal minerals may be available on a case-by-case basis after full consideration of effects on the riparian corridor.

b. Modify standard 11-044 under Riparian Corridors as follows:

~~Federal oil and gas leases exist within these corridors.~~ *On existing Federal oil and gas leases,* roads, ~~wells, and other necessary infrastructure~~ *pipelines, and utilities* associated with *access to lease operations may be* ~~these leases are~~ *allowed to cross riparian areas. Well pads and associated well development infrastructure are not allowed in riparian areas.* Existing lease terms and stipulations are used to protect the riparian corridor.

c. Add forestwide standard under Minerals and Geologic Resources as follows:

The Forest Service will only approve Surface Use Plans of Operations associated with Applications for Permit to Drill that contain the following provisions:

1) Water will not be withdrawn from surface water or groundwater sources on the Forest unless a qualified Forest Service employee determines that this withdrawal will result in less overall environmental impacts than the impacts of not withdrawing the water;
2) Only closed loop systems will be used for hydraulic fracturing;
3) Drill cuttings will be removed from the drill site and disposed of at approved sites off the Forest, unless authorized by qualified Forest Service employee;

4) Secondary containment infrastructure will be used at the site to reduce impacts from stormflow or spills;
5) No surface disposal of flowback water or produced waters will be allowed on the National Forest;
6) Non-native invasive species occurring at the site of new openings constructed in association with drilling activities will be treated as long as the well is under lease.

2. Effects of accidental spills on soils and water during drilling phase and stimulation phase

Contamination of surface water bodies and groundwater resources from ineffective site management and surface and subsurface fluid containment practices.

Contamination of surface water bodies and groundwater resources from accidental spills and releases (from tank ruptures, equipment or surface impoundment failures, overfills, vandalism, accidents (including vehicle collisions), ground fires, or improper operations).

Contamination of surface water bodies and groundwater resources from spilled, leaked, or released fluids, pit leakage or failure.

Greater intensity and duration of surface activities associated with well pads with multiples wells increases the odds of an accidental spill if mitigation measures are not sufficiently durable.

What are the monitoring capabilities and response times for emergency responses to accidents? What is the onsite presence during operations? How long can accidents continue before they are identified and mitigated?

Actions needed to address the concern:

a. Modify current riparian standards 11-043 and 11-044 as shown in Concern 1.
b. Identify Public Water Supply Watersheds as not suitable for leasing to reduce potential for any accidental spills from affecting water supplies. In addition, include the watersheds upstream of the Public Water Supply Watersheds on the Pedlar River and Dry River since they are the only water supplies surrounded by National Forest System lands that do not extend to include the entire watershed.
c. Add a forestwide standard under Minerals and Geologic Resources as in Concern 1.
d. Disclosure of chemicals used (See Concern 15).
e. BLM and the Forest Service will utilize best available information (such as the Gold Book, appropriate standards and best practices for hydraulic fracturing identified by the American Petroleum Institute, Onshore Oil & Gas Order No. 2) in preparing conditions of approval for the APD and in preparing the Surface Use Plan.
f. Monitoring implementation of these measures will be done by State inspectors, BLM inspectors and Forest Service inspectors.

3. Groundwater contamination during drilling or fracking operations

Contamination of surface water bodies and groundwater resources from poor casing construction and grouting.

Flowback components include gelling agents, surfactants, chlorides, dissolved solids, metals, biocides, lubricants, organics and radionuclides (water containing tens of thousands of pounds of chemicals, salt, and sand) that can contaminate surface and groundwater.

Not knowing the composition of the fracking fluids used on the site.

Millions of gallons of contaminated flowback water remaining in the ground during and after production, or stored in injection wells.

Corrosive agents used in fracking fluid could eventually erode casings (even the extra steel and concrete required in wells to protect groundwater) and contaminate entire aquifers.

Earthquakes could crack concrete casings causing contamination of aquifers.

Shale deposits adjacent to limestone geology where residual frac water under pressure could find its way into karst water, potentially affecting fragile aquatic karst biota.

Potential effects of concentrated solids, contaminated with radioactive wastes (radium), extracted from the ground following shale fracture.

Potential effects of natural gas contamination of drinking water.
Water quality monitoring before, during and after activity, including adjacent private wells.

Actions needed to address the concern:

a. Identify Public Water Supply Watersheds as in Concern 2.
b. Add a forestwide standard under Minerals and Geologic Resources as in Concern 1.
c. Disclosure of chemicals used (See Concern 15).
d. Utilize best available information as in Concern 2.
e. Forest Plan strategy should identify that the Forest will encourage companies to monitor any private drinking water wells located within 1,000 feet of wells drilled on the Forest.
f. Monitoring implementation of these measures will be done by State inspectors, BLM inspectors and Forest Service inspectors.

4. Water contamination from improper treatment of flowback water

Proper design, construction, operation, closure, and regulatory oversight of centralized flowback water surface impoundments and pipelines.

Flowback water dilution and reuse system has environmental benefits, including reduced demand for fresh water, reduced truck traffic, and reduced need for flowback water treatment and disposal.

Contaminated flowback that is trucked off site may not be able to be effectively treated, and a mixture of sand, salt, biocides, surfactants, lubricants, and solvents could pass directly into rivers.

Management of drill cuttings and other solid waste materials.

Land application of contaminated flowback and solids could sterilize soil, kill vegetation, and enter surface and groundwater.

At the very least, flowback water is known to contain high levels of chloride, which has a number of biological and non-biological effects, passing readily through soil and will eventually enter surface or ground water.

Actions needed to address the concern:

a. Identify Public Water Supply Watersheds as in Concern 2.
b. Add a forestwide standard under Minerals and Geologic Resources as in Concern 1.
c. There are no authorized underground injection wells for waste disposal on the Forest. These wells are regulated by EPA. Any approval of such a well would be subject to NEPA through a process separate from the forest planning process.
d. Disclosure of chemicals used (See Concern 15).
e. Utilize best available information as in Concern 2.
f. Treatment of any flowback waters would be subject to State requirements for treatment since these fluids would not be allowed to be disposed on the Forest.
g. Monitoring implementation of these measures will be done by State inspectors, BLM inspectors and Forest Service inspectors.

5. Contamination of surface or groundwater from stormwater during operations

Contamination of surface water bodies and groundwater resources from failure to maintain storm-water controls.

Water resource impacts if storm water is not properly managed during all phases of well development (land clearing, access roads, equipment staging areas, well pads, drilling and fracturing operations, production and final reclamation).

Land clearing exposes soil to erosion and more rapid runoff.

Steep access roads, well pads on hill slopes, and well pads constructed by cut-and-fill operations pose particular challenges to stabilizing soil.

Equipment fluids (hydraulic fluid, fuel, and lubricating fluids) and any materials that are spilled are exposed to rainfall and contaminants may be conveyed off-site during rain events.

Greater potential for storm water impacts from a larger well pad during the production phase, compared with a smaller well pad for a single vertical well.

Actions needed to address the concern:

a. Modify current riparian standards 11-043 and 11-044 as in Concern 1.
b. Identify Public Water Supply Watersheds as in Concern 2.
c. Add a forestwide standard under Minerals and Geologic Resources as in Concern 1.
d. Disclosure of chemicals used (See Concern 15).
e. Utilize best available information as in Concern 2.
f. Monitoring implementation of these measures will be done by State inspectors, BLM inspectors and Forest Service inspectors.

6. Pit or surface impoundment leakage or failure affecting vegetation and water quality

Wastewater flowback water stored in holding ponds or onsite tanks, potentially adjacent to perennial or intermittent stream channels, subject to overflow, leakage, or spillage, causing fish kills, affecting aquatic food webs, or drinking water.

Additional potential of releases from hoses or pipes used to convey flowback water to tanks, an on-site pit, a centralized surface impoundment, or a tanker truck for transportation to a treatment or disposal site.

Heightened concern if on-site pits are constructed on the filled portion of a cut-and-filled well pad.

Additional potential of releases from tank leakage or failure of a pit or surface impoundment to effectively contain fluid.

Soil, wetland, surface water and groundwater contamination from spills, leaks, or other failure of the impoundment to effectively contain fluid.

Including problems associated with liner or construction defects, unstable ballast, or operation-related liner damage.

Soil, wetland, surface water and groundwater contamination from spills or leaks of hoses or pipes used to convey flowback water to or from the centralized surface impoundment.

Physical damage similar to that from dam failure if a breach occurs.

Lethal and sub-lethal effects to biota that use the impoundment (mammals, birds, amphibians, reptiles, insects etc.)

Actions needed to address the concern:

a. Modify current riparian standards 11-043 and 11-044 as in Concern 1.
b. Identify Public Water Supply Watersheds as in Concern 2.
c. Add a forestwide standard under Minerals and Geologic Resources as in Concern 1.
d. Disclosure of chemicals used (See Concern 15).
e. Utilize best available information as in Concern 2.
f. Monitoring implementation of these measures will be done by State inspectors, BLM inspectors and Forest Service inspectors

7. Roads and other surface disturbance increasing non-point source pollution

Sediment effects from the large number of trucks on roads, especially if usage continues in any weather, any season.

Fugitive dust contamination into nearby or adjacent waterways.

Actions needed to address the concern:

a. Modify current riparian standards 11-043 and 11-044 as in Concern 1.
b. Identify Public Water Supply Watersheds as in Concern 2.
c. Utilize best available information as in Concern 2.
d. Utilize Forest Plan standards regarding roads and sediment.
e. Add a forestwide standard under Minerals and Geologic Resources as follows:
Generally pipelines associated with development of natural gas resources will be constructed within road corridors.

8. Impact of the creation of openings on the spread of non-native invasive species

Actions needed to address the concern:

a. Utilize forestwide standards related to non-native invasive plants.
b. Add a forestwide standard under Minerals and Geologic Resources as in Concern 1.

9. Effects of new roads and drilling activities on semi-primitive recreation settings, increased probability of encounters with others, public safety with increased truck traffic, wildlife, hunting and other recreation users

Actions needed to address the concern:

a. These impacts can be addressed through conditions of approval of the surface use plan and application for permit to drill. Time of year restrictions can be used, as can use of technology to shield nighttime lighting. Approval of road locations can also influence the extent of these impacts.
b. Public safety based on site specific plans for truck traffic and road use would be part of conditions of approval of the APD.
c. Federal Onshore Oil & Gas Operations Order No. 1 requires: "The operator must improve or maintain existing roads in a condition the same as or better than before operations began...When access involves use of existing roads, the FS may require that the operator contribute to road maintenance."

10. Impacts of drilling operations, road construction, well pad construction and operations on Special Biological Areas

Actions needed to address the concern:

a. Identify Special Biological Areas, Shenandoah Crest and Key Natural Heritage Community Areas as suitable for leasing only with NSO to prevent impacts to the sensitive biological communities in these areas.
b. Identify the area above 3,000 feet in elevation on Shenandoah Mountain south of Highway 250 as suitable for leasing only with NSO due to the known presence of Cow Knob salamander.
c. Identify the Indiana bat secondary protection areas as suitable for leasing only with NSO to reduce impacts to the bat.

11. Effects of drilling and well stimulation on caves and karst resources

Actions needed to address the concern:

a. Identify geologic areas and the Indiana bat primary protection areas as suitable for leasing only with NSO to reduce potential for any impacts on caves and karst resources.
b. Utilize best available information as in Concern 2.
c. Monitoring implementation of these measures will be done by State inspectors, BLM inspectors and Forest Service inspectors.

12. Impacts on scenery of the new roads and the equipment installations

Actions needed to address the concern:

a. Any restrictions on locations of drill sites and roads in relation to scenic resources would be addressed as conditions of approval of the Surface Use Plan associated with the APD.
b. Utilize best available information as in Concern 2.

13. Potential impacts on earthquakes from well development activities

Actions needed to address the concern:

a. There are no underground injection wells on the Forest.

14. Impacts on air quality from well development

Actions needed to address the concern:

a. Operations will be subject to current EPA air quality regulations.
b. Utilize best available information as in Concern 2.
c. Monitoring implementation of these measures will be done by State inspectors, BLM inspectors and Forest Service inspectors.

15. Impacts of the chemicals used in drilling and well stimulation on Forest Service employees and Forest users

Actions needed to address the concern:

a. Add a new forestwide standard under a new section titled Material Safety as follows:
Any commercial operator proposing to work under the following Forest Service issued authorizations or approvals (concessionaire permit, timber contract, range allotment, Surface Use Plan of Operation under an Application for Permit to Drill, special use permit) must, upon request, provide information about materials proposed to be brought onto, stored on, or left on National Forest System lands. This information would include Material Safety Data Sheets (MSDS) sheets as well as identification of materials marked, labeled or placarded in accordance with the U. S. Department of Transportation's Hazardous Materials Regulations (49 CFR Parts 171 through 180). This requirement does not apply to building materials (such as wood, stone or asphalt) or fuel. Permittees are required to maintain Material Safety Data Sheets (MSDS) sheets for any hazardous materials on site. For material exceeding 1,000 gallons (or equivalent volume) in quantity, the permittee must also identify the proposed routes for entry and egress from the National Forest.

16. Concern about operations which could exceed the operations anticipated in RFD and FEIS or experiencing environmental impacts in excess of that identified in the FEIS.

The FS decision on lands available for leasing is subject to conditions in order to comply with FS consent to leasing specific lands (36CFR228.102(e)(1).

Actions needed to address the concern:

a. The FS will monitor oil & gas operations under federal Applications for Permit to Drill. If the number of oil & gas wells drilled reaches 90% of the number of wells estimated in the FEIS, then the Forest will withhold consent to new leases pending a review under 36CFR228.102(e)(1).

17. We have noted a record of accidents, lack of implementation of control measures, and improper use of control measures that have resulted in environmental impacts from development of wells using horizontal drilling and high volume hydraulic fracturing.

This occurs on state administered and federal administered wells. There appears to be an underlying level of violations on 4 to 10 percent of the inspections (or projects) and about 25 percent of these are considered to be serious. (See Part II of this paper)

Actions needed to address the concern:

a. Identify the above measures to reduce potential impacts.
b. Identify the most sensitive areas of the Forest as not suitable for leasing or suitable only with No Surface Occupancy stipulations.
c. Monitoring implementation of these measures will be done by State inspectors, BLM inspectors and Forest Service inspectors.

PART II: A REVIEW OF THE CONCERNS AND RISKS OF IMPROPER IMPLEMENTATION OF MITIGATION MEASURES FOR HORIZONTAL DRILLING AND HYDRAULIC FRACTURING

US FOREST SERVICE
GEORGE WASHINGTON NATIONAL FOREST, VIRGINIA AND WEST VIRGINIA
JULY 20, 2012

Overview: This document was developed to (1) illustrate the issues surrounding potential effects to aquatic resources from horizontal drilling and hydraulic fracturing for natural gas, (2) review mitigation measures that were designed to minimize specific impacts, and (3) use agency inspection data and research to evaluate the risk of improper implementation of mitigation measures and accidents.

1. Issue: Potential impacts to aquatic resources from horizontal drilling and large volume hydraulic fracturing associated with Marcellus shale gas well development on the George Washington National Forest (GWNF). Horizontal drilling in the Marcellus shale involves large volume hydraulic fracturing, which poses a number of risks to aquatic species and habitats. This type of hydraulic fracturing requires about five million gallons of water per well, with 1-3 wells per pad.[1] The water is mixed with sand and chemicals, and is pumped down wells at high pressure to fracture rock and release natural gas. Issues related to water resources and aquatic species and habitat include water withdrawals, surface water and groundwater contamination, and non-point source pollution from ground disturbing activities.

Water Withdrawals

Water Quantity

The impact from large volume water withdrawals varies not only with geographic area, but also with the quantity, quality, and sources of the water used. The removal of large volumes of water could lead to lowering of water tables or dewatering of drinking water aquifers, decreased stream flows, and reduced volumes of water in surface water reservoirs. These activities could impact the availability of water for drinking and other uses in areas where hydraulic fracturing is occurring.[2] Large volume water withdrawals from ground water can also lead to subsidence and/or destabilization of the geology.[2]

While water availability varies across the country, in some regions water used in hydraulic fracturing represents only a small fraction of total water consumption,[3] nonetheless, there are significant concerns about consumptive water use for shale gas development.[4] Furthermore, many of the water uses (such as power generation, and recreation) are not consumptive in the same way as energy extraction since they do not take water out of the system or degrade water quality.[5] A 2006 report to Congress on the Interdependency of Energy and Water points out that nationally, "available surface water supplies have not increased in 20 years, and groundwater tables and supplies are decreasing.".[5]

Public concerns regarding the George Washington National Forest Draft Plan Revision not only focused on large volume, high rate water withdrawals from small streams in the headwaters leaving insufficient stream flow for aquatic biota or to maintain stream habitat;[6,7] but also on withdrawals from watersheds that supply drinking water and other downstream agricultural and industrial uses.[8,9]

Water Quality

The lowering of water levels in aquifers may affect water quality by exposing naturally occurring minerals to an oxygen-rich environment; thereby causing chemical changes that may cause salination of the water and other chemical contaminations. In addition, lowered water tables may cause an upwelling of lower quality water from deeper within an aquifer, siltation or cloudiness of the produced water, or stimulate bacterial growth, causing taste and odor problems.[2]

Withdrawals of large quantities of water from surface water resources (e.g., streams) may have significant impacts on the hydrology and hydrodynamics of these resources. Such withdrawals from streams can alter the flow regime by changing their flow depth, velocity, and temperature.[10] Additionally, removal of significant volumes of water may reduce the dilution effect and increase the concentration of contaminants in surface water resources.[3] Furthermore, it is important to recognize that ground water and surface water are hydraulically connected;[11] any changes in the quantity and quality of the surface water will affect ground water and vice versa.

Surface and Groundwater Contamination

An average well requiring 3 million gallons of water requires the injection of 15,000 to 60,000 gallons of chemical additives.[2] The chemicals used in hydraulic fracturing may include oils, gels, acids, alcohols, and various human-made organic chemicals; many of these chemicals are potentially hazardous to human health and the surrounding environment.[12] In 2010, EPA compiled a list of chemicals that were publicly known to be used in hydraulic fracturing. The chemicals identified, however, do not represent the entire set of chemicals used in hydraulic fracturing activities. EPA also lacks information regarding the frequency, quantity, and concentrations of the chemicals used, which is important when considering the toxic effects of hydraulic fracturing fluid additives.[2]

To this end, the Ground Water Protection Council and Interstate Oil and Gas Compact Commission, two organizations whose missions both revolve around conservation and environmental protection, created a hydraulic fracturing chemical registry website (http://fracfocus.org) to provide the public access to reported chemicals used for hydraulic fracturing within their area. To help users put this information into perspective, the site also provides objective information on hydraulic fracturing, the chemicals used, the purposes they serve, and the means by which groundwater is protected. The chemical data presented on this site has been submitted on a voluntary basis by participating oil and gas companies. An April 13, 2012 web search of WV DEP's database for active gas wells in the Marcellus shale formation in Wetzel County listed 714 unique wells,[13] however, only two wells were included in a FracFocus search of Wetzel County, WV on the same date.[14] Some of the chemical ingredients used in the hydraulic fracturing fluid from these reports are still listed as proprietary.[15] Although the website provides information to the public, it does not give a complete picture of the chemicals that are being used at all wells.

Surface Water

Large hydraulic fracturing operations require extensive quantities of supplies, equipment, water, and vehicles, which could create risks of accidental releases, such as spills or leaks.[16] Spilled, leaked or released fluids could flow to a surface water body or infiltrate the ground, reaching subsurface soils and aquifers.[17] The following are examples of surface spills or releases and their causes:

- tank ruptures
    - Release of 13,000 gallons of fracking fluids that led to elevated salinity and conductivity in an unnamed tributary to Sugar Run and a spring caused by a failed storage tank (Penn Township, Lycoming, PA, 2010).[18]
- piping failures
    - Spill of 250 gallons of fracking fluids into an unnamed tributary of Bruch Creek (a high-quality warmwater fishery) because of a broken transmission line that killed fish and aquatic life (Hopewell Township, Washington County, PA, 2010).[19]
    - Spill of 8,000 gallons of fracking fluid into Stevens Creek and a nearby wetland caused by a failed pipe connection (Dimock Township, Susquehanna County, PA, 2009).[20]
- equipment failure
    - Spill of between 4,200 to 6,300 gallons of flowback fluids into an unnamed tributary to Webier Creek (which drains to the Tioga River) because of a failed pump (Armenia Township, Bradford County, PA, 2010).[21]

surface impoundment failures

- o Discharge of produced waters containing benzene and other hydrocarbons to ground waters and an unnamed tributary to Cascade Canyon because of a tear in a waste pit liner (Garfield, CO, 2010).[22,23]
- o Release of over 1 million gallons of flowback waters into the Parachute Creek drainage because of a ripped waste pit liner (Garfield County, CO, 2008).[24]
- o 550 instances of groundwater contamination caused by failed waste pits (New Mexico, 2003).[25]

overfills

- o Spill of fracking fluid from an overfilled wastewater pit into an unknown tributary of Drake Run (a high-quality watershed) (Hopewell Township, Washington County, PA, 2010).[26]

accidents (including vehicle collisions)

- o Vehicle crash involving two tractor trailers, one of which overturned and leaked fracking fluid onto the roadway and an unknown amount into Larry's Creek (Mifflin Township, Salladasburg, PA 2011).[27]
- o Discharge of petroleum-material to Buckeye Run and Buckeye Creek (Doddridge County, WV, 2010).[28]
- o On April 20, 2011 Chesapeake Energy lost control of the Atgas 2H Marcellus Shale well in Bradford County during hydraulic fracturing, over 10,000 gallons of fracturing flow back fluid escaped the well pad and all containment, flowed down a pasture and into an unnamed tributary to Towanda Creek, and Towanda Creek itself. About seven nearby residences were voluntarily evacuated at Chesapeake's suggestion (Bradford County, PA, 2011).[16]
- o On June 3, 2010 operators lost control of the Punxsutawney Hunting Club 36 well. The well is owned by EOG Resources Inc. The company performing the well completion work at the time of the blowout was C.C. Forbes of Washington, Pennsylvania, a division of Forbes Energy of Texas. Well drilling began in January 2010 and hydraulic fracturing operations began in March. Fracturing was completed on May 28th, and the plug placed after fracturing was being removed in preparation of putting the well into commercial production. When the operators lost control, natural gas was released uncontrollably and fracturing fluids in the well were discharged onto the ground and 75 feet into the air for approximately 16 hours (Punxsutawney, PA, 2010). [16]

drilling and production equipment defects

- o Thousands of gallons of fracking fluids were spilled on farm land and into Towanda Creek (which empties into the Susquehanna River) from a well blowout (LeRoy Township, Bradford County, PA, 2011).[29]
- o Release of benzene and other hydrocarbons into private wells and six springs flowing into Line Creek caused by well blowout (Clark, WY, 2006).[30]

improper operations

- o Partially treated drilling wastewater containing bromide discharged by Beaver Falls Municipal Authority into Beaver River (Beaver County, PA, 2011).[31]
- o Conclusion by industry representatives and state officials that gas drilling is partly responsible for rising bromide levels in rivers (Monongahela River, PA, 2011).[32]
- o Discharge of flowback fluids into a drainage ditch and then an unnamed tributary of the south branch of Sugar Creek (Troy Township, Bradford County, PA, 2010).[33]
- o Study by Arkansas Department of Environmental Quality (ADEQ) found that waste fluids from gas production have been improperly applied to land farms resulting in discharges to surface waters (Arkansas, 2009).[34]

Groundwater

Advocates of natural gas development often state that the process of hydraulic fracturing has never in its history been tied to the contamination of underground sources of drinking water.[16] Virginia's Department of Mines, Minerals and Energy specifically states that "there have been no documented instances of surface water or groundwater degradation from fracing in Virginia."[35] Yet opponents of hydraulic fracturing can point out several instances in which public water supplies have been adversely affected by drilling, such as Dimock, PA. So, who is correct? The evidence suggests both. There are definitely multiple documented cases of water well contamination linked to gas drilling, but all of them have been linked by the EPA to problems with well drilling (as opposed to hydraulic fracturing), such as casing failures, blowouts, and spills.[12]

EPA found evidence showing that improper well construction or improperly sealed wells may provide subsurface pathways for ground water pollution by allowing contaminant migration to sources of drinking water.[36,37,38,39,40,41] Based on these findings, EPA believes that well mechanical integrity will likely be an important factor in preventing contamination of drinking water resources from hydraulic fracturing activities.[2]

In addition to concerns related to improper well construction and well abandonment processes, there are concerns about the repeated fracturing of a well over its lifetime. Hydraulic fracturing can be repeated as necessary to maintain the flow of gas or hydrocarbons to the well. The near- and long-term effects of repeated pressure treatments on well components (e.g., casing, cement) are not well understood. While EPA recognizes that fracturing or re-fracturing existing wells may pose a risk to drinking water resources, this is not part of their proposed study, because they are unable to identify potential partners for a case study.[2]

Below are examples of groundwater contamination from gas well drilling:

- Poorly constructed wells with defective cement and well casings developed by Cabot Oil and Gas Corporation allowed shallow methane to migrate into water supplies, making 14 water supplies unusable (Dimock Township, Susquehanna County, PA, 2009).[16]
- Study of drinking water samples from wells within 1 km of active drilling sites had 17 times more deep "thermogenic" methane than wells further way (Northeastern PA and Otsego County, NY, 2011).[42]
- The causal relationship between drilling activities and methane in drinking water has also been disputed (Susquehanna County, PA 2011)[81]
- Methane in the drinking water supply for 16 families because of improper well completion (Bradford County, PA, 2010).[43]
- Thermogenic methane in two residential drinking water wells from nearby deep gas drilling (Parker County, TX, 2010).[44]
- Thermogenic methane entering shallow groundwater wells because of improper well completion (Dimock Township, Susquehanna County, PA, 2009).[45,46]
- Methane and ethane in two water supplies from over-pressurized wells and improper well completion (Bradford Township, McKean County, PA, 2009).[47]
- Methane in multiple private drinking water wells and surface waters caused by well casing failure (McNett Township, Lycoming County, PA, 2009).[48]
- Methane in two private drinking water wells likely linked to a recently drilled neighboring gas well (Knox Township, Jefferson County, PA, 2009).[48]
- Study showed temporal trend of increasing thermogenic methane in groundwater coincident with the installation of more gas wells in the area (Garfield County, CO, 2008).[49]
- Methane in drinking water aquifer because of over-pressurized wells and improper well completion (Bainbridge Township, Geauga County, OH, 2008).[50]
- Methane in several private water wells caused by an over-pressurized gas well (Hamlin Township, McKean County, PA, 2007).[48]
- Methane in groundwater caused by over-pressurized wells (Allegheny Forest, PA, 2007).[51]

Methane in soil near homes caused by recently drilled neighboring gas wells (Millcreek Township, Erie County, PA, 2007).[48]

Methane in several private water supplies caused when fracking of new well interacted with improperly cased abandoned gas well (Washington County, PA, 2006).[48]

Non-point source pollution from ground disturbing activities

All phases of natural gas well development, from initial land clearing for access roads, equipment staging areas and well pads, to drilling and fracturing operations, production and final reclamation, have the potential to cause water resource impacts during rain and snow melt events if stormwater is not properly managed.[17,52]

Initial land clearing exposes soil to erosion and more rapid runoff. Construction equipment is a potential source of contamination from such things as hydraulic, fuel and lubricating fluids. Equipment and any materials that are spilled, including additive chemicals and fuel, are exposed to rainfall, so that contaminants may be conveyed off-site during rain events if they are not properly contained. Steep access roads, well pads on hill slopes, and well pads constructed by cut-and-fill operations pose particular challenges, especially if an on-site drilling pit is proposed.[17,53]

Each drilling pad occupies 2-6 acres of ground,[1] not including roads and pipeline. The Cumulative Reasonable Foreseeable Development (RFD) for Alternative H for the GW Plan Revision includes 177 wells, 42 miles of roads, and 46 miles of pipeline; which equates to an estimated 672 acres of ground disturbance.[63] Fugitive dust may also be problematic for adjacent waterways.[17] The following are examples of exacerbated erosion and sedimentation:

During a routine inspection of a well site that was drilled and ready for production, the Department observed erosion and sedimentation violations at the site. The Operator did not implement and maintain BMPs to minimize accelerated erosion and sedimentation in order to protect, maintain, reclaim, and restore water quality and existing and designated uses (Greene County, PA, 2009).[54]

Sediment discharge to two unnamed tributaries to Wolcott Creek from construction of a road without proper erosion and sedimentation control measures (Athens Township, Bradford County, PA, 2005).[55]

Runoff from gas well sites was found to contain high concentrations of total suspended solids and heavy metals, rates similar to typical construction activities and urban runoff, respectively (City of Denton, TX, 2008).[56]

Study of gas development in federal forest found erosion and damage to new and existing roads and ditches from heavy truck traffic, significant damage to trees and vegetation in areas were fracking wastes were land applied, and increased forest fragmentation that altered wildlife movements and could facilitate the introduction of invasive exotic species (Fernow Forest study, WVA, 2011).[57]

Preliminary study showed significant correlations between gas well density and riparian canopy coverage and indicators of stream health (chemical contaminants and the degradation of macroinvertebrate community structure) and suggested that increasing well density increases the cumulative impacts of extraction (Academy of Natural Sciences study, Susquehanna County, PA, 2011).[58]

West Virginia Division of Highways notes significant damage to roads from vehicles carrying water, sand, and equipment for local gas recovery activities (Wetzel County, WV, 2011).[59]

Report of road damage and dust from heavy truck traffic that supports shale gas recovery in area (Marshall County, WV, 2011).[60]

EPA cites company for filling of a stream and destruction of a waterfall to create a gravel road, and illegal impoundment (Wetzel County, WV, 2010).[61]

Two major landslides associated with drilling activities caused unstable conditions during wet weather; repairs to well pad will take up to a year (Wetzel and Marshall Counties, WV, 2012).[62]

2. Mitigation Measures: Hydraulic fracturing for oil and gas production wells is typically addressed by state oil and gas boards or equivalent state natural resource agencies. However, EPA retains authority to address many issues related to hydraulic fracturing under its environmental statutes. The major statutes include the Clean Air Act; the Resource Conservation and Recovery Act; the Clean Water Act; the Safe Drinking Water Act; the Comprehensive Environmental Response, Compensation and Liability Act; the Toxic Substances Control

Act; and the National Environmental Policy Act. EPA does not expect to address the efficacy of the regulatory framework as part of their Study on the Potential Impacts of Hydraulic Fracturing on Drinking Water Resources.[2]

In addition to the Department of Mines and Minerals in Virginia, and Office of Oil and Gas in West Virginia, regulatory measures guiding gas development on the GWNF include BLM regulations and FS plan standards. Mitigation measures were developed by the IDT to address each of the potential impacts. These include following Gold Book and API standards and all applicable FS plan standards, BLM regulations, and VA and WV State regulations. To address water withdrawal concerns, water withdrawal for gas development is not allowed on the Forest unless it is demonstrated to result in fewer overall impacts than if water withdrawals were allowed. To address spills and impoundment failures, the plan requires closed loop systems for hydraulic fracturing and the use of a secondary containment system at the drill site. To reduce the potential for groundwater contamination, BLM utilizes strict requirements for casing and cementing of the wells. The plan also contains standards to prevent erosion and sedimentation and to control cuts and fills that could result in unstable conditions. For a complete list of mitigation measures see George Washington Revised Land Management Plan.[63]

A similar approach of developing mitigation around specific concerns was used by New York DEP in their Revised sGEIS for *Well permit issuance for horizontal drilling and high-volume hydraulic fracturing to develop the Marcellus Shale and other low-permeability gas reservoirs for large volume hydraulic fracturing.* NYDEP noted a number of widely publicized regulatory violations, non-routine incidents and enforcement cases; and followed with information about the measures currently required in New York or those that the Department proposes to require that are designed to prevent similar problems if high-volume hydraulic fracturing is permitted in the Empire State. NYDEP then provided a lengthy summary of potential impacts and proposed mitigation measures.[17]

Similarly, after conducting a complete review of existing and proposed statutes, legislation, regulation, and policies that regulate or affect Marcellus Shale natural gas development, the Pennsylvania Governor's Marcellus Shale Advisory Commission came up with list of recommendations dealing with infrastructure, public health, safety, and environmental protection, local impact and emergency response, and economic and workforce development.[16]

In addition, the Ground Water Protection Council (GWPC) conducted a study for the U.S. Department of Energy (DOE), Office of Fossil Energy, Oil and Natural Gas Program, and based on an analysis of the requirements specified in state oil and gas regulations, developed key messages and suggested actions.[64] The State Review of Oil and Natural Gas Regulations, Inc. (STRONGER, Inc.) then took this study and developed draft guidelines (2010).[65]

In August 2011, the Secretary of Energy Advisory Board (SEAB) issued a report with recommendations for improving the safety and environmental performance of natural gas hydraulic fracturing from shale formations. They identified four major areas of concern: possible pollution of drinking water, air pollution, community disruption, and cumulative adverse impacts on communities and ecosystems. Recognizing the serious environmental impacts underlying these concerns and the need for them to be prevented, reduced, and where possible, eliminated as soon as possible, the report included 20 recommendations in four key areas: 1) public accessibility to information about gas production, 2) short term and long-term actions to protect air and water quality, 3) systemic approach to development of best operating practices, and 4) research and development to improve safety and environmental performance. These recommendations if implemented are designed to reduce the environmental impacts from shale gas production.[4]

3. The Concern: The concern is that there will still be a risk of accidents, failure of mitigation measures, and failure to comply with mitigation measures; which can lead to environmental impacts and degradation. In their Ninety-Day-Report, the Secretary of Energy Advisory Board recognizes that public concerns extend to accidents and failures associated with poor well construction and operation, surface spills, leaks at pits and impoundments, truck traffic, and the cumulative impacts of air pollution, land disturbance and community disruption.[4]

Additionally, EPA recognizes that during every stage of water use in hydraulic fracturing operations there is potential for issues with contamination of drinking water, including: on-site spills and/or leaks; chemical and wastewater transportation accidents; accidental release to ground water (e.g., well malfunction); improper pit construction, maintenance, and/or closure; and incomplete treatment of wastewater and solid residuals.[2]

In their review, the NYDEP found that "standard stormwater control and other mitigation measures would not fully mitigate the risk of potential significant adverse impacts on water resources from high-volume hydraulic fracturing. Even with such controls in place, the risk of spills and other unplanned events resulting in the discharge of pollutants associated with high-volume hydraulic fracturing operations, even if relatively remote, would have significant consequences" in the unfiltered water supplies of New York City and Syracuse. "In addition, the increased industrial activity associated with well pad development, road construction and other activities associated with high-volume hydraulic fracturing is not consistent with the long-term protection"[17] of the surface drinking water supplies. Accordingly, NYDEP prohibited this this type of development in the New York City and Syracuse water supply watersheds.[17]

Inspection Data

Even with mitigation measures in place, the record shows there will be impacts to aquatic resources from regulation violations and accidents. A review of PA DEP Marcellus well inspection data from January 2000 to January 2012 found that out of 19,650 inspections, almost 10% (1,822) of the PA DEP inspections had violations with the total number of violations being 3,401.[66]

Below are the numbers of violations that occurred by violation code, with an example from inspection comments for that code in parenthesis. The list is not all inclusive, but meant to quantify and illustrate the types of problems that can occur:

51 violations 102.11 - Failure to design, implement or maintain BMPs to minimize the potential for accelerated erosion and sedimentation (Mud off pad across township road and into creek)
33 violations 102.22 - Failure to achieve permanent stabilization of earth disturbance activity (Site still has erosion issues and is not properly stabilized and 05/10/2011 spill still not cleaned up)
444 violations 102.4 - Failure to minimize accelerated erosion, implement E&S plan, maintain E&S controls. Failure to stabilize site until total site restoration under OGA Sec 206(c)(d) (Fill Berms not constructed per plan and do not exhibit E&S BMPs, erosion occurring at Sediment basin, silt sock not installed per plan)
53 violations for 105NOPERMIT - Encroachment without Permit or Waiver (unpermitted filling of a wetland or stream crossing)
32 violations 206REST - Failure to restore site w/in 9 months of completion of drilling or plugging (No E&S Plan, Well Complete 17 months ago and no restoration/report, waste lying around site)
16 violations 207B - Failure to case and cement to prevent migrations into fresh groundwater (Gas migrating to surface through cement on backside of 13 3/8" water string. Operator in process of mitigating problem)
2 violations 208A - Failure to restore a water supply affected by pollution or diminution (CW-complaint investigation ultimately determined Stang 1 Well had impacted quantity and quality of private drinking water well within 1000 feet of gas well, CO&A negotiated for Stone Energy to replace or restore potable drinking water to Clinton Property)
6 violations 209BOP - Inadequate or improperly installed BOP, other safety devices, or no certified BOP operator (PHC 36H 033-26872 - Failure of blow out prevention equipment, uncontrolled discharge of natural gas and flowback fluids, well vented for approx 18 hours before it was shut in.)
60 violations 301CSL - Stream discharge of IW, includes drill cuttings, oil, brine and/or silt (Investigated 2,400 gallon mud spill to unnamed trib to Ten Mile Creek through a seasonal stream. Violations noted)
40 violations 301UNPMTIW - Industrial waste was discharged without permit (Encroachment without permit, frac out released bore gel to stream, petroleum product spilled to ground with potential to enter stream)
19 violations 307CSL - Discharge of industrial waste to waters of Commonwealth without a permit (operator discharging flowback to site. Less than 5 gal observed being discharged to ground. No containment in place)

10 violations 401CAUSEPOLL - Polluting substance(s) allowed to discharge into Waters of the Commonwealth (Water transfer line - released full volume directly into 2 streams)
258 violations 401CSL - Discharge of pollutional material to waters of Commonwealth (erosion from access road flowing heavily into stream)
130 violations 402CSL - Failure to adopt pollution prevention measures required or prescribed by DEP by handling materials that create a danger of pollution (Drilling Cutting/Cement mix has spilled from the container and onto the ground. Residual waste has sprayed off containment and off site. Containment around tanks is insufficient)
15 violations 402CSL B - Failure to meet requirements of permit, rules and regulations, or order of DEP. (ex. Discharge of ethylene glycol to pad and flowback to drainage ditch)
73 violations 402POTNLPOLL - There is a potential for polluting substance(s) reaching Waters of the Commonwealth and may require a permit.(ex. Violations noted at this site were due to a 1,500 gallon spill of drilling mud being observed on the surface of the)
41 violations 51017 - Administrative Code-General (Accelerated erosion, pollutional substances on ground and not in proper containment, waste on ground) (No well tag, oil spill on ground)
402 violations 601.101 - O&G Act 223-General. Used only when a specific O&G Act code cannot be used (78.86 defective casing or cementing, 78.81(a)(2) failure to prevent migration of gas or other fluids into sources of fresh groundwater, O&G Act 601.201(f) failure to submit written notice of intent to plug well or amend plat. MBC 5/20/09) 6000 gallons of frac flowback off site into wetland. Wetland discharge into unnamed tributary of Webier Creek (CWF).
155 violations 691.1 - Clean Streams Law-General. Used only when a specific CLS code cannot be used (DCNR complaint rec'vd, insp documented CSL 401 & 307 and SWMA 301 viols, surfactant discharge to ground surface exiting fractures in rock formation and leaving site at approx rate of 180 gal/min, entered Pine Creek, applicable wells shut down, follow-up actions needed.)
2 violations 691.401WPD - Failure to prevent sediment or other pollutant discharge into waters of the Commonwealth. (Crews were on-site at the time of the inspection. Site ID and E&S plan located. Violations noted: 1- Failure to minimize accelerated erosion and sedimentation. 2- Inadequate E&S plan. 3- Discharge of Industrial Waste to the Waters of the Commonwealth.)
11 violations 691.402 & 691.402WPP - Site conditions present a potential for pollution to waters of the Commonwealth (Following up on complaint, truck accident resulting in release of diesel fuel in January 2010 not reported to DEP, found other violations existing on well pad, truck accident release was referred to ECP.) (Encroachment without permit, frac out released bore gel to stream, petroleum product spilled to ground with potential to enter stream)
94 violations 78.54 - Failure to properly control or dispose of industrial or residual waste to prevent pollution of the waters of the Commonwealth. (Bubbling observed in cellar. Drilling complete. DEP will investigate bubbling further after cellar cleaned out. Excessive drill mud/cuttings on plastic and has been tracked off containment onto pad and up access road. Tears in plastic observed. Operator to get crews to clean up site ASAP and notify DEP upon completion for follow up inspection.)
15 violations 78.55 - No Control and Disposal/PPC plan or failure to implement PPC plan (operator had 30 gallon diesel fuel spill on ground and also found diesel fuel in drill pit also. ALSO 3rd time operator was ask for ppc plan and is NOT on location !!!!!)
143 violations 78.56(1) - Pit and tanks not constructed with sufficient capacity to contain pollutional substances. (Discharge of ethylene glycol to pad and flowback to drainage ditch)
188 violations 78.56(2) & 78.56FRBRD - Failure to maintain 2 ' of freeboard in an impoundment. (Pit has hole in liner and perimeter fence is down, lacking 2 feet freeboard, drilling mud spill on ground, Accelerated erosion due to insufficient site stabilization)
38 violations 78.56(3) - Impoundment not structurally sound, impermeable, 3rd party protected. (>5 acres disturbance and no ESCGP, accelerated erosion, pit has holes in liner, waste lying around site)
90 violations 78.56LINER - Improperly lined pit (CSL 401 black fluid discharge to surface and waters in area of Hibbard 2H & 4H well pad, 78.56(a)(1) tears in liner.)
103 violations 78.56PITCNST - Impoundment not structurally sound, impermeable, 3rd party protected, greater than 20" of seasonal high ground water table. (Flowback spill extends roughly 800 to 1,000 feet from well site. Large swath of dead vegetation.)
31 violations 78.57 - Failure to post pit approval number (§ 78.57(a) violation. Production fluids were allowed to escape the production pit onto the ground and leave the work site.)

18 violations 78.57C2 & 78.57PITAPPR - Failure to construct properly plug, frac, brine pits (Production tank leak, 400 brls approx.)
12 violations 78.60 & 78.60B - Tophole water discharged improperly ("Discharge to stream Channel. Violation of 78.60(b)(5))
16 violations 78.62 & 78.64- Improper encapsulation of waste and oil tank (Multiple viols for 3 main issues: (1) Above ground pit -- Improperly lined pit, not structurally sound, drill cuttings on the ground around pit. (2) Diesel fuel spill to the ground. (3) Dusting/land application of cuttings without approval.)
27 violations 78.65(1) - Rat hole not filled (Rat hole open and waste all over site)
12 violations 78.65(3) - Failure to submit or submitting an inadequate well site restoration report within 60 days of restoration of the well site & 78.66A - Failure to report release of substance threatening or causing pollution (No E&S Plan, Well Complete 17 months ago and no restoration/report, waste lying around site)
6 violations 78.74 - Hazardous well venting (PHC 36H 033-26872 - Failure of blow out prevention equipment, uncontrolled discharge of natural gas and flowback fluids, well vented for approx 18 hours before it was shut in.)
53 violations 78.83GRNDWTR - Improper casing to protect fresh groundwater (Insufficient casing & Incorrect setting depth)
20 violations 78.84 - Insufficient casing strength, thickness, and installation equipment & 78.85 - Inadequate, insufficient, and/or improperly installed cement (gas in annular space)
127 violations 78.86 - Failure to report defective, insufficient, or improperly cemented casing w/in 24 hrs or submit plan to correct w/in 30 days (Bubbling between 9 5/8 and 13 3/8 annuli. 62% combustible gas reading utilizing MSA Model 60 meter. Uncontrolled release of gas. Isotopic obtained. No well tag on wellhead. 5 wells on location.)
72 violations 91.33A & 91.33B & 91.33POLLINC- Failure to notify DEP of pollution incident. No phone call made forthwith (48bbls of drilling mud released to well pad. No mud left site or into streams. 30hr time lapse between release and report. Report from Patterson Drilling not operator. Cert Mail NOV sent 10/05/09. Inspection report related to Mark Barbier 10/01/2009 inspection.)
26 violations 91.34A - Failure to take all necessary measures to prevent spill. Inadequate diking, potential pollution (Violations noted at this site were due to a 1,500 gallon spill of drilling mud being observed on the surface of the ground outside of the containment area and the site PPC plan was not available for review upon request.)
27 violations CSL402POTPOL - There is a potential for polluting substance(s) reaching Waters of the Commonwealth and may require a permit (KC-report rec'vd of fluid spraying out of vents on holding tanks, water line from well froze, during thaw it released pressure and forced produced fluid (brine) out of vents.)

It is recognized that the majority of the wells in PA are neither on public land, nor subject to federal government oversight by the BLM or FS regulators. It is expected that wells on GWNF would be under more strict guidelines and stringent inspections. Accordingly, the mitigation measures identified by the GWNF would incorporate standards and best practices for hydraulic fracturing identified by the American Petroleum Institute as conditions of approval for the APD;[67] utilize the standard practices (including casing and cementing requirements) for drilling operations in the Gold Book[68] and Onshore Oil & Gas Orders No. 1[69] & No. 2[70]; and monitoring implementation of these measures by State inspectors, BLM inspectors and Forest Service inspectors.[63]

However, recent review of drilling on public lands by the Democratic staff of the House Natural Resource Committee found many safety and drilling violations that have and could harm the environment and public health.[71] There were a total of 2,025 safety and drilling violations that were issued by BLM to 335 companies drilling in seventeen states between February 1998 and February 2011. Of these, 27 percent were classified by Committee staff as a major environmental or safety violation, 20 percent as a minor safety violation and 53 percent as a minor drilling or operational violation. The review goes on to report that only six percent of violations resulted in fines, the fines were inconsistently applied, and they were so low as to be inconsequential to many operators. Since the strongest tool against companies that fail to comply with the rules and regulations of drilling on federal lands is to levy monetary fines, these types of "penalties and the inconsistent way in which they are levied do little to ensure accountability and protection of the surface and subsurface environment."[71]

Furthermore, although Onshore Order No. 1, which contains the information an operator must submit to the BLM for the approval of proposed gas exploration and development on federal lands, was amended in 2007, Onshore Order No. 2, which sets the minimal requirements for well design, construction and well control, including minimum casing and cementing requirements, has not been updated since 1988. It reflects neither the significant technological advances of hydraulic fracturing and associated technologies nor the tremendous growth in its use.[71] BLM makes it a priority to witness the required casing and cementing procedures as planned under Onshore Order No. 2; but the House Natural Resource Committee found that these procedures are frequently not followed and operators regularly fail to notify BLM as to when they will occur, resulting in casing and cementing activities that are often performed without a BLM witness present to ensure it happens in a manner that would protect water sources.[71]

Recently, the Shale Resources and Society Institute at the State University of New York at Buffalo released a report, *Environmental Impacts During Marcellus Shale Gas Drilling: Causes, Impacts, and Remedies.*[72] The report uses the violations previously discussed for the State of Pennsylvania, but it examines them in greater detail. In 3½ years, from January 2008 through August 2011, the State issued 2,988 notices of violation. Of these, 1,144 were for environmental violations (as opposed to administrative or preventive violations) and these violations addressed 854 unique environmental events. Twenty-five of these events (or 3 percent) were classified as major environmental events, defined as major site restoration failures, serious contamination of local water supplies, major land spills, blowouts or venting, and gas migration; of these 25 events, six cases did not have their environmental impacts completely mitigated. The incidence of all environmental events declined from 53 percent of all of the wells drilled in 2008 to 21 percent of the wells drilled in 2011. At this rate, one in five wells would be expected to have an environmental event. The incidence of environmental violations was similarly reduced from 58 percent to 27 percent; one in four wells would have an environmental violation. The report suggests that "while a 26.5% rate of environmental violations appears high, it is important to note that most of these violations are not major." For this report, violations pertaining to erosion and sedimentation are considered minor. The reduction in environmental violations was attributed to improvement by the industry and oversight by the regulators.

The study goes on to examine the twenty-five major environmental events in relation to the guidelines proposed in the Supplemental Generic Environmental Impact Statement in New York.[72] The authors indicate that each of the underlying causes associated with the events could have been either entirely avoided or mitigated under the proposed New York guidelines. However, the final conclusion is that the majority of the polluting environmental events were due to operator error, negligence, or a failure to follow proper procedures when drilling, and that surface activity, rather than the drilling or development process itself, remains the greatest ongoing risk.

Accident Data

Even if all regulations are followed and inspections are clean, because of the extensive quantities of supplies, equipment, water, and vehicles there is still a risk of accidental releases of fluid or chemicals from spills or leaks.[16] In addition, because of the level of ground disturbance associated with multi-well pads, roads, impoundments, and pipelines there is still a risk of failure of erosion control measures to adequately contain sediment or other contaminants.[17]

A good example of the accident potential is from a single well drilled on Forest Service land in the Fernow Experimental Forest, West Virginia. The results of FS researchers monitoring and observing the effects of well development led to two obvious points: "that some effects can be predicted and mitigated through cooperation between landowner and energy developer, and that unexpected impacts will occur. These unexpected impacts may be most problematic."[57] Under the "Expected or Predicted Impact" section of the report, silt fences were undermined and overtopped repeatedly, routing concentrated flow and associated sediment to a sinkhole; three caves were drilled through; and heavy vehicle traffic when the roads were wet caused drainage ditches to fill and collapse and the road surface to erode.

The "Unexpected Impacts" section included loss of control of the drill bore and subsequent release of materials that damaged vegetation adjacent to the well and drill pad, and extensive permanent damage to vegetation caused by land applied drill pit fluids that had a higher actual loading of chloride than the permitted concentration. The "Other Unexpected Impacts" section of the report included effects from heavier-than-predicted truck use leading to road damage (both more trucks on the road, and heavier truck weight); runoff and erosion that was not repaired as soon as it occurred or was pointed out; changes in wetland and stream crossings from the pre-approved directional boring to the energy company's preferred method of dry trenching; an excavator break-down within the stream channel while dry trenching; and damage from a truck carrying pipeline that ran off the road in the Biological Control Area (used as reference for silvicultural research) and from the bulldozer used to push the truck back on the road. Good coordination and cooperation minimized the mostly physical effects from expected impacts, while the unexpected impacts were less likely to be mitigated successfully; [57] this points out the need for good communication among all parties for the duration of the drilling operation.

In an attempt to quantify accidents, the WV DEP Office of Oil and Gas database was queried for oil and gas spills between January 2000 and January 2012. Although, the information is not specific to drilling in Marcellus shale, the returned data shows there were 463 oil and gas spills reported between January 2000 and June 2009.[73] This would average about 54 spills per year, and does not include inspection violations, of which there were 2,102 between July 13, 2000 and December 21, 2011. [74] Examples of comments recorded from the reported spills include:

Oil line running under county road leaked 40 gallons of crude oil into creek (Calhoun County, WV. March 14, 2008)

Spilled 7.5 barrels of drilling fluid into Paddy Run while drilling well. (Gilmer County, WV. July 14, 2008)

Drilling spill released 2,500 gallons saltwater/brine, some of which reached Fink Creek (Lewis County, WV. August 21, 2000)

Set fire to oil tank- oil running in stream (Roane County, WV. May 21, 2008)

Resource on the GW:

The U.S. Geological Survey (USGS) indicates that the Marcellus play for Virginia is on the outer periphery of the major structural body of the shale.[35] As a result, VDMME feels the concerns regarding conditions in other states are less likely to exist in the Commonwealth. Utilized in Southwest Virginia since the early to mid-1950s, much of the hydraulic fracturing process in Virginia uses a pressurized nitrogen-based foam.[35] In their 2011 comments on the Draft GW Plan Revision, VDMME suggested that the nitrogen-based fluids could be used to fracture horizontal wells in Virginia's Marcellus shale, thereby using much less water, and minimizing the potential withdrawal and contaminated flowback issue.[75] However, slick water (water-based) stimulation has been shown to be more effective than nitrogen fracturing in Marcellus shale,[75] and the VDMME now states that water-based hydraulic fracturing fluids would most likely be used in the Virginia Marcellus formation, but at less volume than reported in neighboring states due to the thinner, less extensive formation characteristics. In addition, it is important to note that a well drilled in the Marcellus shale may have to be hydraulic fractured several times over the course of its life to keep the gas flowing, and that each hydraulic fracturing operation may require more water than the previous one,[77] but it is not known how much or how often this would have to be done in Virginia. Clearly, there are still unknowns about the condition of the Marcellus shale and its gas resource on the GWNF.

In a 2011 report about the undiscovered gas resources of the Devonian Marcellus shale[78], the USGS identified three Marcellus shale assessment units. Lands on the GWNF lie within the Folded Marcellus Assessment Unit. It is estimated that this assessment unit contains less than 1 percent of the total undiscovered gas resources in the three assessment units.

4. Implications for Aquatic Resources for Alternative H:

As previously stated in the Mitigation section of this report, measures could be incorporated into the Forest Plan to mitigate or reduce many of the impacts that would be expected in the development of Marcellus shale gas. These include standard measures used by the BLM, required measures from the State of West Virginia and Commonwealth of Virginia, and additional measures developed for the forest plan. While these measures are designed to limit environmental effects, it is recognized that accidents and unintended actions will occur. To address these factors Alternative H has identified areas to further minimize risk of impacts. This alternative makes public water supply watersheds unavailable for leasing and makes the following areas available only with No Surface Occupancy: Special Biological Areas, Shenandoah Crest, Key Natural Heritage Community Areas, Indiana Bat Secondary Protection Areas, Special Geologic Areas, and the areas above 3,000 feet in elevation on Shenandoah Mountain south of Highway 250 (about 141,000 acres). In Alternative H, the lands identified as available for leasing would be further constrained to only address those areas where the potential for gas resources is high. Thus the Lee Ranger District, Pedlar Ranger District and the Warm Springs and Back Creek Mountains of the Warm Springs Ranger District would not be made available for leasing.

This would leave about 330,000 acres with Controlled Surface Use, Standard, or Timing stipulations in Alterantive H. A GIS analysis was done using these 330,000 acres, plus the 141,000 with leasing but No Surface Occupancy, and an additional 39,000 acres of private mineral rights within Marcellus shale, for a total of about 510,000 acres which could be leased for high volume horizontal drilling to extract natural gas from Marcellus shale, to determine the aquatic resources within that area. The Forest's GIS "streams" layer was used to calculate perennial and intermittent stream miles, and riparian corridor acres around streams,[78] while the shapefiles developed for the Aquatic Ecological Sustainability Analysis[79] were used to calculate miles of potential brook trout habitat and aquatic TESLR habitat, as well as acres of waterbodies and wetlands within the potentially leasable, Marcellus shale play on National Forest.

413 miles perennial streams

1,168 miles intermittent streams

26,843 acres riparian corridor around perennial and intermittent streams

745 miles potential Threatened, Endangered, Sensitive, Locally Rare (TESLR) species habitat

514 miles wild brook trout habitat

2,771 acres of waterbodies and wetlands

Each drilling pad occupies 2-6 acres of ground, not including roads and pipeline. The Cumulative Reasonable Foreseeable Development (RFD) for Alternative H for the GW Plan Revision includes 177 wells, 42 miles of roads, and 46 miles of pipeline; which equates to an estimated 672 acres of ground disturbance.[63] With that level of development within the mountainous terrain of the GWNF, it is certain that there would be stream and wetland crossings by roads and pipelines, including wild brook trout and TESLR habitat.

The application of forestwide standards and resource protection measures are designed to limit the extent and duration of adverse environmental effects. The allocation of lands to management prescriptions, the decisions on lands administratively available for leasing, and the decisions on leasing stipulations (like No Surface Occupancy) could limit the exposure of the most sensitive resources to the risk of adverse environmental impacts. The record of declining violations in Pennsylvania is encouraging and many state and federal agencies are developing improved regulations to respond to past incidents. However, the record from drilling in other states indicates that there will be accidents, improper implementation of control measures and unintended actions that result in impacts to aquatic resources.

In addition to accidents, the mountainous terrain results in the potential for increased erosion and sedimentation from soil disturbances associated with road and well pad construction, and associated facilities and pipelines. These effects can be long-term as they involve land use conversion from forest to non-forest with a loss of soil productivity and natural landform. There would also be the potential for increased runoff on compacted soils which could cause changes to streamflow volumes and timing of flows. Some level of sediment from roads would reach streams and wetlands and could impact the physical characteristics and biological integrity of water resources.[53] See the GW Plan Revision EIS for a more complete discussion on potential effects to water resources.[1]

Some level of adverse effects to the above resources would likely be unavoidable and it is important to note actual effects would not occur until project-level decisions are implemented. If we assume that newly developed regulations and control measures would cut violations in half, we could still expect five to ten percent of wells to have problems. Of these from three to twenty-five percent of the wells could cause major impacts. This would translate to about one to two wells. While this is a small amount, the previously identified extent of the sensitive aquatic resources could still result in impacts to miles of streams serving sensitive aquatic resources. In addition, it assumes a level of compliance with regulations and lack of accidents that has not yet been demonstrated. This level of impact generates concerns that would require the continued search for improved control measures and greater oversight to reduce unintended actions during implementation.

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APPENDIX J - FEDERAL OIL AND GAS LEASING AVAILABILITY ANALYSIS– AQUATIC RESOURCES

Table J-1. Marcellus Shale by Aquatic Species and Watershed

Scientific Name	Common Name	Watershed	National Forest (NF) or Private (P) occurrence	% GWNF	Marcellus Acres on GWNF	Marcellus % of watershed on GWNF	Marcellus % of watershed on NF & Private land	Marcellus shale on FS at occurrence	Fed or Pvt Mineral Ownership at occurrence
Pleurobema collina	James spinymussel	Potts Creek	P	26%	12,529	11.3%	47.8%		
		Cowpasture River	P	59%	95,086	42.0%	71.9%		
		Catawba Creek-James River	P	5%	6,955	3.3%	22.1%		
		Craig Creek	P	1%	1,259	0.5%	62.1%		
		Calfpasture River	P	59%	69,850	46.3%	72.5%		
Helenium virginicum	Virginia sneezeweed	Naked Creek-South Fork Shenandoah River	P	10%	1,331	0.6%	0.9%		
Scirpus ancistrochaetus	northeastern bulrush	Dry River-North River	NF	59%	110,980	58.9%	67.8%	Y	FED
		Naked Creek-South Fork Shenandoah River	P	10%	1,331	0.6%	0.9%		
		Potts Creek	NF	26%	12,529	11.3%	47.8%	N	
		Back Creek-Jackson River	P	41%	55,586	25.2%	45.0%		
Notropis semperasper	Roughhead shiner	Dunlap Creek	P	42%	37,679	34.8%	73.6%		
		Potts Creek	P	26%	12,529	11.3%	47.8%		
		Back Creek-Jackson River	NFP	41%	55,586	25.2%	45.0%	Y	PVT
		Wilson Creek-Jackson River	P	38%	22,436	16.2%	44.7%		
		Cowpasture River	NFP	59%	95,086	42.0%	71.9%	Y	FED
		Catawba Creek-James River	P	5%	6,955	3.3%	22.1%		
		Craig Creek	P	1%	1,259	0.5%	62.1%		
		Calfpasture River	P	59%	69,850	46.3%	72.5%		
Noturus gilberti	Orangefin madtom	Cowpasture River	P	59%	95,086	42.0%	71.9%		

Scientific Name	Common Name	Watershed	National Forest (NF) or Private (P) occurrence	% GWNF	Marcellus Acres on GWNF	Marcellus % of watershed on GWNF	Marcellus % of watershed on NF & Private land	Marcellus shale on FS at occurrence	Fed or Pvt Mineral Ownership at occurrence
		Craig Creek	P	1%	1,259	0.5%	62.1%		
Hydraena maureenae	Maureen's shale stream beetle	Shoemaker River-North Fork Shenandoah River	NF	53%	61,945	46.5%	87.8%	Y	FED
		Wilson Creek-Jackson River	P	38%	22,436	16.2%	44.7%		
		Cowpasture River	NFP	59%	95,086	42.0%	71.9%	Y	PVT
		Craig Creek	P	1%	1,259	0.5%	62.1%		
		Calfpasture River	NF	59%	69,850	46.3%	72.5%	Y	FED
Cicindela ancocisconensis	Appalachian tiger beetle	Wilson Creek-Jackson River	P	38%	22,436	16.2%	44.7%		
		Cowpasture River	NFP	59%	95,086	42.0%	71.9%	Y	FED
Sorex palustris punctulatus	southern water shrew	North Fork South Branch Potomac River	NFP	5%	10,384	5.1%	71.3%	Y	FED
		Back Creek-Jackson River	NFP	41%	55,586	25.2%	45.0%	Y	FED
Alasmidonta varicosa	Brook floater	Smith Creek-North Fork Shenandoah River	P	6%	333	0.2%	5.4%		
		Stony Creek-North Fork Shenandoah River	P	28%	4,906	2.2%	20.2%		
Elliptio lanceolata	Yellow lance	Wilson Creek-Jackson River	P	38%	22,436	16.2%	44.7%		
		Cowpasture River	P	59%	95,086	42.0%	71.9%		
		Catawba Creek-James River	P	5%	6,955	3.3%	22.1%		
		Craig Creek	P	1%	1,259	0.5%	62.1%		
Fusconaia masoni	Atlantic pigtoe	Catawba Creek-James River	P	5%	6,955	3.3%	22.1%		
		Craig Creek	P	1%	1,259	0.5%	62.1%		
		Calfpasture River	P	59%	69,850	46.3%	72.5%		
Lasmigona subviridis	Green floater	Stony Creek-North Fork Shenandoah River	P	28%	4,906	2.2%	20.2%		
Villosa constricta	Notched Rainbow	Potts Creek	P	26%	12,529	11.3%	47.8%		
		Cowpasture River	P	59%	95,086	42.0%	71.9%		

Scientific Name	Common Name	Watershed	National Forest (NF) or Private (P) occurrence	% GWNF	Marcellus Acres on GWNF	Marcellus % of watershed on GWNF	Marcellus % of watershed on NF & Private land	Marcellus shale on FS at occurrence	Fed or Pvt Mineral Ownership at occurrence
		Catawba Creek-James River	P	5%	6,955	3.3%	22.1%		
		Craig Creek	P	1%	1,259	0.5%	62.1%		
Peltigera hydrothyria	waterfan	North Fork South Branch Potomac River	NF	5%	10,384	5.1%	71.3%	Y	FED
		Middle River	NF	10%	22,543	9.4%	11.0%	Y	FED
		Stony Creek-North Fork Shenandoah River	NF	28%	4,906	2.2%	20.2%	N	PVT
		Cowpasture River	NF	59%	95,086	42.0%	71.9%	Y	FED
Cambarus monongalensis	A Crayfish	North Fork South Branch Potomac River	NF	5%	10,384	5.1%	71.3%	Y	FED
Anguilla rostrata	American eel	Middle River	P	10%	22,543	9.4%	11.0%		
		Dry River-North River	P	59%	110,980	58.9%	67.8%		
		Naked Creek-South Fork Shenandoah River	P	10%	1,331	0.6%	0.9%		
		Smith Creek-North Fork Shenandoah River	P	6%	333	0.2%	5.4%		
		Stony Creek-North Fork Shenandoah River	P	28%	4,906	2.2%	20.2%		
		Cedar Creek	NFP	19%	422	0.4%	32.7%	N	FED
		Craig Creek	P	1%	1,259	0.5%	62.1%		
Salvelinus fontinalus	Brook trout	North Fork South Branch Potomac River	NFP	5%	10,384	5.1%	71.3%	Y	FED
		South Fork South Branch Potomac River	NFP	29%	55,525	30.1%	90.5%	Y	BOTH
		Cacapon River	NFP	20%	5,484	2.1%	66.9%	N	PVT
		Dry River-North River	NFP	59%	110,980	58.9%	67.8%	Y	BOTH
		Naked Creek-South Fork Shenandoah River	NFP	10%	1,331	0.6%	0.9%	N	PVT
		Shoemaker River-North Fork Shenandoah River	NFP	53%	61,945	46.5%	87.8%	Y	PVT
		Smith Creek-North Fork Shenandoah River	NF	6%	333	0.2%	5.4%	N	PVT

Scientific Name	Common Name	Watershed	National Forest (NF) or Private (P) occurrence	% GWNF	Marcellus Acres on GWNF	Marcellus % of watershed on GWNF	Marcellus % of watershed on NF & Private land	Marcellus shale on FS at occurrence	Fed or Pvt Mineral Ownership at occurrence
		Stony Creek-North Fork Shenandoah River	NFP	28%	4,906	2.2%	20.2%	Y	PVT
		Cedar Creek	NFP	19%	422	0.4%	32.7%	Y	FED
		Dunlap Creek	NFP	42%	37,679	34.8%	73.6%	Y	FED
		Potts Creek	NFP	26%	12,529	11.3%	47.8%	Y	FED
		Back Creek-Jackson River	NFP	41%	55,586	25.2%	45.0%	Y	FED
		Wilson Creek-Jackson River	NFP	38%	22,436	16.2%	44.7%	Y	FED
		Cowpasture River	NFP	59%	95,086	42.0%	71.9%	Y	BOTH
		Catawba Creek-James River	P	5%	6,955	3.3%	22.1%		
		Craig Creek	NFP	1%	1,259	0.5%	62.1%	Y	FED
		Calfpasture River	NFP	59%	69,850	46.3%	72.5%	Y	FED
		Little Calfpasture River	NFP	30%	14,974	28.0%	65.2%	Y	FED
Cottus cf. cognatus	Checkered sculpin	Cacapon River	P	20%	5,484	2.1%	66.9%		
Aeshna canadensis	Canada darner	North Fork South Branch Potomac River	NF	5%	10,384	5.1%	71.3%		
Aeshna tuberculifera	black-tipped darner	North Fork South Branch Potomac River	NF	5%	10,384	5.1%	71.3%	Y	FED
		Dry River-North River	NF	59%	110,980	58.9%	67.8%	Y	PVT
		Naked Creek-South Fork Shenandoah River	NF	10%	1,331	0.6%	0.9%	N	FED
		Potts Creek	NF	26%	12,529	11.3%	47.8%	Y	FED
		Wilson Creek-Jackson River	P	38%	22,436	16.2%	44.7%		
		Catawba Creek-James River	P	5%	6,955	3.3%	22.1%		
Aeshna verticalis	green-striped darner	North Fork South Branch Potomac River	NF	5%	10,384	5.1%	71.3%	Y	FED
Calopteryx amata	Superb jewelwing	North Fork South Branch Potomac River	NF	5%	10,384	5.1%	71.3%	Y	FED
Calopteryx angustipennis	Appalachian jewelwing	Stony Creek-North Fork Shenandoah River	NF	28%	4,906	2.2%	20.2%	Y	FED
		Cowpasture River	NF	59%	95,086	42.0%	71.9%	Y	FED
		Craig Creek	P	1%	1,259	0.5%	62.1%		

Scientific Name	Common Name	Watershed	National Forest (NF) or Private (P) occurrence	% GWNF	Marcellus Acres on GWNF	Marcellus % of watershed on GWNF	Marcellus % of watershed on NF & Private land	Marcellus shale on FS at occurrence	Fed or Pvt Mineral Ownership at occurrence
Cordulegaster diastatops	delta-spotted spiketail	North Fork South Branch Potomac River	NF	5%	10,384	5.1%	71.3%	Y	FED
Enallagma annexum (AKA cyathigerum)	northern bluet	North Fork South Branch Potomac River	NF	5%	10,384	5.1%	71.3%	Y	FED
Epitheca canis	beaverpond baskettail	North Fork South Branch Potomac River	NF	5%	10,384	5.1%	71.3%	Y	FED
Gomphus adelphus	mustached clubtail	Cowpasture River	P	59%	95,086	42.0%	71.9%		
		Calfpasture River	P	59%	69,850	46.3%	72.5%		
Gomphus quadricolor	rapids clubtail	Cowpasture River	P	59%	95,086	42.0%	71.9%		
		Craig Creek	P	1%	1,259	0.5%	62.1%		
		Calfpasture River	P	59%	69,850	46.3%	72.5%		
Ladona julia (AKA Libellula julia)	chalk-fronted corporal skimmer	North Fork South Branch Potomac River	NF	5%	10,384	5.1%	71.3%	Y	FED
Lanthus parvulus	double-striped clubtail	North Fork South Branch Potomac River	NFP	5%	10,384	5.1%	71.3%	Y	FED
Lestes disjunctus	northern spreadwing	North Fork South Branch Potomac River	NF	5%	10,384	5.1%	71.3%	Y	FED
		Back Creek-Jackson River	P	41%	55,586	25.2%	45.0%		
		Wilson Creek-Jackson River	P	38%	22,436	16.2%	44.7%		
Leucorrhinia hudsonica	Hudsonian whiteface	North Fork South Branch Potomac River	NF	5%	10,384	5.1%	71.3%	Y	FED
Nehalennia irene	sedge sprite	North Fork South Branch Potomac River	NF	5%	10,384	5.1%	71.3%	Y	FED
Neurocordulia yamaskanensis	stygian shadowdragon	Stony Creek-North Fork Shenandoah River	P	28%	4,906	2.2%	20.2%		
		Wilson Creek-Jackson River	P	38%	22,436	16.2%	44.7%		

Scientific Name	Common Name	Watershed	National Forest (NF) or Private (P) occurrence	% GWNF	Marcellus Acres on GWNF	Marcellus % of watershed on GWNF	Marcellus % of watershed on NF & Private land	Marcellus shale on FS at occurrence	Fed or Pvt Mineral Ownership at occurrence
Rhionaeschna mutata (AKA Aeshna mutata)	spatterdock darner	North Fork South Branch Potomac River	NF	5%	10,384	5.1%	71.3%	Y	FED
		Potts Creek	P	26%	12,529	11.3%	47.8%		
Somatochlora elongata	Ski-tipped emerald	North Fork South Branch Potomac River	NF	5%	10,384	5.1%	71.3%	Y	FED
Sympetrum obtrusum	white-faced meadowhawk	North Fork South Branch Potomac River	NF	5%	10,384	5.1%	71.3%	Y	FED
Isonychia hoffmani	Hoffman's Isonychia mayfly	North Fork South Branch Potomac River	NF	5%	10,384	5.1%	71.3%	Y	FED
Nemotaulius hostilis	a limnephilid caddisfly	North Fork South Branch Potomac River	NF	5%	10,384	5.1%	71.3%	Y	FED
Glyptemys insculpta	wood turtle	South Fork South Branch Potomac River	P	29%	55,525	30.1%	90.5%		
		Cacapon River	NFP	20%	5,484	2.1%	66.9%	Y	PVT
		Shoemaker River-North Fork Shenandoah River	NFP	53%	61,945	46.5%	87.8%	Y	PVT
		Smith Creek-North Fork Shenandoah River	P	6%	333	0.2%	5.4%		
		Stony Creek-North Fork Shenandoah River	NFP	28%	4,906	2.2%	20.2%	N	PVT
		Cedar Creek	NFP	19%	422	0.4%	32.7%	Y	FED

Table J-2. Aquatic Species Viability Changes due to Marcellus Shale Development in Watershed by Forest Plan Alternative * (Shaded cells indicate a change in viability)

Scientific Name	Common Name	Watershed	Viability outcome from EIS viability	Viability outcome Alt A	Viability outcome Alt B	Viability outcome Alts C and I	Viability outcome Alt D	Viability outcome Alt E	Viability outcome Alt F	Viability outcome Alt G	Viability outcome Alt H
Pleurobema collina	James spinymussel	Potts Creek	C	C	C	C	C	C	C	C	C
		Cowpasture River	C	C	C	C	C	C	C	C	C
		Catawba Creek-James River	E	E	E	E	E	E	E	E	E
		Craig Creek	C	C	C	C	C	C	C	C	C
		Calfpasture River	C	C	C	C	C	C	C	C	C
Helenium virginicum	Virginia sneezeweed	Naked Creek-South Fork Shenandoah River	C	C	C	C	C	C	C	C	C
Scirpus ancistrochaetus	northeastern bulrush	Dry River-North River	D	E	E	D	E	D	E	D	D
		Naked Creek-South Fork Shenandoah River	E	E	E	E	E	E	E	E	E
		Potts Creek	D	D	D	D	D	D	D	D	D
		Back Creek-Jackson River	E	E	E	E	E	E	E	E	E
Notropis semperasper	Roughhead shiner	Dunlap Creek	C	C	C	C	C	C	C	C	C
		Potts Creek	C	C	C	C	C	C	C	C	C
		Back Creek-Jackson River	B	C	C	C	C	C	C	C	C
		Wilson Creek-Jackson River	C	C	C	C	C	C	C	C	C
		Cowpasture River	B	C	C	C	C	C	C	C	C
		Catawba Creek-James River	C	C	C	C	C	C	C	C	C
		Craig Creek	C	C	C	C	C	C	C	C	C
		Calfpasture River	C	C	C	C	C	C	C	C	C
Noturus gilberti	Orangefin madtom	Cowpasture River	C	C	C	C	C	C	C	C	C
		Craig Creek	C	C	C	C	C	C	C	C	C
Hydraena maureenae	Maureen's shale stream beetle	Shoemaker River-North Fork Shenandoah River	D	E	E	E	E	E	E	E	E
		Wilson Creek-Jackson River	E	E	E	E	E	E	E	E	E
		Cowpasture River	B	C	C	C	C	C	C	C	C

Scientific Name	Common Name	Watershed	Viability outcome from EIS viability	Viability outcome Alt A	Viability outcome Alt B	Viability outcome Alts C and I	Viability outcome Alt D	Viability outcome Alt E	Viability outcome Alt F	Viability outcome Alt G	Viability outcome Alt H
		Craig Creek	E	E	E	E	E	E	E	E	E
		Calfpasture River	D	E	E	D	E	D	E	D	E
Cicindela ancocisconensis	Appalachian tiger beetle	Wilson Creek-Jackson River	E	E	E	E	E	E	E	E	E
		Cowpasture River	D	E	E	D	E	D	E	D	E
Sorex palustris punctulatus	southern water shrew	North Fork South Branch Potomac River	D	D	D	D	D	D	D	D	D
		Back Creek-Jackson River	D	E	E	D	E	D	E	D	E
Alasmidonta varicosa	Brook floater	Smith Creek-North Fork Shenandoah River	E	E	E	E	E	E	E	E	E
		Stony Creek-North Fork Shenandoah River	E	E	E	E	E	E	E	E	E
Elliptio lanceolata	Yellow lance	Wilson Creek-Jackson River	C	C	C	C	C	C	C	C	C
		Cowpasture River	C	C	C	C	C	C	C	C	C
		Catawba Creek-James River	E	E	E	E	E	E	E	E	E
		Craig Creek	C	C	C	C	C	C	C	C	C
Fusconaia masoni	Atlantic pigtoe	Catawba Creek-James River	E	E	E	E	E	E	E	E	E
		Craig Creek	C	C	C	C	C	C	C	C	C
		Calfpasture River	E	E	E	E	E	E	E	E	E
Lasmigona subviridis	Green floater	Stony Creek-North Fork Shenandoah River	C	C	C	C	C	C	C	C	C
Villosa constricta	Notched Rainbow	Potts Creek	C	C	C	C	C	C	C	C	C
		Cowpasture River	C	C	C	C	C	C	C	C	C
		Catawba Creek-James River	C	C	C	C	C	C	C	C	C
		Craig Creek	C	C	C	C	C	C	C	C	C
Peltigera hydrothyria	waterfan	North Fork South Branch Potomac River	B	B	B	B	B	B	B	B	B
		Middle River	B	C	C	B	C	B	C	B	C

Scientific Name	Common Name	Watershed	Viability outcome from EIS viability	Viability outcome Alt A	Viability outcome Alt B	Viability outcome Alts C and I	Viability outcome Alt D	Viability outcome Alt E	Viability outcome Alt F	Viability outcome Alt G	Viability outcome Alt H
		Stony Creek-North Fork Shenandoah River	B	B	B	B	B	B	B	B	B
		Cowpasture River	B	C	C	B	C	B	C	B	C
Cambarus monongalensis	A Crayfish	North Fork South Branch Potomac River	B	B	B	B	B	B	B	B	B
Anguilla rostrata	American eel	Middle River	C	C	C	C	C	C	C	C	C
		Dry River-North River	C	C	C	C	C	C	C	C	C
		Naked Creek-South Fork Shenandoah River	C	C	C	C	C	C	C	C	C
		Smith Creek-North Fork Shenandoah River	C	C	C	C	C	C	C	C	C
		Stony Creek-North Fork Shenandoah River	C	C	C	C	C	C	C	C	C
		Cedar Creek	A	A	A	A	A	A	A	A	A
		Craig Creek	E	E	E	E	E	E	E	E	E
Salvelinus fontinalus	Brook trout	North Fork South Branch Potomac River	B	B	B	B	B	B	B	B	B
		South Fork South Branch Potomac River	B	C	C	C	C	C	C	C	C
		Cacapon River	B	B	B	B	B	B	B	B	B
		Dry River-North River	A	C	C	C	C	C	C	C	C
		Naked Creek-South Fork Shenandoah River	B	B	B	B	B	B	B	B	B
		Shoemaker River-North Fork Shenandoah River	B	C	C	C	C	C	C	C	C
		Smith Creek-North Fork Shenandoah River	B	B	B	B	B	B	B	B	B
		Stony Creek-North Fork Shenandoah River	A	C	C	C	C	C	C	C	C
		Cedar Creek	B	C	C	B	C	B	C	B	B
		Dunlap Creek	B	C	C	B	C	B	C	B	C
		Potts Creek	B	C	C	B	C	B	C	B	C
		Back Creek-Jackson River	A	C	C	A	C	A	C	A	C

Scientific Name	Common Name	Watershed	Viability outcome from EIS viability	Viability outcome Alt A	Viability outcome Alt B	Viability outcome Alts C and I	Viability outcome Alt D	Viability outcome Alt E	Viability outcome Alt F	Viability outcome Alt G	Viability outcome Alt H
		Wilson Creek-Jackson River	A	C	C	A	C	A	C	A	A
		Cowpasture River	A	C	C	C	C	C	C	C	C
		Catawba Creek-James River	C	C	C	C	C	C	C	C	C
		Craig Creek	B	C	C	B	C	B	C	B	B
		Calfpasture River	A	C	C	A	C	A	C	A	C
		Little Calfpasture River	B	C	C	B	C	B	C	B	C
Cottus cf. cognatus	Checkered sculpin	Cacapon River	C	C	C	C	C	C	C	C	C
Aeshna canadensis	Canada darner	North Fork South Branch Potomac River	D	D	D	D	D	D	D	D	D
Aeshna tuberculifera	black-tipped darner	North Fork South Branch Potomac River	D	D	D	D	D	D	D	D	D
		Dry River-North River	B	C	C	C	C	C	C	C	C
		Naked Creek-South Fork Shenandoah River	D	D	D	D	D	D	D	D	D
		Potts Creek	B	C	C	B	C	B	C	B	C
		Wilson Creek-Jackson River	C	C	C	C	C	C	C	C	C
		Catawba Creek-James River	E	E	E	E	E	E	E	E	E
Aeshna verticalis	green-striped darner	North Fork South Branch Potomac River	D	D	D	D	D	D	D	D	D
Calopteryx amata	Superb jewelwing	North Fork South Branch Potomac River	D	D	D	D	D	D	D	D	D
Calopteryx angustipennis	Appalachian jewelwing	Stony Creek-North Fork Shenandoah River	B	C	C	B	C	B	C	B	B
		Cowpasture River	B	C	C	B	C	B	C	B	C
		Craig Creek	C	C	C	C	C	C	C	C	C
Cordulegaster diastatops	delta-spotted spiketail	North Fork South Branch Potomac River	B	B	B	B	B	B	B	B	B
Enallagma annexum (AKA cyathigerum)	northern bluet	North Fork South Branch Potomac River	D	D	D	D	D	D	D	D	D
Epitheca canis	beaverpond baskettail	North Fork South Branch Potomac River	D	D	D	D	D	D	D	D	D

Scientific Name	Common Name	Watershed	Viability outcome from EIS viability	Viability outcome Alt A	Viability outcome Alt B	Viability outcome Alts C and I	Viability outcome Alt D	Viability outcome Alt E	Viability outcome Alt F	Viability outcome Alt G	Viability outcome Alt H
Gomphus adelphus	mustached clubtail	Cowpasture River	C	C	C	C	C	C	C	C	C
		Calfpasture River	C	C	C	C	C	C	C	C	C
Gomphus quadricolor	rapids clubtail	Cowpasture River	C	C	C	C	C	C	C	C	C
		Craig Creek	C	C	C	C	C	C	C	C	C
		Calfpasture River	C	C	C	C	C	C	C	C	C
Ladona julia (AKA Libellula julia)	chalk-fronted corporal skimmer	North Fork South Branch Potomac River	D	D	D	D	D	D	D	D	D
Lanthus parvulus	double-striped clubtail	North Fork South Branch Potomac River	B	B	B	B	B	B	B	B	B
Lestes disjunctus	northern spreadwing	North Fork South Branch Potomac River	D	D	D	D	D	D	D	D	D
		Back Creek-Jackson River	C	C	C	C	C	C	C	C	C
		Wilson Creek-Jackson River	C	C	C	C	C	C	C	C	C
Leucorrhinia hudsonica	Hudsonian whiteface	North Fork South Branch Potomac River	D	D	D	D	D	D	D	D	D
Nehalennia irene	sedge sprite	North Fork South Branch Potomac River	D	D	D	D	D	D	D	D	D
Neurocordulia yamaskanensis	stygian shadowdragon	Stony Creek-North Fork Shenandoah River	C	C	C	C	C	C	C	C	C
		Wilson Creek-Jackson River	C	C	C	C	C	C	C	C	C
Rhionaeschna mutata (AKA Aeshna mutata)	spatterdock darner	North Fork South Branch Potomac River	D	D	D	D	D	D	D	D	D
		Potts Creek	C	C	C	C	C	C	C	C	C
Somatochlora elongata	Ski-tipped emerald	North Fork South Branch Potomac River	D	D	D	D	D	D	D	D	D
Sympetrum obtrusum	white-faced meadowhawk	North Fork South Branch Potomac River	D	D	D	D	D	D	D	D	D
Isonychia hoffmani	Hoffman's Isonychia mayfly	North Fork South Branch Potomac River	B	B	B	B	B	B	B	B	B

Scientific Name	Common Name	Watershed	Viability outcome from EIS viability	Viability outcome Alt A	Viability outcome Alt B	Viability outcome Alts C and I	Viability outcome Alt D	Viability outcome Alt E	Viability outcome Alt F	Viability outcome Alt G	Viability outcome Alt H
Nemotaulius hostilis	a limnephilid caddisfly	North Fork South Branch Potomac River	D	D	D	D	D	D	D	D	D
Glyptemys insculpta	wood turtle	South Fork South Branch Potomac River	C	C	C	C	C	C	C	C	C
		Cacapon River	B	C	C	C	C	C	C	C	C
		Shoemaker River-North Fork Shenandoah River	B	C	C	C	C	C	C	C	C
		Smith Creek-North Fork Shenandoah River	C	C	C	C	C	C	C	C	C
		Stony Creek-North Fork Shenandoah River	B	B	B	B	B	B	B	B	B
		Cedar Creek	B	C	C	B	C	B	C	B	B

*Outcome A. Species is well distributed and abundant within watershed. Forest Service may influence conditions in the watershed to keep it well distributed. Likelihood of maintaining viability is high.

Outcome B. Species is potentially at risk in the watershed; however, the extent and location of NFS lands with respect to the species is conducive to positively influence the sustainability of the species within this watershed. Therefore, likelihood of maintaining viability is moderate.

Outcome C. Species is potentially at risk within the watershed; however, the extent and location of NFS lands with respect to the species is NOT conducive to positively influence the sustainability of the species within this watershed. Therefore, species viability in the watershed may be at risk.

Outcome D. The species is so rare within the watershed (population is at very low density and/or at only a few local sites) that stochastic events (accidents, weather events, etc.) may place persistence of the species within the watershed at risk; however, the extent and location of NFS lands with respect to the species is conducive to positively influence the sustainability of the species within this watershed. Therefore, likelihood of maintaining viability is moderate.

Outcome E. The species is so rare within the watershed (population is at very low density and/or at only a few local sites) that stochastic events (accidents, weather events, etc.) may place persistence of the species within the watershed at risk. Forest Service ability to influence the species is limited. Therefore species viability in the watershed may be at risk.

APPENDIX K – REASONABLY FORESEEABLE DEVELOPMENT SCENARIO FOR OIL AND GAS FOR THE GEORGE WASHINGTON NATIONAL FOREST

VIRGINIA AND WEST VIRGINIA

Prepared by:

U.S. DEPARTMENT OF THE INTERIOR

BUREAU OF LAND MANAGEMENT

EASTERN STATES

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SUMMARY

A Reasonably Foreseeable Development Scenario (RFDS) for oil and natural gas is developed based on the assumption that all potentially productive areas can be open under standard lease terms and conditions except those areas designated as closed to leasing by law. It covers a time period of 15 years and includes all lands within the boundaries of the George Washington National Forest (GWNF) regardless of mineral estate ownership and adjacent non-forest lands.

Exploration on GWNF lands has been sparse and activity on surrounding lands has been minimal. Thus far, only five wells have been drilled on GWNF lands. All were designed to test a specific horizon and all were dry holes. Two small natural gas fields have been developed adjacent to GWNF lands, but, with the exception of one well, there has been no drilling activity since the 1990's.

Several oil and gas plays have been identified which cover the area of interest. As such, the oil and gas occurrence potential must be considered as high. One of these plays is related to the Marcellus Shale which is present on the surface and in the subsurface under more than half of the GWNF lands. Another is related to the Utica Shale. Regional cross sections indicate the possible presence of the Utica Shale under some of the same GWNF lands as potentially productive from the Marcellus. With industry focus currently directed toward the exploration for and exploitation of organic shales and in particular the Marcellus and Utica in the Appalachian Region, the oil and gas development potential is also considered as high.

It is foreseen that 20 vertical exploration/evaluation wells will be drilled over the next 15 years which will assess the presence and productivity of the Marcellus and Utica Shale in the area of the GWNF. Additionally, 50 vertical and 249 horizontal development wells are forecast to be drilled over the timeframe of the RFDS. The initial gross surface disturbance associated with the exploration, development, and production activity in the GWNF is estimated at 1,814.05 acres. With partial surface reclamation following completion of productive wells, the net disturbance is projected at 1251.99 acres. An additional 25 acres of lands are allocated for compression operations, produced water handling, material storage, and other facilities.

INTRODUCTION

The United States Department of Interior, Bureau of Land Management (BLM), Southeastern States Field Office prepared this Reasonably Foreseeable Development Scenario (RFDS) for Oil and Gas for the George Washington National Forest (GWNF). The RFDS is consistent with BLM Handbook 1624-1 and BLM Instructional Memorandum (IM) 2004-89. IM 2004-89 requires that the RFDS project a baseline scenario of activity assuming that all potentially productive areas are open to leasing under standard terms and conditions with the exception of those areas closing to leasing by law.

The RFDS is a reasonable, technical, and scientific estimate of anticipated oil and gas activity based on current information and data available. The baseline scenario presented in the document will be used by the United States Department of Agriculture Forest Service (FS) as the basis for determining the cumulative impacts from oil and gas activity relative to each alternative developed in the planning process.

DESCRIPTION OF GEOLOGY

The George Washington National Forest (GWNF), located in northwestern Virginia and eastern and northeastern West Virginia, is situated within portions of three physiographic provinces. From east to west, these are the Blue Ridge, the Valley and Ridge, and the Appalachian Plateau.

Structure

Blue Ridge Province

The Blue Ridge Province is an area of largely igneous and metamorphic rocks that have been thrust over younger Cambrian and Cambro-Ordovician sedimentary rocks. According to the USGS in the 1995 National Oil and Gas Assessment, "the Province underlies parts of eight States from central Alabama to southern Pennsylvania. Along its western margin, the Blue Ridge is thrust over the folded and faulted margin of the Appalachian basin, so that a broad segment of Paleozoic strata extends eastward for tens of miles, buried beneath these subhorizontal crystalline thrust sheets (Harris and others, 1981). At the surface, the Blue Ridge consists of a mountainous to hilly region, the main component of which are the Blue Ridge Mountains that extend from Georgia to Pennsylvania. Surface rocks consist mainly of a core of moderate-to high-rank crystalline metamorphic or igneous rocks, which, because of their superior resistance to weathering and erosion, commonly rise above the adjacent areas of low-grade metamorphic and sedimentary rock. The province is bounded on the north and west by the Paleozoic strata of the Appalachian Basin Province and on the south by Cretaceous and younger sedimentary rocks of the Gulf Coastal Plain. It is bounded on the east by metamorphic and sedimentary rocks of the Piedmont Province."

In a Description of the Geology of Virginia (James Madison University), the Blue Ridge is characterized structurally "as a large, eroded anticline overturned to the west. The core of the anticline is composed of igneous and metamorphic rocks collectively known as the Grenville, although there are also late Proterozoic intrusives and sediments present too. They are the oldest rocks in the state at 1.1 billion back to 1.8 billion years. The east and west flanks of the anticline are much younger volcanics and clastic sediments. Stratigraphic thicknesses range from about 3000 meters to 7000 meters. The final filling of the graben and creation of a divergent continental margin is preserved in the metamorphosed lava flows (Catoctin) and sedimentary rocks (Chilhowee Group and Evington formation) about 570-600 million years old."

Valley and Ridge

The majority of the GWNF lies within the Valley and Ridge Province. The Valley and Ridge represents a physiographic province of the larger Appalachian division which extends from southeastern New York, northwestern New Jersey, northeastern and central Pennsylvania, western Maryland, eastern West Virginia, northwestern and southwestern Virginia, and into Tennessee, Georgia, and Alabama. The Valley and Ridge forms an arc between the Blue Ridge Mountains on the east and the Appalachian Plateau on the west.

The province includes the Great Valley which is an expansive, flat region composed of complexly folded and faulted Cambrian and Ordovician carbonates and the Ordovician aged Martinsburg Shale. The Great Valley extends west to east from North Mountain to the Blue Ridge and is some 20 miles wide.

From North Mountain westward to the Allegheny Front, a distance of about 50 miles, are a series of northeast-trending mountains and valleys from which the Valley and Ridge Province is named. The ridges are comprised of resistant beds of sandstones, conglomerates, or quartzites and the valleys of less resistant carbonates and shales. Formations in the Valley and Ridge are thrust faulted and folded into anticlines and synclines and range in age from Cambrian to Lower Mississippian. The Valley and Ridge province is divided into several sharply defined anticlinal complexes separated by much broader synclinal zones. The most persistent of these synclinoria, the westernmost, extends 250 mi from central Pennsylvania to southern Virginia and averages 10-20 mi in width.

The majority of the GWNF lies within the Valley and Ridge Province between the Little North Mountain Fault and the Allegheny Plateau. This area is part of the Broadtop Synclinorium. Jacobeen and Kanes (1974) state, "Component structures of the Broadtop synclinorium include: Broadtop syncline (Broadtop coal basin) of Pennsylvania; Town Hill syncline, Whip Cove West anticline, Whip Cove syncline, Whip Cove East anticline, Spring Gap syncline, Sideling Hill syncline of Maryland and West Virginia (Tilton et al., 1927); and the Bergton-Crab Run anticline of Virginia (Brent, 1960). In this synclinorium, surface outcrop consists of predominantly Carboniferous and Devonian strata. Ordovician to Lower Devonian rocks comprise the cores of bounding anticlinoria."

Allegheny Plateau

The Allegheny Structural Front is the transition zone between the highly folded and faulted formations of the Valley and Ridge and the relatively flat lying rocks of the Allegheny (Appalachian) Plateau. Formations exposed on the Allegheny Front range in age from Middle Devonian to Lower Mississippian. Only a small portion of the GWNF, that located in Highland County, Virginia, lies within the Allegheny Plateau Province.

STRATIGRAPHY

The following formations crop out in the GWNF.

Pocono Formation – Massive gray sandstone with some dark shale

Hampshire Formation – Chiefly red sandstone; some flagstones, shales, and mudrock.

Foreknobs Formation (formerly Chemung) - Green and greenish-gray, thin- to thick-bedded, fossiliferous (most notably large crinoid stems) quartz sandstone and shale and minor quartz-pebble conglomerate.

Brallier Formation - Olive-gray, thin-bedded, micaceous, sparsely fossiliferous siltstone, shale, and thin lithic sandstone. Thickness: 1500 to 2200 feet.

Millboro Shale (Marcellus) and Needmore Formation - Millboro Shale: black, fissile shale, with thin bentonite beds. Near the base is an interval of dark-gray, aphanic, thinbedded limestone (Purcell Member?). Needmore Formation: olive-gray, weathered, fossiliferous shale, with thin bentonite beds. Composite thickness 800 to 1200 feet.

Ridgeley Sandstone, Helderburg, and Cayugan Groups – Calcareous sandstone; limestone, cherty in part; and calcareous shale; fossiliferous.

Keefer, Rose Hill, and Tuscarora Formations – Quartzarenite, dusky-red shale, and sandstone.

Massanutten Sandstone – Quartzarenite with lenses of conglomerate.

Juniata, Reedsville (possible Utica at base), Trenton, and Eggleston Formations – Dusky-red shale, mudstone, and sandstone; shale and limestone.

Martinsburg Formation – Gray shale, sandstone, and siltstone; gray argillaceous limestone.

PAST AND PRESENT OIL AND GAS EXPLORATION ACTIVITY

Regional seismic exploration was conducted in the late 1960's and early 1970's from the Blue Ridge, through the Valley and Ridge, and into the Appalachian Plateau Province utilizing Vibroseis on existing major east-west roads. Several of these lines crossed through the area of the GWNF. Additional seismic exploration was conducted in the general area in the late 1970's and early 1980's in response to industry interest in the Eastern Overthrust Belt in which most of the GWNF is situated. Five wells in Virginia and two wells in West Virginia were drilled in the overthrust belt in response to these efforts. The primary objective was the middle Devonian Oriskany Sandstone. None of the wells were productive.

There are five wells drilled on GWNF lands – four exploratory and one development. All were dry holes. There are other exploratory wells drilled on private lands between or within the GWNF, but only one discovery was made, that in the Bergton area of Rockingham County.

The only recent exploration activity in the area of the GWNF has been the Hardy County, West Virginia well drilled by Carrizo Marcellus, LLC in March 2010.

PAST AND PRESENT OIL AND GAS DEVELOPMENT ACTIVITY

The discovery of natural gas in the Devonian Oriskany Sandstone at Bergton Field located in Rockingham County, Virginia led to the drilling of 18 development wells. 7 were initially productive, but all are now plugged and abandoned.

There has been a well drilled in Hardy County, West Virginia on the Bergton structure. The well specifically targeted the Marcellus Shale. The same company that drilled the Hardy County well has applied for a permit to drill a Marcellus test on the Bergton structure in Rockingham County, Virginia. This application has been withdrawn.

The only other field of consequence near the GWNF is the Thornwood-Horton Field located in Pocahontas County, West Virginia. The field, which is immediately adjacent to GWNF lands in northwestern Highland County, Virginia, produces from the Oriskany Sandstone. One of the wells in that field communitized GWNF lands into the production unit for the well.

Other than the new Hardy County, West Virginia well and the proposed Rockingham County, Virginia well, activity in the area in and surrounding the GWNF has been nonexistent since the late 1990’s.

OIL AND GAS OCCURRENCE POTENTIAL

The BLM RFDS Handbook, H-1624-1, recommends that all areas within USGS or other defined plays should be given a high potential rating for oil and gas occurrence potential. In the Appalachian Basin Province evaluation of the USGS 1995 National Oil and Gas Assessment, R. T. Ryder defined some 34 real and hypothetical conventional and continuous (unconventional) plays. Four of these plays directly relate to the part of the Appalachian Basin Province where the GWNF is located. These are:

6702 Upper Cambrian, Ordovician, and Lower/Middle Silurian Thrust Belt
6716 Upper Silurian Sandstone Gas
6718 Silurian and Devonian Carbonate Thrust Belt
6720 Oriskany Sandstone Gas/Faulted Anticlines

In response to markedly higher natural gas prices in the 1990's, the Barnett Shale in Texas became a target for exploration and development activities. The play was only marginal from an economic stand point until new drilling and completion techniques were applied, thus demonstrating the viability of continuous resource plays. Since that time, development of continuous resource plays, including the Marcellus Shale, has been at the forefront of industry activity in the United States. Trillions of cubic feet of natural gas reserves have been added as a result of this activity.

In a 2002 assessment of undiscovered oil and gas potential of the Appalachian Basin Province, Milici and others outlined various conventional and continuous (unconventional) oil and gas resources. In this report, the Marcellus Shale Assessment Unit of the Devonian Shale-Middle and Upper Paleozoic Total Petroleum System was estimated to contain a mean value of potential resources of 1.9 TCF, with a range of 822 BCF to 3.67 TCF. Since that time, the Marcellus and other black organic shales in the Appalachian Basin such as the Utica have become the focus of intense exploration and development efforts. In response to these efforts, potential recoverable reserve estimates for the Marcellus Shale have now been projected by industry to as high as 50 TCF (Engelder 2008). In 2011, the USGS revised the estimate for undiscovered, technically recoverable reserves in the Marcellus to 84TCF and 3.4 billion barrels of natural gas liquids (USGS Marcellus Shale Assessment Team, 2011).

Patchen and Avary (2008) state, "The Middle Devonian Marcellus Shale is the oldest, thickest and most widespread of four formations in the Hamilton Group of central and eastern New York. This black shale unit extends from New York southward to Virginia and West Virginia, and westward into eastern Ohio where it pinches out beneath the Middle Devonian unconformity. In Ohio, the Marcellus Shale generally is not separated from younger rocks in the lower Olentangy Formation; in Virginia, the Marcellus usually is included in the basal portion of the thick Millboro Shale. Throughout the basin, the Marcellus Shale overlies the Onondaga Limestone or eastern facies equivalents, the Huntersville Chert or Needmore Shale." Enomoto (2009) states, "In the Virginia portion of the Appalachian Basin, the Devonian Mahantango Formation and the Marcellus Shale are mapped collectively as one unit that is named the Millboro Shale. This unit in Virginia consists of black, fissile shale units, with interbeds of dark gray argillaceous limestone or calcareous shale. Thin, dark gray, aphanitic limestone beds occur near the base. Geophysical logs from wells drilled in Highland and Rockingham counties, Virginia, indicate that the thickness of the Millboro Shale ranges from 368 to 570 feet thick in this region."

The Marcellus Shale underlies more than 50 percent of the area of the GWNF. The Utica Shale is basically an unknown factor in the GWNF, but has significant reserves of natural gas and natural gas liquids in other parts of the Appalachian Basin. As such, the oil and gas occurrence potential of the GWNF is considered as high.

OIL AND GAS DEVELOPMENT POTENTIAL

Well log data from wells drilled in the area indicate that the Marcellus Shale is present in the subsurface. Data evaluated from the cuttings from several of these wells and from samples taken from outcrop, show that the Marcellus Shale in the area of the GWNF has sufficient organic content and thermal maturity to be productive of natural gas (Enomoto, 2010). Patchen and Avary (2008) state, "the thickest accumulation of this organic-rich black shale occurs along the eastern side of the basin from New York to Virginia where thermal maturity is the highest. This combination of thick, thermally mature (dry gas window) black shales with well-developed regional fracture sets makes the Marcellus Shale an attractive play along the eastern side of the basin far from historical shale play areas as well as in the center of the basin," including the Valley and Ridge of Virginia and West Virginia.

There is some general interest in the area as a well targeting the Marcellus Shale has been drilled in Hardy County, West Virginia and another is being permitted by the same company across the state line in the Bergton area of Rockingham County, Virginia. One reason for the interest this area is the proximity of natural gas pipelines. The results of natural gas production from these wells and other new wells if drilled, coupled with evaluations of the log data from previous exploratory wells both within and adjacent to the GWNF, should serve as the basis for the leasing and future development of the Marcellus Shale resource in the GWNF.

The oil and gas development potential for GWNF is considered as high.

TYPICAL DRILLING AND COMPLETION SCENARIO

Drilling

Both vertical and horizontal wells will be utilized for the exploration and development of the Marcellus Shale resource in the GWNF. The true vertical depth (TVD) of these wells will range between 1000' and 8000'. Actual measured depths (MD) should range between 4000' and 12,000'.

In the GWNF, the likely drilling medium for vertical wells will be air or air-mist. For horizontal wells, air or air-mist will be used to the kickoff point, then either water or oil based drilling mud will be used for the radius turn and horizontal lateral portion of the hole.

Vertical wells are drilled from the surface to a point in the subsurface directly below the surface location. Horizontal wells are drilled from the surface to a point in the subsurface some hundreds or thousands of feet from the surface location. In each instance, conductor casing is run to a depth of 30, 60, or 90 feet. Drilling then continues to a point below the level of any aquifers or other zones that contain fresh water and a string of protective casing is run to that depth and cemented to surface per Onshore Oil and Gas Order No. 2 (OOGO No. 2) III, B, c. The surface casing shoe is pressure tested to the next casing setting depth mud weight, insuring a mechanically sound surface casing installation per OOGO No. 2, III, B, i. The setting of the surface casing isolates and protects fresh water and other important zones from contamination by connate waters, drilling mud, and hydraulic fracture fluids.

Below the surface casing, vertical wells are drilled through the objective horizon. Once total depth is reached, a string of production casing is run and cemented in place with the level of cement sufficient for isolation of the productive interval and “to isolate and/or protect all usable water zones, lost circulation zones, abnormally pressured zones, and any prospectively valuable deposits of minerals”, per OOGO No. 2. III. B. Horizontal wells are drilled to a point below the surface casing to the kickoff point where the well is steered from the vertical to the horizontal utilizing a medium or long radius turn. The well is designed for the borehole to enter the objective horizontally and then drill the lateral within the objective formation. Measure While Drilling (MWD) equipment and Geosteering software allow for the drilling of the borehole in a determined direction and attitude. Once Total Depth (TD) is reached, production casing is run to or near the total drilled depth and cemented in place with the level of cement sufficient for isolation of the productive interval. Horizontal lateral length will average 4000’.

By law in Virginia, vertical wells must be drilled at least 2500 feet apart. At a minimum, the vertical well spacing unit is 112.69 acres – a circle with a 1250’ radius. For horizontal wells, the unit size is 320 acres – a rectangle with dimensions of 2640’ X 5280’. Horizontal laterals will be drilled parallel to the long side and are required to have 600’ of separation. There is also a 300’ offset from the unit boundary requirement thus limiting maximum lateral length to 4680’. As a result, a maximum of 3 laterals can be drilled in each horizontal well unit.

Over the 15 year time frame of the RFDS, the average cost for a completed vertical well is estimated to average $2,500,000. For horizontal wells, the estimate is between $6,000,000. and $9,000,000. per well. Although the well cost for a horizontal well is 2 to 4 times higher than that for a vertical well, the potentially productive formation exposed in the horizontal borehole is 10 or more times greater. Recoverable reserves in horizontal wells are normally higher also. Recoverable reserves are estimated at 1,000,000 MCF/well for vertical wells and 3,000,000 MCF/well for the horizontal ones.

Based on the above averages, the drilling, completion, and production costs of the wells projected to be drilled in the GWNF is $2,042,000,000. The estimated ultimate recoverable reserves (EUR) developed from the drilling of these forecast wells is 817,000,000 MCF.

Completion

The higher cost for a horizontal well is the result of the increase in measured depth due to the length of the lateral and also the added stimulation cost. The typical vertical shale well is usually perforated over the potentially productive interval and stimulated by one hydraulic fracture treatment. The typical horizontal well, on the other hand, often undergoes 10 or more staged fracture treatments each the same size as that for a vertical well. This again relates to the demonstrably increased productiveness inherent to horizontal drilling.

Hydraulic fracture stimulation is utilized in many wells, but is a necessary process for wells drilled in low permeability reservoirs like shales. An estimated 90% of the natural gas wells in the US use hydraulic fracturing to produce gas at economic rates.

In addition to the requirements of the BLM Onshore Orders, specific Conditions of Approval (COA) concerning well operations are set forth with the BLM approval of the Federal Application for Permit to Drill (APD). A typical COA would prescribe the testing of the production casing to the highest surface pressure anticipated to be encountered during hydraulic fracturing operations prior to the onset of these operations, and also require the monitoring of annular pressures during the process as a check of wellbore mechanical integrity.

The hydraulic fracturing of horizontal wells requires large volumes of water. Each stage of the stimulation uses 10,000 to 12,000 barrels of water (420,000 to 504,000 gallons). Usually 10 or more treatments are necessary in order to stimulate the entire productive horizon requiring

100,000 to 120,000 barrels of water (4.2 to 5.0 million gallons). During initial post treatment flowback, only 20 percent or less of the fracture fluid is recovered. The rest of the fluid is produced over time. The returning fracture fluid can be treated and reused, treated in the proper facility and disposed of at the surface, or disposed of by underground injection. Both state and federal agencies have oversight of surface disposal. The EPA or EPA-delegated state programs have oversight of underground injection.

RFD BASELINE SCENARIO ASSUMPTIONS AND DISCUSSION

The initial assumption is that all potentially productive areas can be open under standard lease terms and conditions except those areas designated as closed to leasing by law. It covers a time period of 15 years and includes all lands within the boundaries of the George Washington National Forest regardless of mineral estate ownership and adjacent non-forest lands where oil and gas activity may impact Forest lands.

Additional assumptions include:

- Initial and primary activities will be directed toward exploration and development of the resources of the Marcellus Shale. The initial exploration phase will also evaluate for the presence of and the potential productivity of the deeper Utica Shale.
- The Marcellus Shale underlies 569,763 acres of the 1,065,499 acre GWNF. Of this total, 484,299 acres are projected to be ultimately capable of natural gas production from the Marcellus Shale. The area of the GWNF possibly underlain by the Utica Shale is unknown.
- Seismic exploration will utilize existing roads for Vibroseis and heliportable seismic equipment in other areas and will not result in any appreciable surface disturbance.
- Minimum well spacing and unit size will be governed by rules and regulations the various state authorities designated for oversight of oil and gas operations.
- Access roads construction disturbance is based on a 40' wide ROW. The actual travel surface and buffer area, however, is anticipated to be less than 40'.
- Well pad and pit size will vary between 2.07 acres for vertical wells to 5.74 acres for multi-well locations.

For productive wells, those portions of the well site not necessary for production facilities and well operations will be reclaimed. For non-productive wells, the entire area will be restored.

For productive wells, all production facilities will be located on the initial well pad.

Well gathering and other pipelines will utilize existing access and other road right of ways. Utility lines will also be constructed within existing access roads right of ways.

Wells drilled to test the Utica Shale and other, deeper horizons that may become of interest can be drilled from facilities constructed for the exploitation of the Marcellus Shale, either concurrent with or after development.

Compression, processing, produced water, and material storage facilities will most likely be constructed on private lands, but could be constructed on GWNF lands. 25 acres of land is allocated for the construction of these facilities.

SURFACE DISTURBANCE DUE TO OIL AND GAS ACTIVITY

Access Roads and Well Pads

The two primary sources of surface disturbance from oil and gas exploration and development activity are well (drill) pad construction and the building of access roads to the well site. In situations where production is not established, the well site and the access road are reclaimed. In situations where production is established, a portion of the well site is reclaimed and the access road is upgraded for long term use.

New well roads would be necessary to access drill sites from the existing GWNF road system or from other highways. Access roads are generally constructed for temporary use during the drilling phase of operations. After production is established, access roads are upgraded with a single lane or wider all weather travel surface for long term use. For purposes of the GWNF RFDS, disturbance estimates were based on access roads having a consistent 40’ construction limit width. All access roads would be constructed under established GWNF guidelines.

Well pads vary in size depending on the type of well to be drilled, well depth, the number of wells to be located on the same pad, and local topography. Well pad size can also be proportional to the type and amount of equipment and material needed to complete the well once drilling has ended. Well pad size in the area of the GWNF is projected to vary between 2.07 for a single vertical well location to 5.24 acres for typical 3 well directional or horizontal well sites.

Each drilling rig can on average drill and complete approximately 1 horizontal well in this area every 3-4 weeks (12-17 wells/year) or 1 vertical well every 10-14 days (26-35 wells/year). To fully develop the resource in the GWNF would require some 20 rigs, each drilling 15 horizontal wells per year over the 15 year life of the plan. Given the number of wells and rigs required, a projected increasing natural gas supply in the U.S., the need for projected steady gas pricing through the year 2025, and simply that there are better areas for Marcellus and Utica Shale exploitation, full development of the resource in the GWNF is not a likely scenario within the operative time frame of the plan.

Forecast Development and Disturbance

The development of the oil and gas resources within the GWNF is anticipated as follows:

Seismic Exploration: 163 miles of Vibroseis on existing roads and the use of heliportable seismic equipment in other areas (casual use minimal disturbance).

Exploration/Evaluation Wells - Vertical (20 drilled from a single 2.07 acre pad): 41.32 acres

Exploratory/Evaluation Wells Access Roads (1.5 miles/well): 145.45 acres

Development Wells-Vertical (50 drilled from single 2.07 acre pad): 103.31 acres

Development Wells-Vertical Access Roads (1.0 miles/well): 242.42 acres

Development Wells-Horizontal (249 drilled from a 5.74 acre 3 well pad): 476.35 acres

Development Wells-Horizontal Access Roads (83 X 2.0 miles/pad): 804.85 acres

Total Initial Disturbance from exploration and development: 1814.05 acres

Total Area Reclaimed Following Well Completion: 562.06 acres

Total Net Disturbance from exploration and development: 1251.99 acres

Area allocated for Compression operations, gas processing, produced water handling, and material storage facilities: 25 acres

Percentage of GWNF Acres disturbed by oil and gas operations is less than two-tenths of one percent.

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APPENDIX M - INDEX

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APPENDIX N – AGENCY RESPONSES TO PUBLIC COMMENTS

INTRODUCTION

The following is a summary of public comment received regarding the George Washington National Forest Proposed Revised Land and Resource Management Plan (RLRMP) and draft Environmental Impact Statement (DEIS). The comment period was June 3, 2011 to October 17, 2011. We received over 53,000 responses, including letters, emails, resolutions, form letters and petitions. These responses have been analyzed using a process called content analysis.

Content analysis included logging the public respondents and letter numbers into a database, filing copies of every letter, reading the letters, and coding individual requested actions and noted concerns contained within the letters. Each public concern was entered into the database, and given an identifying number that links the specific comment back to the original comment letter. Every effort was made to keep each comment with sufficient context so that it is a stand-alone statement. Comments of a similar nature were combined together to facilitate the development of a response. Once all of the comments were reviewed the Interdisciplinary Team developed responses. The summary of the comment that is displayed in this document often condenses very detailed comments from the letters. When the Interdisciplinary Team members prepared the responses, they reviewed the original comments rather than relying only on the broad summary comment.

The comments received provided valuable input toward development of the Final EIS and Revised Forest Plan. Possible responses to comments included: modifying alternatives, developing new alternatives, improving or supplementing analyses, making factual corrections, or explaining why the comments do not warrant further agency response. The comments were also used to update the draft Forest Plan.

Although this summary and accompanying list of public concerns attempts to capture the full range of public issues and concerns, it should be used with caution. It is important to recognize that the consideration of public comments in not a process in which the outcome is determined by the majority opinion. All comments have been treated equally. They are not weighted by organizational affiliation or status of respondents, and it does not matter if an idea was expressed by thousands of people or a single person. Emphasis is placed on the content of a comment rather than who wrote it or the number of people who agree with it. Although the relative depth of feeling and interest among the public can serve to provide a general context for decision-making, it is the appropriateness, specificity, and factual accuracy of comment content that serves to provide the basis for modifications to planning documents and decisions. Respondents are self-selected; therefore their comments do not necessarily represent the sentiments of the public as a whole. However, these reports do attempt to provide fair representation of the wide range of views submitted. In considering these views, it is important for citizens and decision makers to understand that this process makes no attempt to treat input as if it were a vote. Instead, the content analysis process ensures that every comment is considered at some point in the decision process. Every substantive comment and suggestion has value, whether expressed by one respondent or many.

The comments and responses are grouped by the following resource topics:

Air (Air)	Minerals (MI)
Alternatives (Alt)	Monitoring (MO)
Additional Material (AM)	Net Benefits (NB)
Aquatic Resources (AQ)	Non-Native Invasive Species (NN)
Biologic Resources (BI)	Old Growth (OG)
Biomass (BM)	Process for Preparing the EIS and Plan (PR)
Budget (BU)	Potential Wilderness, Inventoried Roadless & Wilderness (PW)
Climate (CL)	Recreation (R)
Coordination with Other Agencies (CO)	Roads (RO)

Cultural Resources (CU)	Soils (S)
Economics (EC)	Special Biological Areas (SB)
Energy (EN)	Science (SC)
Facilities (FA)	Timber (T)
Fire (FI)	Trout (TR)
Gas Leasing (GA)	Utilities (U)
Geology (GE)	Visual Resources (V)
Herbicides (H)	Water (WA)
Lands (LA)	Wind (WI)
Management Emphasis (ME)	Wild and Scenic Rivers (WSR)

AIR

Air-1: The Forest Service should assure compliance with air pollution regulations for ozone and fugitive dust.

During project implementation the Forest Service will comply with all applicable air pollution control regulations.

ALTERNATIVES

ALT-1: The Forest Service should select Alternative A.

Alternative A would continue management as in the current plan. Comments in favor of Alternative A liked the way the Forest is being managed or perceived that the current plan had fewer restrictions on some management activities. The Record of Decision discusses the reasons for selection of Alternative I and why it was chosen over the other alternatives. In regard to Alternative A, the selected alternative addressed a number of issues that are new since 1993 and addressed new information and research regarding a number of issues.

ALT-2: The Forest Service should modify Alternative C or add an alternative to more closely reflect the issues presented in the "Conservationists Alternative."

The purpose of Alternative C is to represent an emphasis on a large amount of Recommended Wilderness Study areas and very limited active management activities. While it was heavily influenced by the issues presented in the "Conservationists Alternative", it does not exactly duplicate the entire proposed alternative. Alternative C addresses the major issues presented in public comments related to an emphasis on little active management, while still meeting legal requirements for management. In addition, it reflects as close to a viable alternative that incorporates passive management as much as possible. Recreational access (roads) to the national forest is a significant issue that cannot be eliminated or minimized from any alternative.

ALT-3: The Forest Service should select Alternative C.

Alternative C was supported by commenters for a variety of reasons including: all Potential Wilderness Areas would be Recommended Wilderness Study, protection of all old growth, it best addresses climate change with protected core areas and no activities that fragment habitat; all species benefit from no management; it provides the best options for restoration; it is best for tourism and the economy and has the lowest budget to implement; it would keep the forest pristine; more headwaters areas would be protected in wilderness; there would be no prescribed fire which is unnecessary; there would be no timber harvest; there would be no wind development and no gas drilling; all Inventoried Roadless Areas would be protected; all Potential Wilderness Areas would be protected; all Special Biological Areas would be protected; all Virginia Mountain Treasures would be protected; it would reduce impacts from non-native invasive species; and it could be modified to include the Shenandoah Mountain proposal. The Record of Decision discusses the reasons for selection of Alternative I and why it was chosen over the other alternatives. The selected alternative seeks to provide a variety of settings across the forest to address many resource and user needs in a balanced manner. It addresses many of the same issues as Alternative C, but rather than recommending all of the Potential Wilderness Areas for Recommended Wilderness Study, it recommends 7% of them, the ones with the highest level of support and ones that made for large or larger wilderness areas. The selected alternative identifies about 35% of the forest as core areas where little management activities will occur that will address the desire for old growth and core areas with limited activities that fragment mature forested conditions. Much of the forest is not suitable for wind development. The only acres available for federal oil and gas leasing are the 10,200 acres already under an existing lease. The Special Biological Areas and Inventoried Roadless Areas are not suitable for timber production or road construction. About 56% of the Virginia Mountain Treasures are in protective management prescription areas like Wilderness, Recommended Wilderness Study, Recommended National Scenic Area, Special Biological Areas, and Remote Backcountry Areas. While the selected alternative has a higher budget, it also produces many benefits that Alternative C does not, such as more diverse structure in the ecological systems, more habitat for game animals, more wood products, and more road access within the GWNF.

ALT-4: The Forest Service should select Alternative C, but modified to include the Friends of Shenandoah Mountain proposal.

See answer to ALT-3. The selected alternative does include several aspects of the Friends of Shenandoah Mountain proposal including Recommended Wilderness Study for Little River and Recommended National Scenic Area for Shenandoah Mountain.

ALT-5: The Forest Service should incorporate portions of Alternative C in its preferred alternative, including Recommended Wilderness Study and the treatment of Virginia Mountain Treasures.

See response to ALT-3. The final selected alternative did include an increase of 27,000 acres of Recommended Wilderness Study and 67,000 acres of Recommended National Scenic Area. However, a recommendation of 386,000 acres for Recommended Wilderness Study would severely limit the progress toward meeting the ecosystem and species diversity objectives. The selected alternative did consider the characteristics of Virginia Mountain Treasure areas that were within Potential Wilderness Areas or within a large block of semi-primitive non-motorized ROS recreation setting for their contribution to preserving those characteristics when allocating the management prescriptions within Virginia Mountain Treasure areas to Remote Backcountry Areas or Mosaics of Habitat.

ALT-6: The Forest Service should correct errors in the description of Alternative C and its effects.

The effects analysis does include openings and open woodland conditions from natural disturbances in determining how all alternatives address species diversity objectives. An estimated 1-2% of the forest in openings from natural disturbances and 1-2% in open woodlands is used. In regard to adjacent lands providing habitat for species, one cannot rely on any level of management or non-management on adjacent lands. It is important that the forest attempt to provide habitat for a wide range of species that utilize the forest and not defer habitat management to other landowners. Some of the references to species needing active management have been fixed, as has the discussion about prescribed burning in Alternative C.

ALT-7: The Forest Service should fully analyze Alternative C.

Alternative C is fully analyzed in the FEIS and was fully considered in the Record of Decision.

ALT-8: The Forest Service should select Alternative D.

Comments in favor of Alternative D generally relate to a desire to have increased timber harvest and creation of early successional habitat, particularly for game species. The Record of Decision discusses the reasons for selection of Alternative I and why it was chosen over the other alternatives. In regard to Alternative D, given past funding and expected future funding, the increases in timber harvest in this alternative are unlikely to occur. The selected alternative projects an increase in timber harvest and while even this projected increase may be difficult to achieve, it is more in line with expected funding than is Alternative D. The selected alternative also better balances some of the concerns from people who want more emphasis on remote settings on the forest. Large remote settings are rare in this geographic area and we have recognized the importance of retaining these areas.

ALT-9: There are conflicts in the activities proposed in Alternative F.

One of the comments addresses scenic values. The differences in acreages of lands with low and moderate Scenic Integrity Objectives between the current plan (Alternative A) and the other alternatives are addressed in the selected alternative where scenic integrity objectives have been raised in Management Prescription Area

13–Mosaics of Wildlife Habitat. Another comment described concerns that some land allocations where not appropriate for Alternative F's theme of remote habitats and settings. The alternatives were designed to provide a range of options to address issues. Alternative F addresses a number of issues, not just remote settings. Some of the items raised in the comment are addressed in other alternatives, like Alternative C. The comment also questions why the Management Prescription 12D was developed rather than using the Remote Backcountry prescription 12C used in the Jefferson National Forest Plan. The prescription for 12D was developed to address issues about managing areas in a manner similar to the constraints used in the 2001 Roadless Area Conservation Rule and to allow existing roads to remain open. Existing roads could be considered for decommissioning, but it would be based upon future site-specific analysis.

ALT-10: The Forest Service should select Alternative F.

Comments in favor of selecting Alternative F generally refer to its balance among various resources. The Record of Decision discusses the reasons for selection of Alternative I and why it was chosen over the other alternatives. In regard to Alternative F, the selected alternative has modified Alternative G with some of the components of Alternative F.

ALT-11 & ALT -12: The Forest Service should select Alternative G. The Forest Service should select Alternative G with some modifications.

Comments in favor of selecting Alternative G generally refer to its balance among various resources and often specifically mention the prohibition on horizontal drilling. The Record of Decision discusses the reasons for selection of Alternative I and why it was chosen over the other alternatives. In regard to Alternative G, the selected alternative is based on this alternative with some changes brought about after review of public comments on the Draft EIS and Draft Plan. The selected alternative does not allow any new federal oil and gas leasing.

ALT-13: The Forest Service should not select Alternative G.

Comments recommending against the selection of Alternative G identify reasons such as: allowing the cutting of old growth timber in two old growth forest types, additional road construction, only a small amount of Recommended Wilderness Study, limitations on timber harvest, the reliance on timber harvest and prescribed burning, and insufficient protection of water quality. The selected alternative does allow for vegetation management and some associated road construction to allow for the creation of habitat to meet the needs of a wide diversity of species. Given the aging of the forest, the selected alternative also allows for the harvest of stands that meet the definition of old growth in the more common vegetation types to meet the needs for ecological diversity objectives, given the current age class distribution of the forest. The amount of Recommended Wilderness Study and Recommended National Scenic Areas did increase in the selected alternative and protection of water quality remains one of the highest priorities of the forest.

ADDITIONAL MATERIAL

AM-1: The Forest Service should consider the additional information previously sent or in the referenced documents.

The Forest Service has reviewed the material submitted in public comments. This information was used in the final analysis.

AQUATIC RESOURCES

AQ-1: The Forest Service should improve its analysis of aquatic species viability.

Within the Terrestrial Species Diversity and Viability analysis, the riparian species group is addressed generally through the establishment of standards to guide management of activities in riparian areas (FEIS page 3-145). A more specific aquatic/riparian species viability analysis is covered under the Aquatic Species Viability Evaluation (Section B4A). We have included additional information describing how and why species protection would increase or decrease for each alternative (e.g. by widened riparian corridors, through recognition of channeled ephemeral streams, by avoiding activities that would increase sedimentation, by restoring and enhancing water quality and aquatic habitat, by providing the optimal aquatic habitat and water quality which cannot be ensured on private lands). Appendix H lists the species by watershed by alternative.

AQ-2: The Forest Service should reevaluate plan direction for standards for dams.
Riparian corridors are generally unsuitable for new human created stream channel impoundments, but may be considered on a project-specific basis, consistent with appropriate Federal and state regulations. Impoundments will generally be designed to allow complete draining, with minimum flows, cold-water releases, and re-aeration in trout waters and other specific waters when needed. Downstream catch basins and fish ladders are constructed for fish salvage/passage, if necessary. New human-constructed impoundments are unsuitable on streams where federally listed species will be negatively affected (Standard 11-057). The desired condition for riparian corridors includes stream structures that do not decrease in-stream connectivity, with the exception of some existing dams (Plan DC 11-07).

BIOLOGICAL RESOURCES

BI-1: The Forest Service has addressed threatened and endangered species.
We agree.

BI-2: The Forest Service should update its list of species to be addressed under the ESA and implement consultation with the US Fish & Wildlife Service.
The list has been agreed to with the U.S. Fish & Wildlife Service and we did consult on the Forest Plan.

BI-3: The Forest Service should improve the analysis of habitat needs for threatened and endangered species.
The analysis has been updated and includes the Virginia northern flying squirrel (which changed status since the Draft Plan was released) and additional information on shale barren rock cress in relation to burning.

BI-4: The Forest Service should analyze the alternatives in relation to effects on TES species.
For the Virginia northern flying squirrel, Big Levels salamander and shale barren rock cress, all known occurrences are protected in Special Biological Areas in all alternatives. Special Biological Area (SBA) designation protects the values for which the SBA was created. Thus, these species receive a high degree of protection in all alternatives. Some sword leaved phlox populations are protected in SBAs. Where there are populations of a single rare species, such as sword leaved phlox and rock skullcap, these populations will be protected as occurrences under all alternatives during project-level analysis. Chapter 3, Section B2B contains a discussion of the alternatives in relation to the Indiana bat. The Species Diversity Report (EIS, Appendix E) contains a species-specific analysis to evaluate whether additional provisions were needed for federally listed terrestrial species and the Aquatic Ecological Sustainability Analysis (EIS, Appendix G) did the same for aquatic species. The FEIS also contains viability outcomes for TES species by alternative.

BI-5: The Forest Service should improve the analysis of habitat needs for the Indiana bat.
We have addressed the habitat needs of the Indiana bat in the analysis in Section B2b of Chapter 3 of the EIS. The US Fish and Wildlife Service provided us with recent research related to the Indiana bat during the formal consultation between the Draft and Final Plan, which we have incorporated into the Final Plan.

BI-6: The Forest Service should collect adequate population data for TES species.
The type and level of data that needs to be collected to determine the effects of a given project on TES species varies with the species and the type of project. This is a site-specific analysis and the needs should be addressed during the project level analysis.

BI-7: The Forest Service should correct errors in the terrestrial viability analysis.
Comments question the identification of the small footed bat and the northeastern bulrush as species that are not affected differently among the alternatives.

For the northeastern bulrush and swamp pink, all of the alternatives allocate the locations where the bulrush is found as Special Biological Areas. The Special Biological Areas are developed to provide whatever habitat management is needed for the species or community for which the area was established. That is why they are all identified as having the same effect. In regard to the Cow Knob salamander, most of the known locations are in the Shenandoah Crest/Cow Knob salamander prescription area. Plan direction also specifies that for any locations where Cow Knob salamanders are found, the same management constraints as the prescription area will apply. With this direction, all of the alternatives are considered to have the same effects.

Viability is addressed in each alternative. Errors were corrected in the table of acres of soil disturbance by alternative and Alternative D now correctly is displayed as the alternative with the greatest amount of soil disturbance. Alternatives G, H and I have the next highest levels. While Alternative G may have second largest amount of soil disturbance, this does not mean that there would be significant impacts on aquatic species. Many of the standards in the Plan are designed to minimize the potential for any disturbed soil to reach stream channels.

The Forest Service has utilized the latest information in the identification of species to be addressed in the analysis. The wood turtle is specifically addressed in the analysis. We have updated the information on the global status of the wood turtle.

The common names of the species have been corrected.

BI-8: The Forest Service appropriately utilized the Ecological Sustainability Evaluation in the planning process, but some additional analysis is needed.

The Forest Service updated the ecological analysis with the latest information on ecological zones. The extent of highly departed stands will be addressed during project level implementation of the Plan.

The desired conditions of the Oak Woodland system have been updated in the Forest Plan.

A discussion of potential changes in the composition of the tree species over time has been added to the EIS.

To put in perspective the Forest Plan objective of returning about 800 acres of land to shortleaf pine, it is estimated that shortleaf pine should occupy about 2.5 percent of the forest (about 26,000 acres) of the GWNF.

In regard to the age of regenerating forests in the LANDFIRE models and the traditional definition of early successional stage as zero to ten years in age, we have described the forest desired conditions in ecological terms, but have described the desired conditions in Management Prescription Area 13-Mosaics of Habitat in terms of the 0-10 year age class.

The immediate focus on spruce restoration will be on the Laurel Fork area, other areas may be considered in the future.

BI-9: The Forest Service should use a combination of core biological areas and surrounding multiple-use areas.

The selected alternative does incorporate the concept of core areas with relatively little management activity and areas around the cores where these is existing access and sometimes historic management activities as areas where more management activities are implemented. Core areas include the Remote Backcountry Areas at Massanutten North, Duncan Knob, Southern Massanutten, Big Schloss, the ridge of Great North Mountain, Jerkemtight, Elliott Knob, Crawford Knob, Archer Knob, Shaws Ridge, Laurel Fork, Little Alleghany, Oliver Mountain, Little Mare Mountain, Dolly Ann, Beards Mountain, Rich Hole, Adams Peak, the western flank of the Blue Ridge, and Three Sisters. It also includes the existing and Recommended Wilderness Study areas at Saint Mary's, Ramsey's Draft, Rich Hole, Rough Mountain, Three Ridges, Priest, Little River and Beech Lick Knob, the existing and Recommended National Scenic Areas at Mount Pleasant and Shenandoah Mountain, and the large Special Biological Areas at Kelly Mountain and the Shenandoah Crest Zone.

BI-10: The Forest Service should focus on the need for old growth and connected large core areas to meet ecological diversity goals.

The selected alternative allocates about 44 percent of the GWNF into prescriptions where timber will not be harvested and old growth conditions will continue to develop. These areas contain about 53 percent of the area currently identified as likely to contain old growth forests. In addition, all stands of timber in eight of the ten old growth forest types currently identified as old growth are not suitable for timber production. The current age class distribution shows that about 22 percent of the forest is over 120 years old and in thirty years this will be 70 percent. Even if the upper limits of timber harvest (30,000 acres per decade) occurred during those thirty years and all of the harvest were in stands greater than 90 years of age, the forest would still have 61 percent of the forest greater than 120 years in age. Based on projected age class distributions, there should be adequate connections of late-successional mature forest habitat between old growth areas.

BI-11: The Forest Service should re-examine the goals for open woodlands.

Research supporting the historic evidence for open woodland habitat in the Appalachians is found in the FEIS Section B, Ecological Systems Diversity section and the Fire-Wildfire and Prescribed Fire section. The need for open woodland habitat to provide habitat for a number of TES and locally rare species is documented in FEIS Section B2 and Appendix F, Terrestrial Viability Evaluation, and Federally listed Threatened and Endangered Species. In addition, the ability of open woodland habitat to help provide habitat needs for a number of public interest species like white-tailed deer, wild turkey, black bear, and northern bobwhite quail is documented in the Demand Species section.

BI-12: The Forest Service should not disturb lands above 4000 feet in elevation.

There is little land above 4000 feet. The areas on Shenandoah Mountain and Elliott Knob are in Special Biological Areas or the Shenandoah Crest, as is the area on Paddy Knob. Some areas above 4000 feet are along the state line in Highland County where vegetation management is allowed. There are no rare communities present there and no particular reason not to manage these areas. However, there is a need for additional early successional habitat at elevations greater than 3,000 feet.

BI-13: The Forest Service should minimize conversion of oak stands to pine.

The selected alternative does not propose large scale conversion from oak to pine. Rather, the goal is to restore systems through the use of fire and other tools to the potential historic vegetation type. This may result in some stands that are oak and pine mixed to favor pine in some areas. However, there will not be wide scale changes. The restoration of shortleaf pine to some locations is an objective.

BI-14: The Forest Service should better address the potential loss of oak and hickory species.

We recognize the stresses and threats to the oak and hickory ecosystem across the forest and have incorporated strategies in the Forest Plan to address non-native invasive species and regeneration of oak and hickory species through timber harvest and the use of fire. A discussion of potential changes in the composition of the tree species over time has been added to the EIS.

BI-15: The Forest Service should improve the species diversity analysis.

The concern about how individual tree species were addressed in the analysis was addressed through the ecological analysis, wherein the ecological systems are, in large measure, based on the assemblage of individual tree species in the system. Regeneration of southern yellow pine species, especially table mountain pine which is declining, is part of the rationale for an increased objective for prescribed burning in the selected alternative. There is a standard to preserve butternut trees (which is included in the species diversity analysis) during timber harvest.

In regard to the comment to specify an objective for creating savannahs of a certain size, this objective can be part of the current objectives to restore and maintain 12,000 to 20,000 acres of forest in open woodland conditions through the use of wildland fire on an annual basis.

BI-16: The Forest Service should complete an accurate inventory of the Forest's myriad of species.

It would be very difficult to inventory all of the species on the forest. The purpose of the ecological analysis is to identify the ecological systems on the forest and develop a strategy to maintain them. In this way most of the species on the forest should have habitat they need. Since some species are rare or in decline, these have also been identified and additional management direction prescribed to assure their protection as well. Much inventory of these species has been done on the Forest by our staff and other agencies.

BI-17: The Forest Service should update its analysis of effects on specific species, including: Big Levels salamander, wood turtle, cerulean warbler, Cow Knob salamander.

For the Big Levels salamander, all known occurrences are protected in Special Biological Areas in all alternatives. The global rank for the wood turtle has been updated in the documents. Specific guidance for the wood turtle has been updated in Chapter 3 of the Forest Plan. Habitat needs and effects of alternatives for Cerulean warbler are discussed in the FEIS, Species Diversity Report, Appendix F, Section B Terrestrial Viability Evaluation, and the Migratory Species Section. Forest Plan direction specifies that “If Cow Knob salamanders are found in areas outside the Shenandoah Mountain Crest management prescription area, those areas will be subject to the same management measures as described in the Shenandoah Mountain Crest Management Prescription Area 8E7.”

BI-18: The Forest Service should recognize the important role of fungi in the EIS and Forest Plan.
We recognize the importance of fungi in the ecosystems on the GWNF. In regard to using fungi in restoration practices, we will need to evaluate this at the project level as we implement the Forest Plan. We do not currently have enough information to select a species of fungi as a management indicator species.

BI-19: The Forest Service should re-evaluate the selected Management Indicator Species to assure that the best species are selected to indicate changes in management.
The process and rationale for the selection of Management Indicator Species is found in FEIS Section B, Management Indicator Species, Analysis of the Management Situation, and George Washington Management Plan Management Indicator Species Selection Process Paper. Rationale for species proposed for MIS selection includes the need for consistency between the GW Plan Revision and the Jefferson Plan Revision, since both National Forests are administratively combined and share common ecosystems, issues and management direction. The MIS selected complement the species chosen on the Jefferson NF, allowing for better monitoring data on these species.

Management Indicator Species are but one method of monitoring changes from forest management. The ecological analysis identified nine ecological systems and about 295 species needing additional direction for management. We will be monitoring these systems and the implementation of direction for the species' management.

BI-20: The Forest Service should use beaver as a MIS.
Beaver is a MIS in the Forest Plan (FEIS Section B, Management Indicator Species).

BI-21: The Forest Service should incorporate the best science on game management.
The GW Plan Revision strove to use best science in determining the desired conditions for ecological sustainability and species sustainability, which includes a number of public interest species (FEIS Terrestrial Viability Evaluation). Sound science was also used in identifying the needs for game species and to establish our desired conditions and objectives (FEIS Chapter 3, Section B, Demand Species).

BI-22: The Forest Service should protect fish and wildlife habitat.
We agree and have incorporated protection measures in the Forest Plan land allocations, objectives and standards, as well as analyzed effects of proposed alternatives (FEIS Chapter 3 Section B – Biological Environment).

BI-23: The Forest Service should address the impacts of habitat fragmentation from vegetation management activities.
The definition of what constitutes habitat fragmentation depends on the species in question. Habitat fragmentation is addressed in the FEIS in many areas, including the following: Chapter 2, Comparison of Alternatives, Climate Change Issue Statement, Chapter 3, Section B, Ecological Systems Diversity, Terrestrial Species Diversity, Migratory Birds, Management Indicator Species, Old Growth, Aquatic Species Diversity, Aquatic Species Viability Evaluation, Fire – Wildfire and Prescribed Fire; Chapter 3, Section C, Wilderness and Inventoried Roadless Areas, Scenery, Chapter 3, Section D, Federal Oil and Gas Leasing Availability; Appendix E Ecosystem Diversity Report, specifically Ecosystem Diversity Characteristics; Appendix, F Species Diversity Report, specifically Area Sensitive Mature coniferous, Deciduous, and/or Mixed Forest Associates and Area Sensitive Grassland and Shrubland and Open Woodlands Associates.

BI-24: The Forest Service should consider the impacts of the existing deer population.
The FEIS includes existing deer population statistics in analysis of effects of alternatives in Chapter 3, Section B, Demand Species. Desired conditions for a range of vegetation ages and structural conditions presented in alternatives benefit a large suite of species, including white-tailed deer (FEIS, Chapter 3, Section B, Terrestrial Species Diversity, and Appendix F, Species Diversity Report). Alternatives also provide for large areas of the forest to move to mature forested characteristics.

BI-25: The Forest Service should not increase early successional habitat.
We used an ecosystem sustainability model and species diversity analysis patterned after a system used by the Nature Conservancy to provide a coarse and fine filter approach to providing habitat needs for a large number of species currently utilizing the Forest (FEIS Chapter 3, Section B, Ecological Systems Diversity and Terrestrial Species Diversity, Appendix E, Ecosystem Diversity Report, and Appendix F, Species Diversity Report). There are a number of declining species that require early successional habitat at some stage of their

life cycle. The desired conditions and level of regenerating forests or early successional habitat were also derived from the LANDFIRE models developed by the USGS, USFS and others. These models indicate a need for a range of forested ages and structural condition, including regenerating forests, to meet the needs of a large suite of rare species, species with declining populations, and public interest species inhabiting the Forest.

BI-26: The Forest Service should consider the early successional habitat provided by intensively managed lands like roads and recreation areas.

Early successional habitat includes habitat that is in the process of regenerating (0-10 years old), old fields, grass/shrubland conditions and openings created by natural disturbances. These varying conditions do not provide the same quality of habitat that is needed for species. The FEIS analyzes the effects of currently available early successional habitat found in a variety of conditions, including road ROWs, powerline ROWs, recreation areas, grasslands found in wildlife openings and rangelands in assessing current conditions (FEIS Chapter 3, Section B, Ecological Systems Diversity and Terrestrial Species Diversity, Migratory Birds, Management Indicator Species, Demand Species, Chapter 3, Section C, Recreation, Minerals Management, Roads System Management, Special Uses, Range, Appendix E, Ecosystem Diversity Report, and Appendix F, Species Diversity Report).

BI-27: The Forest Service should better address early successional habitat created through natural disturbances.

An amount of early successional habitat created through natural disturbance regimes is used in the analysis. This estimate is highlighted in greater detail in the final EIS Chapter 3, Section B, Ecological Systems Diversity and Terrestrial Species Diversity, Appendix E, Ecosystem Diversity Report, and Appendix F, Species Diversity Report.

BI-28: The Forest Service should increase the amount of early successional habitat on the forest.

The Plan revision process utilized an ecosystem sustainability model and species diversity analysis patterned after a system designed by the Nature Conservancy to provide a coarse and fine filter approach for habitat needs for high priority and public interest species on the Forest (FEIS Chapter 3, Section B, Ecological Systems Diversity and Terrestrial Species Diversity; Appendix E, Ecosystem Diversity Report and Appendix F, Species Diversity Report). The need for a range of ages and structural conditions of habitat in the various ecosystem types present on the forest was clearly demonstrated for whole suites of species groups.

The selected alternative would increase the amount of early successional habitat on the forest by increasing the amount created from timber harvest (2,400 acres per year in the current plan to 3,000 acres per year) and through increasing prescribed burning (3,000 acres per year in the current plan to 20,000 acres per year).

BI-29: The Forest Service should find ways to expedite the timber sale process so that more early successional habitat can be created.

We agree with the comment and acknowledge challenges in implementing timber sales efficiently. However this comment pertains to implementation rather than a Forest Plan component. We received many suggestions from the public regarding ways to expedite the timber sale process and look forward to future collaboration with other agencies and stakeholders in an effort to increase the efficiency of the timber sale program.

BI-30: The Forest Service should modify the management prescription area direction to emphasize wildlife habitat.

The management direction for Mosaics of Habitat has been updated to more clearly emphasis wildlife habitat in response to these comments.

BI-31: The Forest Service should evaluate a number of activities to improve game habitat.

The plan provides for a variety of activities to improve game habitat including timber harvest, prescribed burning, maintaining existing openings, creating new openings, and maintaining old fields. Many of these comments involve implementation activities that will be considered during site-specific project analysis.

BI-32: The Forest Service should emphasize appropriate seeding and planting to benefit wildlife.

Seed mixtures that benefit wildlife are generally used and the Forest often works closely with partner agencies and organizations in seeding efforts that will benefit wildlife.

BI-33: The Forest Service needs to increase the area of open grasslands.
The need for grassland/open woodland habitat is clearly demonstrated for a large suite of species in the FEIS (FEIS Chapter 3, Section B, Ecological Systems Diversity and Terrestrial Species Diversity; Appendix E, Ecosystem Diversity Report and Appendix F, Species Diversity Report). The selected alternative does have objectives to create and maintain open grasslands.

BI-34: The Forest Service should address the impacts of the coyote population.
The Forest Plan does not directly provide population controls for any species but provides emphasis on habitat management. The responsibility for population management for a species such as coyotes is with state game agencies, VDGIF and WVDNR. While the coyote does impact populations of deer and other animals (FEIS, Chapter 3, Section B, Demand Species), specific population objectives are set by state agency regulations, not through the Forest Plan.

BI-35: The Forest Service should consider that the lack of early successional habitat affects the level of hunting and the economic benefits of hunting.
The Forest Service recognizes this relationship and is a factor in the decision to increase habitat management through timber harvest and increased prescribed burning. The economic importance of hunting is addressed in the FEIS (Chapter 3, Section C, Recreation).

BI-36: The Forest Service should improve access for hunters.
Areas with a wide variety of access are available for hunting. The Forest Plan will likely maintain most current access, though some roads may become open only seasonally and many roads will be maintained at lower maintenance levels. Many of the roads that would be decommissioned are already closed to public use.

BI-37: The Forest Service should provide habitat for birds and opportunities for bird watching.
Nature viewing is recognized as an important recreational activity, as well as the need to maintain or improve habitat for bird species.

BI-38: The Forest Service should protect the areas of significant ecological or recreational value within Management Prescription Area 13-Mosaics of Habitat.
Management Prescription Area 13 is the portion of the forest where most timber harvest will occur. Areas of significant ecological value have been protected through allocation to Special Biological Areas, or the Shenandoah Crest Zone and areas with significant recreational value are allocated to prescriptions such the Appalachian Trail Corridor, Dispersed Recreation Areas, Developed Recreation Areas, National Scenic Areas and Wilderness. While a large percentage of the Forest is in Management Area 13, any significant recreation or ecological values can still be recognized during project analysis. In addition, while timber harvest and road construction is allowed in Management Area 13 only about 15 miles or road are expected to be constructed and 30,000 acres of the 500,000 acre area are expected to harvested in the next 10 years.

BI-39: The Forest Service should identify a true restoration strategy.
The selected alternative does provide a framework for ecological restoration. The use of timber harvest to achieve some of the restoration objectives is not just "a simplistic model of rotational forestry." The George Washington National Forest is not a typical southern Appalachian forest that historically was dominated by gap phase dynamics and only occasional larger disturbances. The GWNF is predominantly an oak hickory forest which was dominated by fire that occurred on both large and small scales. While fire may be the optimum tool to restore this system and the pine systems on the GWNF, there are limitations to the extent, duration and intensity of fire that can be readily managed in a forest located in an area with such a high level of adjacent development. Timber harvest is used as an additional tool that can be used to mimic open woodland conditions, small openings and large openings.

We agree that the current age class distribution is heavily slanted to middle aged structure and that early successional habitat and old growth conditions are both needed. The land allocations in the forest plan that do not allow timber harvest make up about 44 percent of the forest, so old growth will be plentiful with little additional effort. Early successional habitat, on the other hand requires management action, thus the identified need to manage vegetation through timber harvest and fire.

Regenerated stands are part of the composition, structure, function and productivity of native forest ecosystems. The ecological and species diversity analyses identified many species that need early successional habitat at some stage of their life cycle. Much of forest is departed from its reference conditions due to the change in fire suppression over the past hundred years and addressing this departure is a main component of the Plan.

The role of natural disturbance is addressed in the Plan and EIS. It is estimated that from 1 to 2 percent of the forest is in openings created by natural disturbances and that another 1 to 2 percent is in open woodlands.

The Forest Plan does meet the intent of national direction on restoration. Ecological restoration goals are clearly identified in the desired conditions by ecological system in Chapter 2. The implications of climate change and management strategy to address climate change are in Chapter 3. Ecological refugia can take many forms, but the increase in Recommended Wilderness Study areas, Recommended National Scenic Areas and Remote Backcountry Areas would certainly be considered one example.

Open woodlands would predominantly be created and managed through the use of fire. However, timber harvest can also be used to create or enhance open woodland communities. In Tables 3B1-1 and 3B1-2 of the FEIS, the estimates of open woodlands are based solely on areas created and maintained by fire. Timber harvest in these tables is only included in the regenerating forests. In the Forest Plan, the species diversity objectives in Chapter 3 clearly identify open woodland creation through the use of fire. So, while timber harvest could enhance open woodland creation, the goals and objectives in the plan for open woodlands are based on the fire management program.

We disagree that open woodland conditions would be inappropriate in riparian areas, cove forests or northern hardwoods. While these systems are generally too moist to be easily affected by fire, each of these systems contains a gradation of moisture levels and there are portions that are drier than the general condition. The LANDFIRE models for both cove forests and northern hardwood forests include a small amount (9-10%) of the area in open canopy late succession conditions. While much of this would be created by other extreme weather events, some would be due to fires. It is unlikely that these areas would be targeted for prescribed fires, but small patches of these systems could be located within large burn blocks and under the right conditions could burn.

BI-40: The Forest Service should emphasize restoration of American chestnut and hemlock.

Restoration of American chestnut and hemlock are part the Forest Plan.

BI-41: The Forest Service should meet restoration goals through improving the age class distribution.

Improving the age class distribution, particularly in those areas of the forest managed for Management Prescription 13-Mosaics of Habitat is a priority in the revised plan.

BIOMASS

BM-1: The Forest Service should not allow timber harvesting for biomass to use in energy production.

Wood biomass energy is becoming an emerging market in some areas of the Forest. The Forest Service realizes that developing and using renewable sources of energy are national goals and that woody biomass is a potential source of renewable energy and fuel. Woody biomass utilization of smaller diameter trees not considered merchantable in traditional markets can also be used to facilitate forest restoration, the growth of higher-value trees and forest products, reduce forest-fire risk, and support the removal of invasive species. Small scale local firewood vendors can play a significant role in economically achieving thinning, especially in younger stands, through woody biomass utilization.

Air quality and water use associated with off- Forest energy production is permitted and regulated by Virginia Department of Environmental Quality, West Virginia Department of Environmental Protection and Division of Air Quality in conjunction with the West Virginia Division of Energy which is part of the permitted operating plan of the facility producing the energy. Where we will be utilizing woody biomass, we will not remove the woody biomass from the entire site but will leave at least 30% of the logging slash. We will leave more material where there are soils most susceptible to impacts from acid deposition and nutrient depletion.

The Forest Service is also charged with protecting the productivity of the lands we manage and ensuring that ecosystems are sustainable. There is a concern that increasing demand for wood biomass energy could result in increased harvest levels using unlimited woody biomass utilization, especially on formerly low productivity or less commercially valuable sites. We do not envision the production of wood biomass energy to be a sole purpose and need of any commercial timber sale. The GWNF will not allow below ground biomass, downed logs, or stumps to be part of the woody biomass utilization of a site. What is included in the woody biomass utilization are logging slash, small diameter trees not considered merchantable in traditional markets, tops and limbs. This material, which has been traditionally left onsite, has contributed to the nutrient pool and the productivity of the soils on the site. Review of scientific literature suggests that removing tree branches and foliage can have negative effects on long term soil productivity. Intensive removal of woody biomass may cause nutrient depletion on sensitive sites such as those with shallow, coarse textured soils. On sites with existing large quantities of woody biomass on the ground, less retention is necessary. A graph was added to the Forest Plan strategy section to guide the level of logging slash that would be left on site after timber harvest. It indicates where harvest intensity is low and harvests are infrequent less woody biomass needs to remain onsite. Using the graph, at least 30 percent of the logging slash will be retained on all sites. On poorer sites, like site index 50, about 60 percent of the logging slash will be retained.

BM-2: The Forest Service should examine the impacts of harvesting timber for biomass for energy production.

Literature cited related to soil productivity is included in FEIS Appendix L-References. Currently we remove material down to 4 inch diameter in timber harvest areas. We have examined research done regarding harvesting smaller diameter wood and we will be leaving some (at least 30 percent) logging slash on all sites. On less productive sites, more slash will be retained, see Forest Plan Chapter 3, Forestwide Standards FW-11 and FW-13. No stumps, exisiting downed material or below ground biomass will be removed.

BM-3: The Forest Service should provide timber to support the market for biomass for energy production.

The Forest will utilize timber harvest to achieve restoration goals and objectives. It is likely that some timber sales would include options of utilizing smaller diameter wood than is normally utilized for the biomass energy production market. This would only be done on soils we determine to have low risk for impacts from nutrient depletion.

BUDGET

BU-1: The Forest Service should accurately display the costs of implementing each alternative.

A table has been added to Chapter 3 of the Final EIS displaying the estimated costs of implementing each alternative.

BU-2: The Forest Service should prepare a draft plan based on a realistic budget.

The selected alternative does have a budget substantially higher (about 3 million dollars or thirty percent) than the current budget. Most of the difference between the two budgets is in the timber, recreation, and soil/water/air/vegetation budgets. These increases represent the priority that the public and the agency place on these resources and the need for additional financial resources to reach the objectives of the plan. The timber objective was stated as a range of 1,800 to 3,000 acres per year, the budget reflects the 3,000 acre level. The difference between the two levels is about one million dollars. Another one million dollars would represent the difference between the current level of timber harvest and the level of 1,800 acres per year. Many groups were asking for an increase in early successional habitat and timber harvest and there was much attention given to identifying means to improve the efficiency of conducting timber harvest. The recreation budget reflects the desire to maintain the current level of recreation opportunities and infrastructure to support it. The soil/water/air/vegetation management budget increase reflects the emphasis on soil and water improvement projects and on the control of non-native invasive species.

BU-3: The Forest Service should consider the budget in selecting a preferred alternative.

The budget was a factor in the decision on the preferred alternative.

CLIMATE

CL-1: The Forest Service should plan for climate change by protecting core area and decreasing stresses like vegetation management, road construction and gas drilling.

The selected alternative does incorporate the concept of core areas with relatively little management activity and areas around the cores where more management activities are implemented. Core areas include the Remote Backcountry Areas at Massanutten North, Duncan Knob, Southern Massanutten, Big Schloss, the ridge of Great North Mountain, Jerkemtight, Elliott Knob, Crawford Knob, Archer Knob, Shaws Ridge, Laurel Fork, Little Alleghany, Oliver Mountain, Little Mare Mountain, Dolly Ann, Beards Mountain, Rich Hole, Adams Peak, the western flank of the Blue Ridge, and Three Sisters. It also includes the existing and Recommended Wilderness Study at Saint Mary's, Ramseys Draft, Rich Hole, Rough Mountain, Three Ridges, Priest, Little River and Beech Lick Knob, the existing and proposed National Scenic Areas at Mount Pleasant and Shenandoah Mountain, and the large Special Biological Areas at Kelly Mountain and the Shenandoah Crest Zone. Vegetation management, road construction and mineral development are not allowed in these areas.

Vegetation management and road construction to facilitate the vegetation management is needed outside the core areas to restore vegetation structure needed for many species. Surface use of gas drilling is not allowed in the most biologically sensitive areas of the Forest. We agree that the preservation of forested landscapes is a critical aspect of managing for climate change, but we believe that resiliency is best achieved when the forest is represented by a variety of structure (different ages of the mature trees).

CL-2: The Forest Service should better protect, connect and restore the national forest.

The response to the previous comments addresses the nature of the selected alternative in relation to core areas and restoration of resilient systems. In regard to connections between core areas, it is important to provide forested connections, but as described in the previous response, these forested connections do not all need to be old growth. There will be adequate stands of mature trees throughout the forest and in areas connecting core areas.

CL-3: The Forest Service should show how the forest will adapt to climate change.

It is very difficult to predict exactly how the forest will adapt to climate change. The science is evolving. Several years ago, it was expected that climate change would substantially reduce the number of streams that would retain cold enough temperatures to maintain native brook trout. A more recent study indicated that groundwater sources may be more important than previously identified and it appears that stream temperature may not change as directly as air temperature. As described in the EIS, we expect that temperatures will increase, as will precipitation, but precipitation is likely to demonstrate more extreme dimensions in storms and droughts. Some plant species more adapted to warmer climates may expand their range, and colder adapted plants may have shrinking ranges. There will also likely be new assemblages of plants that have not occurred in the past.

CL-4: The Forest Service should recognize that forests and soils are more valuable as carbon sinks than in using forest resources as fuel or as a source of renewable energy.

We agree, but part of managing forests for resiliency involves vegetation management. Timber is one of our tools in vegetation management and we do not control the ultimate fate of the wood removed from the site. A substantial portion of harvested wood carbon remains stored in durable wood products, paper and landfills for a long time and wood residues that are used for energy production are a renewable source that replaces fossil fuel. New growth created through vegetation management often sequesters carbon at a faster rate and will eventually develop additional stocks of carbon that will replace the harvested wood. In regard to concern about removal of too much biomass from sites of sensitive soils, please review the comments related to biomass.

CL-5: The Forest Service should develop a response to acid deposition.

The Forest Service has been addressing acid deposition for many years and will continue to do so. This involves a very active role in reviewing state air pollution permits; continuing the 25 years of monitoring acid sensitive streams, and liming a number of streams that have been acidified.

CL-6: The Forest Service should develop a more comprehensive strategy to address climate change including an adaptation strategy, monitoring and vulnerability analyses.
The Forest Plan does address climate change. It allocates many core unmanaged areas for some species and also provides opportunities to manage vegetation to benefit other species.

As described in Section A3 of Chapter 3 in the FEIS, the forest represents a major carbon sink. So the main effect that management will have in regard to affects to climate change is to maintain the carbon sink function of the forest. While there are differences in the level of management activities between alternatives, the overall effect on climate change should not be substantially different between the alternatives. We have estimates of the total current carbon stocks on the forest, but do not believe that incorporating these numbers into the EIS would improve the discussion. A monitoring question about climate change has been added to the monitoring plan. Many of the existing monitoring tasks, like water quality monitoring, bird surveys, and tracking ecological conditions will provide the data to examine trends associated with climate change.

The Forest Plan does acknowledge the importance of maintaining forests. However, there is a need to have the forests in varying conditions of structure and so vegetation management activities are needed and identified in the Plan.

CL-7: The Forest Service should better compare alternatives in their response to climate change.
Section A3 of Chapter 3 of the FEIS does compare the alternatives in response to climate change. However, it is difficult to identify more distinctions between the alternatives since climate change is at a large scale and the differences between alternatives in regard to the amount of active management activities is small on a Forest-level scale. While there is little difference between the effects of the alternatives on climate, the selected alternative is considered among the best adaptation alternative in light of known effects on the Forest.

CL-8: The Forest Service should consider climate change in its species viability analysis.
Climate is addressed in that it was considered as a threat in the species diversity analysis (FEIS Appendix F).

COORDINATION WITH OTHER AGENCIES

CO-1: The Forest Service should continue to coordinate with other agencies and groups in forest management.
The Forest has a long history of coordinating activities with other state and federal agencies and many different advocacy groups. This type of coordination will be an important aspect of implementing the selected alternative.

CULTURAL RESOURCES

CU-1: The Forest Service should consider the impacts of its activities on cultural resources.
The Forest Service will continue to assure that all of its activities are in compliance with all of the regulations regarding cultural resources. Chapter 4 of the Plan contains forestwide standards for the protection of cultural resources including direct consultation when necessary with the State Historic Preservation Offices (Virginia Department of Historic Resources and West Virginia Division of Culture and History), and federally recognized Native American tribes with geographic or cultural ties to the Forest. Under all alternatives, cultural resource surveys are conducted by national forest archaeologists during the project-level NEPA process for proposed actions that include ground disturbance or historic properties.

ECONOMICS

EC-1: The Forest Service should update its social and economic analysis, particularly the use of the IMPLAN model.
The IMPLAN model was updated with 2011 data and new estimates of effects on jobs and labor income were determined. New information from the 2010 Census and the Economic Profile System-Human Dimensions Toolkit (http://headwaterseconomics.org/tools/eps-hdt) was obtained and analyzed. Additional employment information for the wood products sector and the recreation/tourism sector was obtained for each county of

interest from state employment organizations. The interpretation of the tables presented in Chapter 3, Social and Economic Environment and the effects discussions were also expanded.

With regard to determining the effect on the local economy from the development of Marcellus shale gas, a more extensive review of existing studies for other areas was done. Additional discussion of the complexities of bringing a new industry into the local economy and the economic and social impacts was added. During review of the IMPLAN model, an error was identified in the estimates of natural gas production for each alternative by a significant magnitude. The final estimates of effects of natural gas production on jobs and labor income now reflect a higher, more accurate contribution to the local economy.

EC-2: The Forest Service should carefully evaluate the economic effects when it selects a preferred alternative.

The consideration of economic effects is reflected in two of the seven evaluation criteria used to evaluate the alternatives: "the extent to which the alternative provides a variety of uses, values, products, and services for present and future generations by managing within the capability of sustainable ecosystems" and "the extent to which the alternative addresses issues raised by forest staff (as reflected in the Analysis of the Management Situation), partners, and the public." One of the thirteen significant issues used to develop and evaluate alternatives was Economics and Local Community where the issue statement is "Management activities may affect the economic role of the Forest, particularly the role it plays in the economy of local communities, including the production of ecosystem services and commodity outputs. Increasing population and development near the Forest may influence access to the National Forest and management activities such as special use requests, fire management, and responses to additional recreation demands."

EC-3: The Forest Service should support local wood products producers and non-timber product producers.

With the exception of MeadWestvaco, the majority of our timber sale purchasers represent small, locally owned businesses that either utilize the product or supply local small sawmills and pulpwood facilities. We do receive a small number of requests for non-timber forest products.

ENERGY

EN-1: The Forest Service should help to contribute to renewable energy production.

The selected alternative does contribute to renewable energy production. It provides 82,000 acres of high wind potential lands as available for consideration for wind energy development.

EN-2: The Forest Service should acknowledge that energy production is inconsistent with priorities of the Forest.

We believe that energy production is consistent with other priorities in the Forest Plan. Mineral development has long been a component of national forest management. Development of mineral resources was included in the Organic Administration Act of 1897, the Mineral Resources on Weeks Law Lands Act of 1917 and its development was reaffirmed by the Multiple-Use Sustained-Yield Act of 1960. Energy development would only be done with appropriate mitigation to reduce impacts to other resources such as water quality, soil productivity and management of sensitive biological resources.

EN-3: The Forest Service should allow for energy production on the Forest.

The selected alternative does allow for energy production on the forest. It provides 82,000 acres of high wind potential lands as available for consideration for wind energy development.

FACILITIES

FA-1: The Forest Service should follow state regulations regarding hazardous waste management, solid waste management, energy efficiency, and pollution prevention at its facilities.

The Forest Service complies with applicable regulations regarding hazardous waste management, solid waste management, energy efficiency and pollution prevention. This comment deals more with site-specific activities as opposed to the broad management direction of a Forest Plan. These issues will be addressed at the site-specific project level for activities implementing the Forest Plan.

FIRE

FI-1: The Forest Service should continue to use the Virginia Interagency Coordination Center.
This is a site-specific issue that is not part of a Forest Plan level decision.

FI-2: The Forest Service should not increase its use of prescribed fire.
Research on fire and its role in shaping the ecological systems that dominate this forest are clear in regard to the need to restore fire to the landscape. This is described in Chapter 3 of the EIS and in FEIS Appendix E.

FI-3: The Forest Service should increase its use of prescribed fire.
The selected alternative would increase the use of prescribed fire with an objective of burning 12,000 to 20,000 acres per year.

FI-4: The Forest Service should increase its use of prescribed fire as in Alternative G.
The selected alternative would increase the use of prescribed fire as in Alternative G with an objective of burning 12,000 to 20,000 acres per year.

FI-5: The Forest Service should use prescribed fire as a tool.
We agree.

FI-6: The Forest Service should formulate a wildfire prevention policy.
Wildfire prevention is an important aspect of plan implementation, but not a part of the Forest Plan.

FI-7: The Forest Service should address some concerns with prescribed fire.
We acknowledge that there are many resource concerns to address when planning and implementing prescribed burns. This includes the timing of the burns, the type of vegetation and soil in the burn area, the fuels to be burned, resources on adjacent lands, and impacts on forest users and adjacent communities. These can all be considered in the site-specific analysis completed before burns are implemented.

FI-8: The Forest Service should use wildfire to achieve fire objectives.
We agree.

GAS LEASING

GA-1: The Forest Service should not ban horizontal drilling or hydraulic fracturing.
The selected alternative (Alternative I) does not make any new federal lands available for leasing and therefore no drilling (horizontal or vertical, with or without hydraulic fracturing) would occur on federal minerals.

The FEIS evaluated alternatives that allowed for horizontal drilling (A and H), that had a moratorium on horizontal drilling (B D, and F), that prohibited horizontal drilling (E and G), and that had no gas leasing (C and I). In regard to gas leasing, Alternative H was developed to examine the impacts of gas development using high-volume hydraulic fracturing with a strict set of land alllocations and standards to protect sensitive resources on the GWNF. From Alternative H we determined that the use of horizontal drilling and hydraulic fracturing to develop gas resources on the GWNF could be done in a manner that would reduce the potential for adverse impacts to water and other resources. However, while Alternative H illustrates that adverse impacts from gas development may be mitigated, there is insufficient reason at this time to make any new federal lands available for oil and gas development. After completing the analysis of Alternative H, all of the alternatives were evaluated in relation to the issues, public comments, current information and discussions about energy development in relation to the GWNF. Currently, there is an apparent lack of interest in gas development as evidenced by the fact that both existing federal leases on the Forest and existing mineral rights owned by private parties are not active. There are concerns expressed by local citizens, their elected officials, and many other interested parties regarding potential impacts of gas development. Throughout our planning process, we have seen changes in drilling technology, changes in the research on potential impacts of drilling, changes in regulations on drilling, and many studies that are ongoing and not complete. In response to these considerations, an alternative that included all of the forest plan components of Alternative H, but combined the lands available for oil and gas leasing component of Alternative C was developed. This resulted in Alternative I that would make no lands available for oil and gas leasing.

Concerns expressed by local citizens, their elected officials, and many other interested parties included potential impacts of gas development on water quality, biological diversity and recreation use, and the associated traffic and noise. There is a low amount of estimated gas reserves in the portion of the Marcellus formation under the GWNF. Alternative I will also further reduce the potential for any additional stresses on: our watersheds in relation to sensitive aquatic species, drinking water, and the Chesapeake Bay; the remote recreation settings and the high level of recreation use on the GWNF; and the high level of biological diversity on the GWNF.

GA-2: The Forest Service should not ban horizontal drilling since it is inconsistent with:
-multiple use sustained yield act, mineral leasing act
-inappropriately affecting national energy policy through forest management planning
-limiting technology in an unprecedented way in forest planning
- should be addressed at the APD stage of permitting
-court decisions.

See response to GA-1.

GA-3: The Forest Service should not ban horizontal drilling since it will positively address climate change concerns.

See response to GA-1. While the burning of natural gas can produce less greenhouse gas emissions than burning coal, there are some questions about the impacts of extracting natural gas and the release of methane to the atmosphere during drilling.

GA-4: The Forest Service should not ban horizontal drilling since it will reduce the amount of land disturbance compared with vertical drilling.

See response to GA-1. Horizontal drilling does reduce the amount of land disturbance compared to vertical drilling since more of the formation can be developed from one well, and multiple wells can be drilled from one well pad.

GA-5: The Forest Service should not ban horizontal drilling because there are no adverse environmental effects.

See response to GA-1. The Final EIS describes the estimated effects from gas drilling. Some impacts could be expected, particularly impacts from accidents.

GA-6: The Forest Service should not ban horizontal drilling since stipulations are available to reduce impacts to other resources.

See response to GA-1. A number of comments included references and information about measures that can be used to reduce impacts. These measures are sometimes standard practices used by state and federal agencies and other measures could be added as plan standards or as site-specific conditions of approval for a permit to drill.

GA-7: The Forest Service should not ban horizontal drilling because water resources can be protected during drilling and operations.

See response to GA-1. Alternative H was developed to examine measures that could be employed to allow a level of gas development that would not adversely affect water quality. In that alternative public water supply watersheds would not be available for mineral leasing; no surface or groundwater withdrawals from National Forest System lands would be allowed unless an analysis shows that the overall impacts of the drilling could be reduced through the use of such withdrawals; and there would be requirements for closed loop systems for hydraulic fracturing and the use of a secondary containment system to reduce the risk of spills reaching a stream. The analysis of Alternative H indicated that these measures could reduce the potential for adverse impacts to water.

GA-8 & GA-9: The Forest should not ban horizontal drilling since it is needed to develop the gas resources in the Marcellus shale and this development will produce substantial economic benefits to the area and to the nation and is necessary to meet the country's energy needs.
See response to GA-1.

GA-10: The Forest Service should not ban horizontal drilling because it is a safe practice.
See response to GA-1.

GA-11: The Forest Service should continue its ban on horizontal drilling to reduce impacts of climate change.
See response to GA-1. While the burning of natural gas can produce less greenhouse gas emissions than burning coal, there are some questions about the impacts of extracting natural gas and the release of methane to the atmosphere during drilling.

GA-12: The Forest Service should keep its ban on horizontal drilling.
See response to GA-1.

GA-13: Support the ban on horizontal drilling due to the adverse environmental effects.
See response to GA-1. The Final EIS describes the estimated effects from gas drilling. Some impacts are expected, particularly the possibility of impacts from accidents.

GA-14: Support the ban on horizontal drilling due to the adverse environmental effects on water quality.
See response to GA-1.

GA-15: Support the ban on horizontal drilling, need a moratorium until more information is available.
See response to GA-1. We looked at options for a moratorium on the gas leasing decision. There are many studies currently underway and much new information has come out during the time we have been preparing the EIS. EPA is working on a study of the potential impacts of hydraulic fracturing on drinking water resources. The Bureau of Land Management has new regulations on hydraulic fracturing that are under review at this time. It is likely that studies of horizontal drilling and hydraulic fracturing will continue for many years.

GA-16: The Forest Service should consider additional options if it decides to put a moratorium on any drilling.
We did not include a moratorium on drilling in the selected alternative.

GA-17: The Forest Service should not allow horizontal drilling until appropriate regulations are in place.
See response to GA-1. Like the research and studies, regulations on horizontal drilling and hydraulic fracturing will likely be modified many times over the coming years. BLM has regulations currently out for review. The State of West Virginia has just implemented new regulations.

GA-18: The Forest Service should not allow horizontal drilling until science shows it to be safe.
See response to GA-1.

GA-19: The Forest Service should ban horizontal drilling and further analyze the impacts of vertical drilling.
See response to GA-1. The impacts of other types of drilling were considered in the development of Alternative H.

GA-20: The Forest Service should ban horizontal drilling and wind energy development.
See response to GA-1. The selected alternative does limit the locations where wind energy development would be allowed and then a site-specific analysis will determine whether it is appropriate for that location.

GA-21: Support the ban on horizontal drilling and would like a ban on all hydraulic fracturing.
See response to GA-1.

GA-22 & 23 & 24: The amount of land available for leasing: a) is appropriate; b) should be less; c) should not be allowed in certain locations, such as: drinking water watersheds, priority watersheds, recreation areas, sensitive biological areas, Remote Backcountry Areas, South Massanutten, Eligible Wild and Scenic river corridors, scenic areas, Shenandoah Mountain, old growth, Special Biological Areas, riparian areas.

An additional alternative (Alternative H) was developed to evaluate additional options for areas available for gas leasing. The alternatives in the FEIS evaluated a wide range of options from no leasing to leasing of nearly the entire GWNF. The selected alternative does not allow any new oil and gas leasing.

GA-25: The Forest Service should not allow leasing of gas on the Forest.

The selected alternative does not allow gas leasing on the federal minerals on the GWNF. However, this decision does not affect the approximately 10,200 acres of existing leases.

GA-26: The Forest Service should base its decisions on gas leasing on science.

We carefully reviewed all of the information submitted in comments and reviewed recent research and studies on the potential impacts of gas development and on control measures that can be used to reduce impacts as demonstrated in Alternative H. See also response to GA-1.

GA-27 & 28: The Forest Service needs to improve the analysis of the effects of gas leasing decisions and should consider additional information in regard to the effects of gas leasing, including: economic information, adverse effects of high-volume hydraulic fracturing, fluids used in hydraulic fracturing, road effects and stipulations to reduce road effects, safety of high volume hydraulic fracturing, geologic information, additional stipulations.

The analysis of effects of gas leasing has been updated in the Final EIS.

GA-29 & 30: The Forest Service should further study the effects of vertical drilling and should further study the effects of vertical drilling and ban vertical drilling in specified locations.

We did a further review of the effects of vertical drilling before making our decision to select Alternative I.

GA-31: The Forest Service should carefully consider effects on other resources in making any decisions on gas leasing.

Section D of Chapter 3 of the Final EIS does include an analysis of effects on other resources.

GA-32 & 34: The Forest Service should consider the geology of the Marcellus shale formation in making its decision on horizontal drilling and better address the geologic setting of its analysis of horizontal drilling in the Marcellus shale.

We did consider the geology of the Marcellus and updated the Final EIS with the latest information.

GA-33: Alternatives B, D, E, F and G are the same as Alternative C in areas underlain by Marcellus shale.

The Final EIS reflects a range of alternatives for addressing the question of what lands should be available for gas leasing.

GA-35: The Forest Service should separate the oil and gas leasing availability decision from the consent to lease decision.

The analysis in this EIS is to support an oil and gas leasing availability decision. The consent to lease is an administrative process, rather than a decision, to verify that the decision on lands administratively available is valid and that the appropriate stipulations have been placed on the lands. The consent to lease occurs when the BLM is getting ready to offer leases for sale.

GA-36: The Forest Service should not use the EIS and Forest Plan to regulate technology for gas drilling.

The selected alternative no longer has the ban on a particular technology for gas drilling.

GA-37: The DEIS contains virtually no evidence regarding the potential impacts of horizontal drilling.

We have updated our analysis of effects in the EIS.

GA-38: The Forest Service needs to correct several errors, inconsistencies in the analysis of the effects of gas development and better define several practices.
We corrected the error in Chapter 2 of the FEIS by clarifying that Alternatives E and G only prohibit horizontal drilling; they do not prohibit hydraulic fracturing. In regard to flowback water, Appendix K states that only 20 percent of the flowback water is recovered during initial post treatment flowback. The reference on page 3-336 of the DEIS that refers to up to 60-80% return of flowback refers to a longer period of time. There is a range of flowback and since no wells have been drilled in the vicinity of the GWNF, it is difficult to specify a precise number.

GA-39: The Forest Service should appropriately use the Reasonably Foreseeable Development in its analysis.
The Reasonably Foreseeable Development Scenario has been updated and used in our analysis.

GA-40: The Forest Service should require additional stipulations to minimize impacts from gas drilling.
Alternative H contained additional stipulations to reduce impacts. A discussion of those additional control measures is included in Appendix I of the FEIS.

GA-41: The Forest Service needs to identify monitoring requirements in regard to any gas development.
Monitoring requirements would be developed and included in the preparation of the surface use plans associated with permits to drill on existing federal leases. This would be part of the second stage of the decision-making on gas drilling.

GA-42: The Forest Service should identify the environmentally preferred alternative.
The Record of Decision does identify the environmentally preferred alternative.

GA-43: The Forest Service ignores the relationship of their decision to the federal and state efforts to increase regulation of horizontal drilling and hydraulic fracturing.
We have incorporated a discussion of state regulations in our analysis. The impacts of other regulations on the impacts of gas drilling on the Forest are considered in the final analysis.

GA-44: The Forest Service should select Alternative A since the other alternatives all contain restrictions on horizontal drilling.
See response to GA-1.

GA-45: The Forest Service should purchase outstanding and reserved mineral rights.
The purchase of outstanding and reserved mineral rights is outside the scope of this analysis. It is dependent upon annual appropriations for land acquisition.

GEOLOGY

GE-1: The Forest Service should protect caves and other geologic resources.
The forest plan does protect caves and other geologic resources through land allocations including Geologic Areas, Special Biological Areas and Indiana bat Conservation Areas and through desired conditions and standards applicable to caves and karst systems.

HERBICIDES

H-1: The Forest Service should only use herbicides or pesticides in accordance with manufacturers' recommendations.
The Federal Insecticide, Fungicide and Rodenticide Act (FIFRA), as amended, requires that the use of all pesticides must adhere to the pesticide label as registered by the Environmental Protection Agency (EPA). The label includes information regarding application rates and methods targeted to a variety of pests as well as mixing and loading recommendations. These are essentially the manufacturer's recommendations for the use of the pesticide as approved by the EPA. Because this is statutory law, no Forest Plan guidance (e.g. a Standard) is necessary. However, Forestwide Standard FW-120 does require us to use the lowest rate effective in meeting project purposes while protecting human and wildlife health (emphasis added).

LANDS

LA-1: The Forest Service should address the issue of lands to a greater extent in the EIS.

The issue of Lands was not identified as a significant issue in the EIS. It only differs in one alternative and that difference is only in the budget for the lands program which is much higher in Alternative A. The funding level of 1.5 million dollars as identified in Alternative A has never been achieved. The highest funding for both the GWNF and the Jefferson NF has been 1.2 million dollars. The level of funding in Alternative A would achieve a much higher level of boundary line maintenance and this maintenance is important in all aspects of forest management. However, it is unlikely that it would ever be achieved. The budget level used in all of the other alternatives is a much more realistic budget expectation.

In regard to land acquisition, the forest has some identified needs, but these are not extensive and do not vary by alternative.

LA-2: The Forest Service should increase land acquisition.

The Forest Plan identifies priorities for land acquisition, but the amount of acquisition is likely to be small.

LA-3: The Forest Service should not increase land acquisition.

The Forest Plan identifies priorities for land acquisition, but the amount of acquisition is likely to be small.

LA-4: The Forest Service should re-evaluate the standards regarding special use permits for water wells in relation to gas drilling.

Standard FW-241 regarding well and spring permits only applies to special use permits. It does not apply to the exercise of private mineral rights or to mineral leases or permits to drill.

MANAGEMENT EMPHASIS

ME-1: The Forest Plan management emphasis should not be on timber production.

Timber production is not the management emphasis of the Forest Plan. Restoration of functioning ecological systems is one of the main emphasis areas of the Forest Plan. Timber harvest is an important tool in managing vegetation to achieve the ecological goals of the Forest Plan. In addition, the production of timber is an important component of the Forest Plan and is an important reason for the existence of the National Forest System. It continues to be an important aspect of our management while we achieve our goal of ecological restoration.

ME-2: The Forest Plan management emphasis should be to conserve a core network of resilient forests, emphasize ecosystem restoration, maintain and improve healthy watersheds, and provide necessary ecosystem services and recreational benefits for people.

We agree and these are some of the main emphasis items in the Forest Plan.

ME-3: The Forest Plan management emphasis for the Cove Creek Wildlife Management Area should be as described in the comment.

The Cove Creek Wildlife Management Area is allocated to Management Prescription Area 13-Mosaics of Habitat and so can be managed for game species and a trout fishery and timber can be monitored for future silvicultural treatments as recommended in the comment.

ME-4: The Forest Plan management emphasis should recognize the need to be a good neighbor to adjacent landowners.

We agree and take adjacent landowners into consideration, particularly in management strategies for treatment of non-native invasive plants, control of damaging insects, fire management and vegetation management.

ME-5: The Forest Plan management emphasis should be to allow for natural processes to guide restoration of the forest.

The Forest Plan allocates about 70,000 acres of land to wilderness and recommended wilderness study where natural processes will guide restoration. It also allocates about 300,000 acres of land to National Scenic Areas, Recommended National Scenic Areas, Shenandoah Crest, Remote Backcountry Areas, and Special

Biological Areas where natural processes will be the main guide of restoration, but where prescribed fire may also be used.

ME-6: The Forest Plan management emphasis should not be on exploitation of natural resources for commercial gain.

The emphasis of the Forest Plan is not on resource exploitation for commercial gain. The sale of timber is part of the plan and it is used to achieve ecological objectives while also producing timber and jobs. The Forest Plan also allows consideration of wind energy development on the Forest to help meet energy needs while reducing emissions of carbon.

ME-7: The Forest Service should have less active management.

The level of active vegetation management in the Forest Plan is the same as in Alternative G (the preferred alternative in the Draft EIS). This level of management is needed to achieve ecosystem objectives and to provide habitat for many species identified in the species diversity analysis that need openings or open woodlands for parts of their life cycle.

ME-8: The Forest Service should emphasize forest management activities.

Restoration of functioning ecological systems is one of the main emphasis areas of the Forest Plan. Timber harvest is an important tool in managing vegetation to achieve the ecological goals of the Forest Plan. In addition, the production of timber is an important component of the Forest Plan and is an important reason for the existence of the National Forest System. It continues to be an important aspect of our management while we achieve our goal of ecological restoration.

ME-9: The Forest Plan management emphasis should be on protection and management of forest resources for future generations.

We agree. All of the land allocations and management direction in the Forest Plan is designed to manage and protect the forest resources and assure sustainable management for future generations.

ME-10: The Forest Plan management emphasis should be on multiple use and sustained yield.

We agree. This is required by law and the concepts of multiple use and sustained yield are part of the management direction in the Forest Plan.

ME-11: The Forest Plan management emphasis should be on protection.

Protection of the resources of the GWNF is a management emphasis. Standards are prescribed to protect water quality, soil productivity, biological diversity, scenery and other values. A portion of the Forest is allocated to wilderness and other areas are allocated for the protection of Special Biological Areas and remote recreation character. Still other areas are allocated for management of mosaics of wildlife habitat where protection involves vegetation management activities to protect habitat for vegetation and animals that need varying levels of openings in the forest canopy for periods of time.

ME-12 & 13: The Forest Service should increase the amount of old growth, restrict horizontal drilling, (restrict road building), and preserve our scenic vistas.

Under the Forest Plan the amount of old growth conditions is projected to increase, no new federal oil and gas leases are permitted, restrictions on road construction are on about 376,000 acres, and there is an allocation of 34,000 acres of land for scenic corridors.

ME-14: The Forest Plan management emphasis should be on forest health.

Forest health is addressed through management direction on insect and disease control, management of non-native invasive species, allocation to a variety of management prescription areas to provide a variety of levels of active or passive vegetation management.

ME-15: The Forest Plan management emphasis should be on forest ecology, drinking water, and enjoyment of visitors.

These are all emphasis items in the Forest Plan as evidenced by the standards, management direction and land allocation decisions.

ME-16: The Forest Plan management emphasis should be on large areas of mature, undisturbed forests.
Large areas of mature, undisturbed forests are provided through the existing and recommended wilderness study. The selected alternative has additional recommended wilderness study acres from that proposed in the draft Plan. In addition to the Recommended Wilderness Study, the Forest Plan allocates large blocks of mature forest to National Scenic Areas, Recommended National Scenic Areas, Shenandoah Crest, and Remote Backcountry Areas, where only limited disturbance is allowed (prescribed fire).

ME-17: The Forest Plan management emphasis should be on recreation and water supply.
The Forest Plan places great emphasis on water supply and provides for a wide diversity of recreation opportunities to address the high level of demands on recreation.

ME-18: The Forest Service should restrict drilling, wind development, new roads and energy exploration.
Gas drilling, wind development, new roads and energy exploration are all limited in the Forest Plan to protect the most sensitive areas from these types of development. However, there is also a need to address the energy demands, clean energy demands, and the desire for good access to the forest. So some areas of the forest are identified where these types of development could be allowed.

ME-19: The Forest Service should not transfer agricultural lands to non-agricultural lands.
The Forest Plan will not result in the transfer of agricultural lands to non-agricultural lands. However, some lands currently managed in open conditions using livestock may be allowed to grow into riverine forests.

ME-20: The Forest Plan management emphasis should be on access and local businesses.
While the management emphasis of the Forest Plan is on water and ecological diversity, access and impacts on local business is an important consideration in the Plan. Local business will benefit from the high level of water quality, scenery, and condition of the ecological systems on the Forest. Local business will also benefit from the level of timber harvest and recreation opportunities provided under the Forest Plan.

MINERALS

MI-1: The Forest Service should continue to make mineral resources available for use.
We agree and retain the direction in the final plan.

MONITORING

MO-1: The Forest Service should have a strong system for monitoring water quality.
The Forest's extensive monitoring of aquatic macroinvertebrates and water chemistry will continue under the Revised Plan. This provides an assessment of water quality across the Forest and also assesses the effectiveness of protective measures implemented during resource management activities. There will also be visual monitoring of the implementation and effectiveness of Best Management Practices.

MO-2: The Forest Service should improve its monitoring plan.
The monitoring plan has been updated in the Final plan.

MO-3: The Forest Service should include recreation in its monitoring plan.
Recreation is included in the monitoring plan. The monitoring plan does not specify meetings with user groups, but this type of interaction with user groups will continue during plan implementation.

MO-4: The Forest Service should provide monitoring of climate change in the monitoring plan.
A monitoring question for climate change has been added to the monitoring section of the Forest Plan.

NET BENEFITS

NB-1 & 2: The Forest Service should improve its analysis of net public benefits in the EIS. The Forest Service should include an analysis of ecosystem services.
The comments relate to the following direction in the planning regulations. In its opening paragraph, the 1982 National Forest System Land and Resource Planning Rule states “the resulting plans shall provide for multiple

use and sustained yield of goods and services from the National Forest System in a way that maximizes long term net public benefits in an environmentally sound manner." The term "net public benefits" is defined in the 1982 NFMA regulations as "An expression used to signify the overall long-term value to the nation of all outputs and positive effects (benefits) less all associated inputs and negative effects (costs) whether they can be quantitatively valued or not. Net public benefits are measured by both quantitative and qualitative criteria rather than by a single measure or index. The maximization of net public benefits to be derived from management of units of the National Forest System is consistent with the principles of multiple use and sustained yield."

A similar set of comments relate to an inadequate discussion of ecosystem services. These are described in the Forest Plan Appendix E as "the suite of goods and services from the Forest that are vital to human health and livelihood and are traditionally viewed as free benefits to society, or "public goods" - wildlife habitat and diversity, watershed services, drinking water, carbon storage, and scenic landscapes, for example."

The comments go on to state that the analysis does not assess the net public benefits of the various alternatives and does not identify the alternative that does maximize net public benefits.

As evidenced in the definitions of net public benefits and ecosystem services, many of the most important benefits from the National Forest cannot be readily quantified in terms of dollars. As such it is not possible to create a table or a model that assesses the value of each output from the Forest and calculates which alternative is the best. An additional complicating factor is that different people can place different relative values on a particular output. A wilderness advocate might put a very high value on a trail through a wilderness. A mountain biker (who cannot ride a bike in a wilderness) might see that as having lesser value.

Each alternative was developed to respond to issues regarding how the GWNF should be managed. While different alternatives responded with different levels of management activities, each alternative also prescribed methods for achieving the level of outputs that would reduce impacts to other resources. For example, riparian standards are prescribed for each alternative, so that if one alternative creates more soil disturbance than another alternative, the overall impact to water quality would be minimal in either alternative.

In regard to quantifying the benefits and costs, that is the purpose of the EIS. However, to examine all the benefits and costs, one needs to examine all of the tables in the document; they cannot be summarized in a simple table. For the resources that can be valued, their values are described in the Social and Economic Analysis section of Chapter 3 of the EIS. A table has been added to display the costs of implementing each alternative. In regard to outputs that cannot be readily valued, one must examine the other tables and descriptions of the impacts of the alternatives.

The Record of Decision that accompanies this EIS describes the alternative that maximizes net public benefits and provides the rationale for the selected alternative.

NON-NATIVE INVASIVE SPECIES

NN-1: The Forest Service should consider prevention as a management goal for non-native invasive species.

The Plan does include a discussion of prevention and includes standards to prevent the spreading of non-native invasive species.

NN-2: The Forest Service should consider the role of fungi in the control and spread of non-native invasive species.

The Forest Service utilizes Integrated Pest Management techniques to control non-native invasive species. Which methods to use are decided on a site-specific and species-specific case-by-case basis.

NN-3: The Forest Service should improve the Forest Plan direction on non-native invasive species.

The Plan sets priorities for non-native plant species treatment.

NN-4: The Forest Service should actively control non-native invasive species.

We agree and have objectives to do so.

NN-5: The Forest Service should discontinue management activities that encourage non-native invasive species.
Nine of the twelve objectives for Species Diversity include some form of active management to create grasslands, shrublands, early successional habitat, open woodlands, and old fields. To accomplish these objectives timber sales and prescribed fire are necessary. The Forest Plan includes standards to prevent non-native invasive plants from becoming established in areas where management activities are occurring.

NN-6: The Forest Service should recognize that vegetation management and road construction creates conditions in which non-native invasive species thrive.
See above.

OLD GROWTH

OG-1: The Forest Service should improve its analysis of old growth including the estimated amount of old growth, definitions of old growth, how regional guidance is followed.
The analysis has been updated to more clearly describe the current and expected extent of old growth on the Forest

OG-2: The Forest Service should protect old growth.
Old growth will be protected in the following manner: land allocations, plan direction, unsuitable stands, and site-specific analysis.

OG-3: The Forest Service should complete an inventory of all old growth.
Inventory will be better documented in the future as stands are examined.

OG-4: The Forest Service should inventory old growth stands for fungi.
Our inventory funds are limited and we have many priorities for inventory. Inventory of old growth is one priority that would be higher than inventory for fungus within any old growth areas. We would gladly support outside research into this issue, but it is unlikely to be a priority for our limited inventory funding.

OG-5: The Forest Service should not harvest any old growth.
Some old growth can be harvested in the more common vegetation types, but we do not expect to harvest much old growth in the next ten years. Appendix B contains a discussion of the extent old growth that is currently on the Forest and what is projected to be present in 10 and 50 years.

OG-6: The Forest Service should provide old growth stands as they are an important part of the ecosystem.
The Forest Plan does provide for old growth and it extent across the forest will continue to expand.

OG-7: The Forest Service should protect old growth and not expand it beyond 50% of the forest.
The Forest Plan does provide for old growth and its extent across the forest will continue to expand.

OG-8: The Forest Service should manage to enhance old growth obligate plants and animals.
We know of no old growth obligate plants or animals that have been identified on the GWNF.

OG-9: The Forest Service should protect Peters Mtn and Frozen Knob for old growth.
These areas have been identified as Key Natural Heritage Areas.

OG-10: The Forest Service should provide wildlife transit corridors between old growth areas.
We know of no specific wildlife that require transit corridors of old growth. Connections of forested areas are important for some species and some species may benefit from connections of mature forest (which do exist in abundance).

OG-11: The Forest Service has retained more old growth.
Yes it has and the selected alternative protects a similar amount of old growth as in the draft Plan.

OG-12: The Forest Service will satisfy the need for old growth forest with its proposed management.
We agree and the selected alternative protects a similar amount of old growth as in the draft Plan.

OG-13: The Forest Service should harvest old growth to improve deer populations.

Some old growth can be harvested in the more common vegetation types, but we do not expect to harvest much old growth in the next ten years.

PROCESS FOR PREPARING THE EIS AND PLAN

PR-1: The Forest Service should fix the issues that made the DEIS and Draft Plans substantially flawed documents.

Public comments on the Draft Plan and Draft EIS did note a number of errors in the documents. In response to a number of these comments, errata (a list of errors, corrections and corrected versions of the text) were prepared and posted on the Forest website. An additional 45 days were added to the comment period to allow the public to review these changes. These errors have been fixed in the Final EIS and Final Plan. The Final EIS and Final Plan are consistent with the requirements of the 1982 planning regulations.

PR-2: The Forest Service made errors in the AMS.

The AMS meets the requirements of the 1982 planning regulations. The errors in the present net value analysis have been corrected. These errors did not affect the development of the "need for change" component of the AMS.

PR-3: The Forest Service needs to allow for public comment after the IMPLAN analysis is updated.

The purpose of issuing a Draft Plan and Draft EIS is to receive comments about errors, additional information, and additional analyses that could improve the analysis. Public comments identified the errors in the IMPLAN analysis. These have been corrected in the Final EIS. There is no requirement to have another comment period to review this information.

PR-4: The Forest Service should respond to comments.

This appendix is the response to comments. In addition all of the comments were posted on our website, so that anyone could review them.

PR-5: The Forest Service did not seek industry input.

The Notice of Intent to prepare the EIS was sent to our Forest Plan mailing list. This included the following: Cabot Oil and Gas Corporation, Columbia Gas Transmission Corporation, Columbia Natural Resources, Equitable Production Company, West Virginia Oil and Natural Gas Association, Pennzoil Products Co, Carrizo Oil and Gas, CNX Gas Company, High Mount Exploration and Production, and Nomad Geosciences. The prohibition on horizontal drilling in the Draft Plan was developed in response to public comments; it was not proposed at the time that the Notice of Intent was issued.

PR-6: The Forest Service should provide criteria and a better process to compare alternatives.

The Forest Service used the following criteria to identify the preferred alternatives in the Draft EIS and the selected alternative in the Final EIS:

Evaluation Criteria for Identification of the Preferred/Selected Alternative

Criterion 1: *The extent to which the alternative maintains or restores water quality and the soil productivity necessary to support ecological functions in upland, riparian, and aquatic areas.*

Criterion 2: *The extent to which the alternative maintains or restores plant and animal diversity and provides habitats needed to sustain viable populations of native and desired non-native species, including threatened and endangered species.*

Criterion 3: *The extent to which the alternative maintains the resiliency of the ecological systems in relation to futures changes such as increased development adjacent to the National Forest, climate change, and increased demand for ecosystem services and products from the National Forest.*

Criterion 4: *The extent to which the alternative maintains or restores forest vegetation to ecological conditions with reduced risk of damage from fires, insects, diseases, and invasive species.*

Criterion 5: *The extent to which the alternative provides settings for a variety of recreation opportunities.*

Criterion 6: *The extent to which the alternative provides a variety of uses, values, products, and services for present and future generations by managing within the capability of sustainable ecosystems.*

Criterion 7: The extent to which the alternative addresses issues raised by: the forest (in the AMS), partners, and the public.

A number of the objectives in the Forest Plan are expressed as a range rather than as a single number. The range was used to reflect the fact that budgets may constrain activities that would otherwise be desired at higher levels. When addressing objectives for a ten to fifteen year plan, a range of objectives seems to express a more realistic vision than the use of a single number. The use of ranges does complicate the analysis of effects in the EIS. To facilitate the analysis sometimes the full range was analyzed, at other times the maximum, or minimum or average value was used in the analysis. The description of the effects includes statements as to which value was used.

NEPA requires evaluation of a No Action alternative. For a Forest Plan, the No Action alternative represents continuing implementation of the current Plan. Alternative A is the No Action alternative and is described by the current (1993) Forest Plan. However, in many areas the levels of activities identified in the current plan are different from the levels actually achieved. To reflect this difference, the narrative description of effects also identifies the effects of the current plan as implemented. The Final EIS also includes the current Plan, as implemented, in a number of the tables comparing alternatives. The "as implemented" version of Alternative A is generally based on the years 2009 to 2011, unless otherwise noted.

PR-7: The Forest Service should appropriately portray the current forest plan in the EIS.

The Draft EIS contained some errors in describing the current plan in Alternative A. Errors were made in describing the amount of timber regeneration harvest planned (it should be 2,400 acres per year and not the 3,000 acres displayed throughout the DEIS), in describing the Scenic Integrity Objectives (Alternative A has higher levels of Moderate and fewer acres of Low than is shown in the DEIS), in describing the level of recreation development planned (much higher than is displayed), and in the costs to implement the Alternative (much higher than displayed). These errors were corrected in the Errata issued during the comment period and are included in the Final EIS.

PR-8: The Forest Service erred in its analysis of Alternative B.

Alternative B is based is based on changes to the current plan identified in the Analysis of the Management Situation. The analysis was based on an IDT evaluation of the 1993 Forest Plan direction, monitoring and evaluation results, new policies, best available science and an attempt to balance public issues that were identified as of March 2010. There is no need to change the Alternative or to drop it from consideration.

The comment states that the Analysis of Management Situation document recommends maintaining a suitable base between 350,000 and 370,000 acres, but Alternative B displays the suitable base as 476,000 acres. The AMS recommended striving to maintain at least the existing amount of forest suitable for timber production or suitable for timber harvest between 350,000 to 370,000 acres. The 476,000 acres of forest suitable for timber production is greater than the range of 350,000 to 370,000 acres and so meets the goal of at least matching that level. After the discussion of the acreage, the AMS recommendation goes on to state a need to identify: 1) all of those NFS lands currently within MA 17 (Timber Production) but outside of any other special areas and otherwise consistent with timber suitability requirements as Suitable for Timber Production; and 2) all of those NFS lands currently within other MA but outside of any other special areas and otherwise consistent with timber suitability requirements as Suitable for Timber Harvest. The identification of these areas helped to increase the suitable base to 476,000 acres.

PR-9: The Forest Service should correct errors in Alternative C.

The comment addresses the budget cost for fire which is higher in Alternative C, than in Alternative A. The budget for fire includes fire preparedness as well as prescribed fire. Without a prescribed fire program in Alt C, the budget is projected to have a small increase in preparedness funds to address the lack of fuels treatment. The budget figure used for prescribed fire is the same as in Alternative A, since it is expected that unit costs to perform any needed burning would be higher, since less total acres would be burned. There is no need to correct the budget.

PR-10: The Forest Service should have an alternative that examines the timber harvesting at a level similar to the past three years of harvest.

Alternative A is the No Action alternative and is described by the current (1993) Forest Plan. However, in many areas the levels of activities identified in the current plan are different from the levels actually achieved. To reflect this difference, the narrative description of effects also identifies the effects of the current plan as implemented. The Final EIS also includes the current Plan, as implemented, in a number of the tables comparing alternatives. The "as implemented" version of Alternative A is generally based on the years 2009 to 2011, unless otherwise noted.

PR-11: The Forest Service should have an adequate range of alternatives.
The Final EIS evaluates nine alternatives in detail. These alternatives reflect a wide range of outputs and reflect a reasonable range of alternatives.

PR-12: The Forest Service should correct errors in existing wilderness acreage.
The acreage of land on the GWNF that are located within the Barbours Creek Wilderness and Shawvers Run Wilderness are included in the description of existing wilderness in Chapter 3 of the Final EIS.

PR-13: The Forest Service should make some specific changes to the wording in the EIS.
There is no need to add Didymo, hemlock wooly adelgid and invasive species to the list of changes needed on page 1-6 of the EIS, since these items are all discussed in Chapter 3. Adding the adjacency of the Monongahela to the description of the Forest Profile on page 1-2 of the EIS is not needed since it is clearly identified on the vicinity map on the next page. The *Vegetation Management in the Appalachian Mountains* is a reference to an EIS that contains environmental analysis that provides support for some of the decisions in the Forest Plan EIS. We corrected the names of agencies and organizations in the Final EIS and Plan.

PR-14: The Forest Service should improve Chapter 3 of the EIS by providing additional tables.
Additional tables have been added to Chapter 3.

PR-15: The Forest Service should improve its analysis of cumulative effects.
The effects analyses have been updated in the Final EIS.

PR-16: The Forest Service should fix problems with the analysis of present net value.
The comment questioned the use of a range of numbers for the timber volume output for each alternative since the acres to be harvested are represented by a range; however, the PNV analysis uses a discrete volume estimation that represents the Allowable Sale Quantity (maximum amount) for each alternative. The cost estimates used in the PNV analysis has been updated.

PR-17: The Forest Service should follow NFMA.
The Forest Plan follows the need for inventories of the applicable resources of the forest (National Forest Management Act of 1976 Sec.6) through the inventories created for the Analysis of the Management Situation, the EIS and the Forest Plan. There are many inventories used in the analysis and these include potential old growth, Potential Wilderness Areas, recreation opportunity spectrum, ecological systems, species of concern in the ecological analysis, scenery, soil survey, geologic surveys, and Special Biological Areas.

The Forest Plan follows the identification of the suitability of lands for resource management (National Forest Management Act of 1976 Sec. 6) in Forest Plan Appendix C.

The Forest Plan follows the need for obtaining inventory data on the various renewable resources, and soil and water, including pertinent maps, graphic material, and explanatory aids; (National Forest Management Act of 1976 Sec. 6) as described above.

The Forest Plan follows the need for methods to identify special conditions or situations involving hazards to the various resources and their relationship to alternate activities (National Forest Management Act of 1976 Sec. 6) through the previously identified inventories, the ecological and species diversity analyses (EIS Appendix E and Appendix F) and Chapter 3 of the EIS.

The Forest Plan follows the need to insure consideration of the economic and environmental aspects of various systems of renewable resource management, including the related systems of silviculture and protection of forest resources, to provide for outdoor recreation (including wilderness), range, timber, watershed, wildlife, and fish; (National Forest Management Act of 1976 Sec. 6) through the effects analysis in Chapter 3 of the EIS.

The Forest Plan follows the need to provide for diversity of plant and animal communities (National Forest Management Act of 1976 Sec. 6) through the ecological and species diversity analyses (EIS Appendix E and

Appendix F), Chapter 3 of the EIS and the resulting management direction for species and ecological systems in the Forest Plan.

The Forest Plan follows the requirement to provide, where appropriate, to the degree practicable, for steps to be taken to preserve the diversity of tree species similar to that existing in the region controlled by the plan; (National Forest Management Act of 1976 Sec. 6) through the ecological analysis in Appendix E of the EIS and the management direction for ecological diversity in the Forest Plan.

The need to insure research on and (based on continuous monitoring and assessment in the field) evaluation of the effects of each management system to the end that it will not produce substantial and permanent impairment of the productivity of the land; (National Forest Management Act of 1976 Sec. 6) 103 is largely the purview of the research branch of the Forest Service. Soil productivity is part of the monitoring plan in Chapter 5 of the Forest Plan.

The Forest Plan follows the need to insure that timber will be harvested from National Forest System lands only where- "(i) soil, slope, or other watershed conditions will not be irreversibly damaged; "(ii) there is assurance that such lands can be adequately restocked within five years after harvest; (National Forest Management Act of 1976 Sec. 6) through the suitability analysis in Forest Plan Appendix C and in forest-wide standards including FW-131.

The Forest Plan follows the requirement that protection is provided for streams, stream-banks, shorelines, lakes, wetlands, and other bodies of water from detrimental changes in water temperatures, blockages of water courses, and deposits of sediment, where harvests are likely to seriously and adversely affect water conditions or fish habitat (National Forest Management Act of 1976 Sec. 6) through the riparian management direction including the standards for riparian areas.

NFMA has a requirement to insure that clearcutting, seed tree cutting, shelterwood cutting, and other cuts designed to regenerate and even-aged stand of timber will be used as a cutting method on National Forest System lands only where- "(i) for clearcutting, it is determined to be the optimum method, and for other such cuts it is determined to be appropriate, to meet the objectives and requirements of the relevant land management plan; "(ii) the interdisciplinary review as determined by the Secretary has been completed and the potential environmental, biological, esthetic, engineering, and economic impacts on each advertised sale area have been assessed, as well as the consistency of the sale with the multiple use of the general area; "(iii) cut blocks, patches, or strips are shaped and blended to the extent practicable with the natural terrain; "(iv) there are established according to geographic areas, forest types, or other suitable classifications the maximum size limits for areas to be cut in one harvest operation, including provision to exceed the established limits after appropriate public notice and review by the responsible Forest Service officer one level above the Forest Service officer who normally would approve the harvest proposal: Provided, That such limits shall not apply to the size of areas harvested as a result of natural catastrophic conditions such as fire, insect and disease attack, or windstorm; and "(v) such cuts are carried out in a manner consistent with the protection of soil, watershed, fish, wildlife, recreation, and esthetic resources, and the regeneration of the timber resource. (National Forest Management Act of 1976 Sec. 6). The Forest Plan follows these requirements through the analysis in Forest Plan Appendix C and forest-wide standards on Timber Management.

The Forest Plan follows the requirement to identify lands within the management area which are not suited for timber production, considering physical, economic, and other pertinent factors to the extent feasible (National Forest Management Act of 1976 Sec. 6) through the analysis documented in Forest Plan Appendix C and the land allocations in the Forest Plan.

PR-18: The Forest Service should follow appropriate planning criteria.

Criteria for evaluating the alternatives are described in PR-6.

PR-19: The Forest Service should make the Plan more consistent with the Jefferson NF Plan.

Making the Forest Plan for the GWNF more consistent with the Forest Plan for the Jefferson NF was a goal of the revision process. Management prescriptions from the Jefferson form the basis of the prescription in the final Forest Plan. However, some aspects of the management prescriptions were modified based on the conditions of the GWNF or on new information. One example is the combination of the wildlife and timber prescription areas from the Jefferson NF (management prescription areas 8A1, 8B, 8C, 8E1 and 10B) into a single management prescription area on the GWNF, 13-Mosaics of Wildlife Habitat. The purpose of this was to facilitate the use of ecological systems identified on the GWNF and the desired conditions that go with these systems.

PR-20: The Forest Service should simplify the plan by reducing the number of management areas.

We utilized management areas as needed to adequately describe the desired conditions on the Forest, particularly because so many unique areas exist on the GWNF (e.g. Appalachian Trail, Cow Knob salamander). We also had a desire to make the GWNF Forest Plan more consistent with the Jefferson Forest Plan. We utilized many of the prescription areas from the Jefferson Forest Plan, but did reduce the number of management areas in response to a desire to simplify the Plan.

PR-21: The Forest Service should better define the terms desired future condition and objectives.

We believe that these terms are clearly defined in Chapter 1 of the Forest Plan.

PR-22: The Forest Service should acknowledge the proposal made by the stakeholders group.

We did review the proposal made by the stakeholders group and made some changes in the Final Plan in response to recommendations made by the stakeholders (and other individuals and groups). The changes included the final Recommended Wilderness Study acres, and the recommendation of a National Scenic Area at Shenandoah Mountain.

PR-23: The Forest Service should improve its niche statement.

The suggested additions to the niche statement are more of a list of current conditions and statistics on numbers of recreation areas than items indicating the role of the Forest. No changes were made.

PR-24: The Forest Service should follow state regulations.

The Forest Service will follow applicable state regulations.

POTENTIAL WILDERNESS AREAS, INVENTORIED ROADLESS AREAS, WILDERNESS

PW-1: The Forest Service should protect roadless areas.

In the Forest Plan all Inventoried Roadless Areas, not recommended for congressional designation, have management direction that is consistent with the 2001 Roadless Area Conservation Rule.

PW-2: The Forest Service should manage all inventoried roadless areas under the 2001 RACR.

In the Forest Plan all Inventoried Roadless Areas, not recommended for congressional designation, have management direction that is consistent with the 2001 Roadless Area Conservation Rule. The Forest Plan has been changed to implement this in those portions of prescription areas like Special Biological Areas that are within inventoried roadless areas.

PW-3: The Forest Service should adjust the boundaries of inventoried roadless areas in relation to roads and areas suitable for timber production.

The Inventoried Roadless Areas were identified in the 2001 Roadless Area Conservation Rule and FEIS, and currently, there are no provisions for the Agency to update those IRA boundaries.

PW-4: The Forest Service should manage all Potential Wilderness Areas not recommended for federal designation under the requirements of the 2001 Roadless Rule.

The 2001 RACR specifically applies to those Inventoried Roadless Areas identified in the EIS supporting the rule, so there is no requirement under the RACR that it apply to newly identified PWAs. Of the 372,000 acres of Potential Wilderness Areas, 228,000 are Inventoried Roadless Areas (and additional 14,000 acres of Inventoried Roadless Areas were not included in the Potential Wilderness Area inventory). Of the remaining 144,000 acres 6,000 acres were allocated to Recommended Wilderness Study, 12,000 acres were allocated to Recommended National Scenic Area, 42,000 acres to Remote Backcountry Areas (with standards that meet the 2001 RACR) and Special Biological Areas where timber harvest and road construction are limited, but not prohibited. About 80,000 acres were allocated to Management Prescription Area 13-Mosaics of Habitat which allows timber harvest and road construction. Many of the areas allocated to MA 13 are already roaded and have been actively managed for many years. A few, like Paddy Knob, Galford Gap and Little Alleghany have few existing roads, but have some potential for vegetation management from the existing boundary roads.

PW-5: The Forest Service should assure that management activities in PWAs will only be done if they will not affect the PWA to the point that it would no longer meet the definition of a PWA.

The portions of PWAs that were allocated to Management Prescription Area 13-Mosaics of Habitat were allocated so that vegetation could be managed for ecological and wildlife benefits, rather than management for remote characteristics. As such, no restrictions on road construction are placed on these areas. However, any project involving permanent road construction that exceeds the level of roads allowed in a PWA would require an analysis of the effects of the road construction on the wilderness character of the area.

PW-6: The Forest Service should make all Potential Wilderness Areas and all Virginia Mountain Treasures free from logging and road building.

See the response to PW-4 for Potential Wilderness Areas and the response to PW-31 for the Virginia Mountain Treasures.

PW-7: The Forest Service should manage Potential Wilderness Areas as recommended by the Stakeholders group.

Many comments were received regarding the management of Potential Wilderness Areas (PWAs), with some in favor of treating all of them the same as Inventoried Roadless Areas (IRAs) and some opposed to special treatment of the PWAs. The stakeholders group dealt with specific PWAs on a case by case basis with recommendations for Mosaics of Habitat, Remote Backcountry Recreation, Special Biological Areas and Recommended National Scenic Area.

The stakeholders recommended that all Inventoried Roadless Areas, not recommended for congressional designation, be managed consistent with the 2001 RACR. This is in the final Forest Plan. The stakeholders recommended no permanent road construction in any PWAs. The final Forest Plan does this for the areas allocated to Remote Backcountry Areas. However, as noted in PW-5, the Forest Plan places no restrictions on those portions of PWAs allocated to MA 13 Mosaics of Habitat. The stakeholders recommended that all other PWAs be allocated to Mosaics of Habitat except for part of Crawford Mountain, Duncan Knob, and Archer Knob that should be allocated to Remote Backcountry Areas. The Forest Plan allocates more areas to Remote Backcountry Areas than recommended by the stakeholders and does have Remote Backcountry Areas in much of Archer Knob. The Forest Plan does not allocate the Crawford Mountain or Duncan Knob areas to Remote Backcountry Areas. These two areas are closer to existing roads and are allocated to Mosaics of Habitat.

PW-8: The Forest Service should not make all Potential Wilderness Areas consistent with the restrictions in the 2001 RACR.

The Forest Plan did not make all PWAs consistent with the restriction in the 2001 RACR. Each PWA that is not an Inventoried Roadless Area and not recommended for congressional designation was evaluated on its own merits. The allocations are summarized in the response to PW-4.

PW-9: The Forest Service should address concerns with those Potential Wilderness Areas that would be allocated to Mosaics of Habitat.

Some comments were received regarding the Potential Wilderness Areas (PWAs) and Virginia Mountain Treasures not being adequately protected from road construction and logging in the preferred alternative. See response to PW-31 regarding Virginia Mountain Treasures. In the final selected alternative, those PWAs found to be not suitable for wilderness recommendation are allocated to a variety of management prescription areas, many which do have restrictions on road construction and timber production including Special Biological Areas, Remote Backcountry Recreation and the Appalachian Trail Corridor. Many PWAs are partly or entirely allocated to Mosaics of Habitat in Alternative I, which allows for multiple uses including road construction and timber production.

The effects of allocating lands in PWAs to Mosaics of Habitat are described in the EIS. This allocation could result in disqualifying some areas for future consideration as wilderness. However, based on past management and past inventories, our experience has been that at each new inventory of areas that qualify for consideration as wilderness, the extent of the areas that qualify increases and increases substantially (from 168,000 acres in 1979 to 293,000 acres in 1993, to 412,000 acres now).

One comment included concern over PWAs' vulnerability to non-native invasive species (NNIS) where allocated to Mosaics of Habitat. Forestwide standards FW-91 through FW-100 require mitigating measures to minimize the introduction and spread of NNIS. OBJ NNI-1 and OBJ NNI-2 provide Forest Objectives for surveys and treatment of NNIS plants annually. The potential effects of management activities (including the potential introduction and spread of NNIS) is provided in the EIS for each alternative.

PW-10: The Forest Service should not consider the 37 areas identified as new Potential Wilderness Areas as having any special designation.

The 37 Potential Wilderness Areas do not have a special designation. The areas or portions of the areas are allocated to a variety of management prescription areas in the Forest Plan. Some of these are recommendations for designation by Congress as wilderness or national scenic area. Management direction for the areas is identified by the management prescription area in the Forest Plan. However, since these areas qualify as Potential Wilderness Areas, future projects proposed in these areas will need to evaluate the potential for affecting the wilderness characteristics that made the area eligible as a PWA.

PW-11: The Forest Service should change the rules that define Potential Wilderness Areas.

The rules that define Potential Wilderness Areas are established in the US Forest Service Manual and Handbook and are based on direction from the Wilderness Act of 1964. Therefore, they cannot be changed on the forest or by the Forest Plan.

PW-12: The Forest Service should add several areas as Potential Wilderness Areas.

The GWNF followed "Guidelines on How to Conduct the 'Potential Wilderness Area Inventory' for the Revision of the Revised George Washington Forest Plan". That document is based on national direction provided in Chapter 70 of the Forest Service Land Management Planning Handbook 1909.12 as amended in January 2007. Using this national direction, the Forest did an extensive review of areas to be considered as Potential Wilderness Areas. This is documented in Appendix C of the EIS. The Whites Run area does not meet the guidelines in regard to size of the area. In regard to the Virginia Mountain Treasures, there is an analysis document on our website and in the process record that reviewed these areas.

PW-13: The Forest Service should update its evaluations of Potential Wilderness Areas.

The evaluations of Potential Wilderness Areas in Appendix C of the EIS were reviewed and updated as a result of many public comments received on the Draft Environmental Impact Statement. There was a comment that acres of existing designated Wilderness on other federal lands in Virginia and West Virginia should not be considered since there wasn't a corresponding inclusion in the timber harvest analysis. The evaluation of wilderness suitability includes determining whether each PWA may contribute something new to the National Wilderness Preservation System, such as an unrepresented ecological land type association. This requires a review of other federal lands with designated Wilderness that may contain the same landtype associations. Furthermore, Chapter 70 - Wilderness Evaluation of the Forest Service Land Management Planning Handbook 1909.12 directs at section 72.31 that the location, size and type of other designated wildernesses in the general vicinity be a factor in the evaluation.

Another comment stated that too much emphasis was given to concerns over illegal ATV use because it is just as illegal in other parts of the national forest. This concern remains part of the capability analysis because: (1) the impacts of ATVs can have greater significance when they occur in an area that, by definition, provides opportunities for remoteness, solitude, and a setting where the earth and its community of life are untrammeled by man. Forest Service Land Management Planning Handbook 1909.12, Chapter 70, Wilderness Evaluation, Section 72.1 Evaluation of Potential Wilderness-Capability, Paragraph 5. Manageability: "In determining capability, consider the ability to manage an area as wilderness as required by the Wilderness Act... Forest Service ability to manage an area as an enduring resource of wilderness, untrammeled by humans, retaining its primeval character.... consider such factors as size, shape, and juxtaposition to external influences; (2) It can be significantly more challenging for law enforcement to apprehend illegal ATV use in Wilderness compared to other parts of the national forest, as law enforcement cannot pursue with motorized vehicles into designated Wilderness. It is more time consuming to investigate on foot or horseback for evidence in wilderness in order to build a case; and (3) Without the use of chainsaws and other mechanized equipment, repairing trails damaged by ATVs and removing trails created by ATV riders can be more challenging.

Another comment stated that private mineral rights should be acquired for certain PWAs in order to expand an existing Wilderness or recommend a new one (Little River). Acquisition of mineral rights would improve the suitability of certain PWAs for wilderness study recommendation. However, Forest Service funding is not available for acquisition of mineral rights at the time of this Forest Plan revision process.

PW-14: The Forest Service should keep the areas Recommended for Wilderness Study in Alternative G.

As a result of the public comments received, the evaluations of PWAs were reviewed and updated. Subsequently, the final Forest plan keeps the Recommended Wilderness Study areas that were in Alternative G and adds recommendations for Beech Lick Knob and Rough Mountain Addition.

PW-15: The Forest Service should not increase the amount of wilderness on the Forest.

During the draft plan comment period, concerns were expressed about the loss of access for hunting and fishing (particularly for those who find it challenging or impossible to hike or ride horses), loss of timber benefits, potential delays in fire suppression, and the permanence of wilderness designation that would prohibit reverting back to other uses in the future.

In the selected alternative, we strived to meet the many needs and desires of the public in a balanced and environmentally responsible manner. We recognize that for a variety of reasons, many people cannot access the national forest on foot or horseback. No system roads are included in the areas Recommended for Wilderness Study. With regards to timber benefits, the suitable acres will increase from about 348,000 acres to about 439,000 acres and timber harvest is expected to increase from an actual average harvest (past ten years) of 629 acres per year to 1,800-3,000 acres per year.

The Forest Plan does recommend increasing the amount of wilderness from the current level of 40,000 acres up to about 70,000 acres. In regard to objections by several county boards of supervisors, there is a group of stakeholders that are working together to increase the level of timber harvest and the amount of wilderness on the forest and this group will be working with the county boards. At least one of the county boards has indicated a willingness to engage in these discussions. The Record of Decision recognizes this fact and we hope that any designations by Congress would strongly consider the opinions of the local county boards.

One comment references a DEIS statement that there are no old growth obligate plant or animal species on the GWNF, therefore additional wilderness designation would be to the detriment of early successional dependent species. The selected alternative includes objectives (SPD-1 through SPD-7) that provide for regeneration of 1,800-3,000 acres per year from timber harvesting, with the amount and location of early successional based on ecological objectives and restoration needs. If this objective is met, regeneration harvest will create 18,000-30,000 acres in age class 0-10 by the end of the first decade; in addition, old fields, grasslands, shrublands and open woodlands will be created and maintained. The impacts of the alternatives analyzed on terrestrial habitat components and wildlife species are contained in Appendix E of the EIS.

PW-16: The Forest Service should reduce the acreage of wilderness and backcountry prescriptions.

Several comments were received opposing additional wilderness recommendations, and at least one comment opposing allocations to remote backcountry, because of the loss of flexibility to manage habitat. In the final selected alternative, the GWNF attempts to find the best balance between lands that allow for active management of habitat and those where other needs and values are emphasized. The reasons for increasing the areas recommended for Wilderness study are provided in response to other comments in this section.

With regards to remote backcountry, the majority of acres allocated to this management prescription area are within IRAs. The setting provided by IRAs is compatible with the type of primitive recreation opportunities people seek in the remote backcountry. Similarly, after evaluating PWAs that are outside of IRAs (including some of the Virginia Mountain Treasures) on a case by case basis, some are allocated to remote backcountry as the most prudent and reasonable option for a variety of reasons. One is to strive to maintain core, unmanaged areas. Areas with existing road access and those where active management have occurred in the past are preferred for habitat and timber management over those lacking road access and past management.

While the Forest Plan does increase the area Recommended for Wilderness Study and Remote Backcountry Areas, it also increases the amount of land available for timber production. In addition, the amount of prescribed burning would be increased and this burning would improve habitat for game species.

PW-17: The Forest Service should avoid recommending wilderness in some specific areas that would affect trail maintenance.

During the wilderness suitability evaluation of PWAs, consideration was given to the presence of trails with known volunteer trail maintainers, especially the Appalachian National Scenic Trail. We appreciate the support expressed for Alternative G by the Appalachian Trail Conservancy and the Natural Bridge Appalachian Trail Club. The final selected alternative is the same as Alternative G with respect to the Three Sisters and Three Ridges Addition PWAs. No additional wilderness has been recommended that would affect trail management on the Appalachian Trail.

PW-18: The Forest Service should not recommend more wilderness until adequate environment monitoring and mitigation has taken place.

There is not a requirement to restrict Wilderness study recommendations to areas with adequate environmental monitoring data. However, the Forest has considered the impacts of acid deposition and climate change in the decision to recommend the areas proposed for designation as wilderness. Forest Service specialists were consulted throughout the evaluation of PWAs with regards to the suitability and availability for recommended wilderness study evaluations. These Forest Service specialists brought to the process not only their own professional, working knowledge, but also that of research and monitoring accomplished by partners such as state agencies, universities and other organizations. The evaluation of each PWA was provided to the public for review and comment in the DEIS, and those public comments were used to update the PWA evaluations found in Chapter 2, Appendix C of the EIS.

PW-19: The Forest Service should consider the size of Potential Wilderness Areas when making Recommendations for Wilderness Study.

The areas that are Recommended for Wilderness Study are large areas or additions to make existing wilderness larger. Our Forest Service Land Management Planning Handbook, Chapter 70, directs that areas containing 5,000 acres or more (or less than 5,000 acres if additional criteria are met) are to be evaluated. The capability portion of the evaluation (Section 72.1.3) directs that a determination of the area's ability to provide solitude include a look at the size of the area, presence of screening, distance from impacts and degree of permanent intrusions. Many of the areas, though relatively small, do possess the presence of topographic screening and a lack of permanent intrusions.

Several of the largest PWAs evaluated were found to be unavailable in their entirety or in part due to the competing values and benefits of other resources and/or due to concerns over the Forest Service's ability to manage the area as an enduring resource of Wilderness. This resulted in eliminating several of the larger PWAs from Recommended Wilderness Study. However, a portion of Beech Lick and Little River are being recommended for wilderness study. Existing Ramseys Draft, Saint Mary's, Rich Hole and Rough Mountain Wildernesses will have additions recommended that will bolster their size. The evaluation of PWAs is found in the EIS, Appendix C.

PW-20: The Forest Service should add more areas as Recommended Wilderness Study.

We heard well-reasoned and passionate comments on both sides regarding whether or not to recommend additional acres for Wilderness Study. Many in support of wilderness stated that 4% of the GWNF designated as Wilderness is far too low. There is no legal requirement or national direction with regards to a minimum percent of national forest system lands to be designated as Wilderness.

Many comments were received regarding the lack of permanent protection from road construction, timber harvesting and special uses when areas are allocated to remote backcountry or other management area prescriptions. We also heard many comments that the Forest Service should maintain future management flexibility to deal with emerging issues. We have attempted to provide optimum protection to IRAs during the life of this revised plan. IRAs that are not allocated to Recommended Wilderness Study are allocated to Recommended National Scenic Area, Special Biological Areas, Remote Backcountry and Appalachian Trail Corridor. These management prescription areas restrict road construction and timber harvesting (with specific exceptions), are not suitable for wind development, and are not suitable for federal oil and gas leasing.

The nine alternatives in the Final EIS provide wilderness recommendations ranging from 1,500 acres in Alternative A to 386,809 acres in Alternative C. Alternative I, the final selected alternative, keeps the areas Recommended for Wilderness Study from Alternative G and adds recommendations for Beech Lick Knob and Rough Mountain Addition. Chapter 3 of the Final EIS describes effects to all resources and uses under the various alternatives. The Record of Decision explains the rationale for which alternative provides the best balance in meeting the wide range of public desires evident in the comments.

PW-21: The Forest Service should increase the acreage of the areas Recommended for Wilderness Study including Little River, Rich Hole, Ramseys Draft and Laurel Fork.

Alternative C included all PWA acres in Little River, Rich Hole, Ramseys Draft Addition and Big Schloss as Recommended for Wilderness Study. In Alternative I, the Little River area that is Recommended for Wilderness Study is reduced from the total PWA due to conflicts with popular bicycle trails and the proposed boundary was developed by a group of interested users. The Rich Hole area was reduced to not include a block of land with an extensive private land boundary that would make management difficult. The western addition to Ramseys Draft was not included because of outstanding or reserved mineral rights.

Another PWA for which we received many comments is Laurel Fork. Laurel Fork is recommended for Wilderness Study in Alternatives C and F. It was not recommended in other alternatives, in part, due to the concerns over climate change. This is a high elevation area with many species more common in northern environments. As such, these species may be more vulnerable to changes in climate. We feel it is critical, until additional information is known about the impacts of climate change, to maintain management flexibility that allows the Forest Service to take needed action to protect and retain the species in Laurel Fork.

A comment was received that it is the responsibility of the FS to provide the full range of recreation opportunities and settings including the primitive setting which does not currently exist on the GWNF. It is not legally required that the GWNF offer every opportunity within the Recreation Opportunity Spectrum. For example, there is currently no Urban ROS provided by the GWNF. While the primitive recreation setting is compatible with the GWNF niche, the national protocol for inventorying the primitive setting is that it be at least three miles from roads and 5,000 acres in size (or smaller if contiguous lands are semi-primitive non-motorized that can offer a primitive experience). There are no areas within the GWNF that meet this criterion. In order to create the Primitive ROS setting, multiple roads would need to be closed, and there is no evidence that there is public or political support for this. However, per Plan standards, we manage designated Wilderness (1A) and Recommended for Wilderness Study (1B) Areas for the Primitive ROS setting.

One comment cites the island biogeography study by Robert MacArthur and E.O. Wilson and stated that it is necessary to increase the size of forest islands and reduce the distance between them in order to increase the number of species and reduce the threat of extinction. We feel this final plan, with the mix of Wilderness, Recommended Wilderness Study, Special Biological Areas and Remote Backcountry, increases core areas and their connectivity over the existing (No Action) alternative. Alternatives C and F also maximized core islands. Chapter 3 of the Final EIS describes effects to all resources under the various alternatives.

Several comments received state that the DEIS showed a FS bias against wilderness designation. We disagree and believe the evaluation of PWAs demonstrates that the FS made a concerted, good faith effort to find a balance between the value and need for wilderness and the value and need for other resources. The Record of Decision explains the rationale for which alternative provides the best balance in meeting the wide range of public desires evident in the comments.

PW-22: The Forest Service should follow the recommendations of the stakeholders group in relation to Recommended Wilderness Study, National Scenic Areas and Backcountry Recreation.

Many comments were received regarding the management of Potential Wilderness Areas (PWAs), with some in favor of treating all of them the same as Inventoried Roadless Areas (IRAs) and some opposed to any special treatment of the PWAs. The stakeholders group dealt with specific PWAs on a case by case basis with recommendations for Mosaics of Habitat, Remote Backcountry, Special Biological Areas and Recommended National Scenic Area. The final Forest Plan is similar to the recommendations of the stakeholders group. The Shenandoah Mountain National Scenic Area is recommended but with slight modifications to the boundary. Beech Lick Knob, Rich Hole, and Rough Mountain Additions are Recommended for Wilderness Study with some boundary modifications. The Bald Ridge portion of the Ramseys Draft Addition is recommended, but the Lynn Hollow portion is not recommended due to private mineral rights. High Knob is not Recommended as Wilderness Study, but is included in the national scenic area. The Three Ridges Additions were not recommended due to ownership and trail maintenance concerns on two areas and the small size of the additions.

PW-23: The Forest Service should adopt the recommendation from the Friends of Shenandoah Mtn.

Alternative F incorporated the Friends of Shenandoah Mountain (FOSM) proposal. As a result of public comments, Alternative I was developed. It incorporates much of the FOSM proposal as modified in their letter of November 2011, such as a Recommended National Scenic Area (NSA), Recommended Wilderness Study area for Little River and Ramseys Draft addition. It does not include allocating Lynn Hollow, Bald Ridge or Skidmore Fork to Recommended Wilderness Study, but does include these areas in the recommended NSA. Alternative I reduces the acres of the Little River PWA area allocated to Recommended Wilderness Study from the FOSM proposal.

A desire raised by the Friends of Shenandoah Mountain as well as many others is the protection of the area from oil, gas and wind energy development, timber harvesting, and the road construction associated with these activities. There were also comments received by others in favor of these developments to increase the United States' energy independence and for economic benefits. In Alternative I, the Recommended Shenandoah Mountain NSA and the Recommended Wilderness Study Areas are not suitable for federal oil and gas leases, timber production or wind energy development. New road construction and timber harvesting are prohibited or very limited. A notable exception to this is the Hankey Mountain/Dowells Draft area that the FOSM recommend for NSA, but that is allocated to Dispersed Recreation 7E2 in the selected alternative. This management area prescription is suitable for timber production and wind energy development, but an inventory of wind classifications indicates this area would not support utility scale development. Another area in the FOSM proposal shown as "other national forest lands" is allocated to Dispersed Recreation 7E1, which is unsuitable for timber production, but vegetation management activities are allowed to meet specific resource objectives.

The Forest Plan does adopt the major portion of the proposal from the Friends of Shenandoah Mountain with the recommendation of the Shenandoah Mountain National Scenic Area. The Plan makes the Kelley Mountain area a Special Biological Area and makes the Laurel Fork area a Special Biological Area and a Remote Backcountry Areas.

PW-24: The Forest Service should recommend the following areas for designation as Recommended National Scenic Areas, recommended National Recreation Areas and Recommended Wilderness Study:

Northern Massanutten as a recommended National Recreation Area
Shenandoah Mountain as a Recommended National Scenic Area
Kelley Mountain as a Recommended National Scenic Area
Big Schloss as a Recommended National Scenic Area
Little Alleghany as Recommended Wilderness Study
Laurel Fork as Recommended Wilderness Study
Three High Heads as Recommended Wilderness Study
Beech Lick Knob as Recommended Wilderness Study
Three Ridges as Recommended Wilderness Study
Shenandoah Mountain proposal for Recommended National Scenic Area and Recommended Wilderness Study

Alternatives C and F included all of the Recommended Wilderness Study areas put forth in this statement, and Alternative F included the proposed National Scenic Area (NSA) designation for Shenandoah Mountain and Kelley Mountain. Based on public comments, Alternatives H and I were developed. It recommends the Shenandoah National Scenic Area and Beech Lick Knob as Recommended Wilderness Study. While a popular area for recreation, we do not believe that Northern Massanutten has the size, access or diversity to make a high quality national recreation area. Kelley Mountain and Laurel Fork have important biological components that make them more important as Special Biological Areas rather than Recommended Wilderness Study Areas or Recommended National Scenic Areas. Big Schloss is another remote area and its hiking, biking and equestrian recreation management needs can best be addressed as a Remote Backcountry Area. Little Alleghany has an odd configuration and we have allocated the Inventoried Roadless Area portion to Remote Backcountry Areas and the other portion to Mosaics of Habitat. The four additions (total of 370 acres) to Three Ridges are very small in size. One of them contains a large bridge across the Tye River, another is not National Forest System lands (it is National Park System land managed by the Forest Service, and the other two are small and have issues with adjacent private lands.

PW-25: The Forest Service should recommend all of the possible wilderness areas suggested in the past by the Virginia Wilderness Committee.

The Virginia Wilderness Committee recommended the areas in the stakeholder's agreement, and this is addressed in the response to PW-22.

PW-26: The Forest Service should recommend the following list of areas as Recommended Wilderness Study.

The recommendations in the Forest Plan have been addressed in the responses to the other wilderness comments. In regard to Adams Peak, the area is relatively small and has a bicycle trail that is important to a number of interested parties, so it was not Recommended as Wilderness Study.

PW-27: The Forest Service should recommend all Virginia Mountain Treasures as Recommended Wilderness Study. All undesignated Potential Wilderness Areas should be managed the same as Inventoried Roadless Areas.

The information contained in the Virginia Mountain Treasures was revisited and considered. The Forest Plan seeks to address many public and agency issues. Allocating all of the Virginia Mountain Treasures would result in conflicts with our ability to achieve our goals of ecological restoration; it would result in the closure of trails to bicycle use and some types of equestrian use and would limit our ability to respond to management needs in response to changes in the climate. The final Plan is the best balance of land allocations to meet the needs we identified in our analysis.

PW-28: The Forest Service should follow the Recommended Wilderness Study and Potential Wilderness Area recommendations in Alternative C.

Alternative C was developed to examine an alternative with a large amount of Recommended Wilderness Study. Comments on the Draft Plan included area specific recommendations for stronger protection of certain Potential Wilderness Areas (PWAs) than what is provided in Alternative G. Some expressed support for the protections provided in Alternative C which allocates these areas to Recommended Wilderness Study. Chapter 3 of the Final EIS describes effects to all resources and uses under the various alternatives. The Record of Decision explains the rationale for which alternative provides the best balance in meeting the wide range of public desires evident in the comments. We believe the special places of the GWNF will be protected by allocations other than the Recommended Wilderness Study Area prescription only. Many of these areas are allocated in the selected alternative as Special Biological Areas, Remote Backcountry and Recommended National Scenic Area. A forestwide standard restricts road construction and timber harvesting in Inventoried Roadless Areas. While Alternative C addresses the issues of many wilderness advocates, it does not address many other issues related to access, biological diversity, climate change and energy development.

PW-29: The Forest Service should recognize the impacts to mountain biking in Recommended Wilderness Study recommendations.

The Forest Plan and the land allocations made for the Plan do recognize the impacts to mountain biking in Recommended Wilderness Study Areas. The presence of trails used by mountain bicyclists was considered in the Potential Wilderness Area evaluations. The recommendations are in line with many of the comments we received from mountain bikers. Some comments expressed appreciation that the recommended Wilderness Study Area prescription standards do not prohibit mountain bicycle use. Our direction for these areas is to manage them so as to retain those qualities for which they qualify for Wilderness study. Continued mountain bicycling on existing trails during the study period is not expected to detract from those qualities.

PW-30: The Forest Service should protect all areas identified as Virginia Mountain Treasures, protect all roadless areas as much as possible, designate more wilderness areas, and protect all existing old growth forests.

All inventoried Roadless Areas have management direction as in the 2001 RACR. More areas are Recommended for Wilderness Study in the final Forest Plan. See the responses to comments on old growth.

PW-31: The Forest Service should protect all areas identified in the Virginia's Mountain Treasures publication by designating them as unsuitable for timber harvest, new road building and surface-occupying oil and gas drilling.

Allocation of lands included in the Virginia Mountain Treasures was given much consideration. In total, they comprise almost 60% of the George Washington National Forest including areas that are currently in active management prescriptions, and the majority outside of IRAS have existing road access. We received many comments on the Draft Revised Plan from individuals, groups and state agencies in favor of not only continuing but increasing active management particularly for early successional habitat.

About 56 percent of all of the Virginia Mountain Treasure areas are allocated to management prescription areas that are unsuitable for timber production and unsuitable for road construction. The following table identifies the allocations within the selected alternative for each area. All of the GWNF, including the Virginia Mountain Treasure areas are unavailable for federal gas leasing.

Table N-1. Acres by Management Prescription Area within Virginia Mountain Treasure Areas

Virginia Mountain Treasure Area	Acres by Management Prescription Area				
	1B	12D	Other Unsuitable For Timber Production Prescriptions 2C2, 2C3,4A,4B,4C,4D,4F,8E4a,8E7	Prescriptions Suitable For Timber Production 5A,7A1,7B,7C,7E1,7F,7G,8E4b,13	Grand Total
Adams Peak		8,617	0	1,350	9,967
Archer Knob		5,079	24	4,691	9,793
Back Creek			1,467	4,245	5,712
Beards Mtn		7,200	1,003	3,511	11,714
Bearwallow Mtn			0	3,724	3,724
Beech Lick Knob	5,730	3,438	0	7,974	17,142
Benson Run		3,861	0	6,865	10,726
Big Ridge			0	4,683	4,683
Big Schloss		20,157	1,031	9,994	31,181
Broad Run			2,513	2,534	5,047
Browns Run			1,138	6,099	7,237
Church Mtn		4,341	455	7,191	11,986
Cove Mtn			99	2,473	2,572
Crawford Mtn		9,702	0	5,265	14,967
Dolly Ann		6,272	2,086	1,253	9,611
Dry River		4,491	3,721	4,725	12,937
Dunkle Knob			2,429	5,963	8,391
Elliot Knob		6,232	3,324	7,097	16,652
Falls Ridge		3,193	0	4,542	7,735
Feedstone Mtn			1,713	2,342	4,056
Fore Mtn			618	5,169	5,787
Friar		2,128	0	1,847	3,976
Great North Mtn		2,078	7	4,576	6,661
Green Mtn			48	4,305	4,353
Gum Run		44	14,619	0	14,663
Hog Pen Mtn			0	9,209	9,209
Jerkemtight		16,826	1,598	2,833	21,258
Jerrys Run			0	4,761	4,761

Virginia Mountain Treasure Area	Acres by Management Prescription Area				
	1B	12D	Other Unsuitable For Timber Production Prescriptions 2C2, 2C3,4A,4B,4C,4D,4F,8E4a,8E7	Prescriptions Suitable For Timber Production 5A,7A1,7B,7C,7E1,7F,7G,8E4b,13	Grand Total
Jonnies Knob		1,892	0	603	2,496
Kelley Mtn			10,193	2,698	12,891
Kritchie Mtn			1,433	5,243	6,676
Laurel Fork		3,581	6,695	38	10,314
Little Alleghany		10,321	0	5,537	15,857
Little Cow Knob			1,706	3,596	5,302
Little Mare Mtn		4,286	220	8,073	12,579
Little River	9,543		18,464	1,330	29,337
Long Mtn		1,028	22	9,444	10,494
Longdale Furnace			0	3,937	3,937
Mill Mtn	4,608	5,989	444	1,358	12,399
Mud Run			16	4,282	4,298
North Massanutten		11,018	1,117	6,247	18,382
Oak Knob			10,656	5	10,660
Oliver Mtn		12,235	718	42	12,994
Paddy Lick			786	4,575	5,361
Panther Knob			0	4,178	4,178
Ramseys Addition	6,117	0	7,454	5,469	19,040
Revised Hankey			3,038	8,345	11,383
Rough Mtn Addition	983	122	120	971	2,195
Scaffold Run			0	7,633	7,633
Shaws Ridge		7,165	90	4	7,259
Short Mtn			273	4,375	4,647
Sideling Hill			0	7,152	7,152
Signal Corp Knob			0	4,044	4,044
Signal Knob			824	4,637	5,461
Skidmore			5,702	1	5,703

Virginia Mountain Treasure Area	Acres by Management Prescription Area				
	1B	12D	Other Unsuitable For Timber Production Prescriptions 2C2, 2C3,4A,4B,4C,4D,4F,8E4a,8E7	Prescriptions Suitable For Timber Production 5A,7A1,7B,7C,7E1,7F,7G,8E4b,13	Grand Total
Slaty Mtn			0	4,040	4,040
Snake Run Ridge			1,598	4,676	6,274
South Massanutten		11,544	155	9	11,708
St Mary's Add A			3,007	0	3,007
St Mary's Add B	271		1	0	272
St Mary's Add C		1,455	0	51	1,506
Three Sisters		7,404	2,055	3,565	13,024
Toms Knob			301	6,732	7,033
Walker Mtn			29	5,564	5,594
Warm Springs Mtn		3,005	69	4,755	7,829
Waterfall Mtn		3,287	181	2,871	6,340
West Back Creek			1,019	6,937	7,956
Whites Peak		4,297	0	316	4,613
Wildcat Ridge			7,347	1,169	8,516
All VMT	27,252	192,286	123,624	273,723	616,885

PW-32: The Forest Service should improve its analysis of alternatives regarding the issue of wilderness.

Comments were received from individuals, groups and organizations with regards to deficiencies and additional information to consider in the wilderness evaluations and analysis of the alternatives. The wilderness evaluations were revisited as a result of these comments, and the analysis was updated in the Final EIS.

PW-33: The Forest Service should modify forest plan direction for Recommended Wilderness Study areas.

Additional direction has been added for management of Recommended Wilderness Study areas.

PW-34: The Forest Service should manage wilderness to limit motor traffic, not maintain wildlife openings, and prohibit timber harvest.

Motorized and mechanized equipment, maintenance of wildlife openings and timber harvesting are prohibited in Wilderness. This is standard management direction for wilderness as required by law.

One comment poses the question whether viewsheds from Wilderness should be available for wind. The Forest Plan does not restrict industrial wind energy development based solely on visibility from a designated Wilderness. The potential impacts of industrial wind energy development on designated Wilderness(es), including the area visible from trails and known viewpoints or overlooks, would be considered during project-level NEPA analysis.

RECREATION

R-1: The Forest Service should maintain the current level of ATV trails and roads.

We received comments both in favor of developing more ATV trails as well as opposed. Those opposing it cited noise, environmental and scenic degradation, availability of non-public land for this activity, and the need for Americans to get more exercise through hiking and mountain biking. The alternatives included a range from no change in miles of ATV trail (Alternatives B, C and E) to an increase of up to 60% (Alternative D). The final selected Alternative I provides for no new designated ATV areas, but allows for expanding the existing ATV trail systems within their designated areas. Any proposed expansion would require project-level NEPA that would consider the potential environmental, social and economic effects of the proposal. The Archer Run trail system identified in the 1993 plan will not be developed.

R-2: The Forest Service should increase monitoring of illegal ATV use and not increase ATV use.

Monitoring of illegal ATV use is included in the monitoring plan in Chapter 5 of the Forest Plan.

R-3: The Forest Service should increase roads available for ATV use.

Comments in favor of increasing ATV trails and roads cited local economic benefits, the need for single-track trails that aren't currently offered on the GWNF, and the seemingly obvious solution of converting closed roads into motorized recreation trails. The current ATV trail systems fall short of the desired opportunities that we would like to provide. While progress has been made in improving our ATV trails through grants obtained, there is room for improvement. We would like to provide the types and quality of trails desired including single track trails and a range of difficulty levels with beginner level being separated from the moderate and difficult loops. It is because the existing trails were converted from old closed roads not sited or designed for ATV use that there are deficiencies in the quality of the riding opportunity currently offered. Some of those converted roads were constructed to be temporary roads and are not environmentally sustainable for long-term motorized uses. It is for these reasons that the selected alternative allows for expansion of existing trail systems to improve the ATV and motor-bike riding opportunities, but it does not provide for a broad brush approach of converting old roads or closed roads into motorized trails.

The Forest Plan provides for maintaining the existing motorized trail systems. Allowances are made for additional miles of trails within the ATV areas, but no new ATV areas are proposed. The Archer Run trail system identified in the 1993 plan will not be developed, since ATV trail systems require a high level of design and maintenance to remain sustainable. In addition, the potential for impacts to soil and water quality are high as are impacts of noise and disturbance to wildlife.

R-4: The Forest Service should open up areas for the use of ATVs during hunting season.

The context of this comment pertains to providing a special recreation permit to seniors during hunting season. Under the Travel Management Rule, use inconsistent with designations shown on the motor vehicle use map is prohibited unless exempted. Programs that grant exceptions to prohibitions in favor of one group of recreationists raise significant program, policy and legal concerns. Roads that are closed seasonally or year round are done so for specific reasons. The impact to the resource by the vehicle is the same regardless of the age of the operator.

ATVs are only authorized for use on the designated ATV trail systems. ATV trail systems need to be designed and maintained to prevent soil and water quality impacts. We have many roads open for access during hunting season and many areas where hunters and park and camp. We believe that these provide access even for hunters whose ability to hike is limited.

R-5: The Forest Service should work more closely with 4WD user groups.

We agree. Forest Service policy identifies motorized uses, including ATV and OHV riding, as legitimate uses of the national forest. There is room for improvement in the collaboration between the GWNF and the ATV and OHV users. We hope to work closely with all user groups in implementing the revised Forest Plan.

R-6: The Forest Service should not increase motorized use for ATV or OHV.

The Forest Plan provides for maintaining the existing motorized trail systems. Allowances are made for additional miles of trails within the ATV areas, but no new ATV areas are proposed and the Archer Run trail system identified in the 1993 plan will not be developed.

R-7: The Forest Service should not reduce motorized use for ATV or OHV.

The comment received includes a recommendation that roads closed for environmental, financial or other reasons be converted to use by off road vehicles. Continued motorized use on roads that were closed due to cost of maintenance or environmental impacts will continue to have those same issues. The Forest Plan provides for maintaining the existing motorized trail systems. Allowances are made for additional miles of trails within the ATV areas, but no new ATV areas are proposed and the Archer Run trail system identified in the 1993 plan will not be developed.

R-8: The Forest Service should not allow ATV use on the Forest.

The comment letter states that this recreational activity should be provided by the private sector. To date, the private sector has not provided for this activity in any significant way. Forest Service national policy is that motorized trails are legitimate uses of the national forests. The comment adds that the costs are disproportionately high and the use is apparently highly subsidized. The cost of maintaining motorized trail miles is higher than non-motorized trail miles. However, there are 65 miles of trail available for motorized use compared to 1,013 miles of trail available for non-motorized use. The limited miles of ATV trails on the forest, combined with the special recreation permit fees paid by users, keep the use of appropriated funding to a reasonable level forestwide.

We believe that ATV use of the Forest is appropriate in areas where the use can be regulated. The existing ATV use areas will continue to be managed and monitored for ATV use.

R-9: The Forest Service should maintain the current system of featured OHV roads.

Three of the OHV roads featured in the 1993 Forest Plan have been closed due to flood damage or unacceptable levels of resource damage. Now we have the Motor Vehicle Use Maps that identify the roads open and seasonally open on the Forest. We have about 600 miles of road on the Forest that are managed as Maintenance Level 2-High Clearance and are open seasonally or year round. We believe that we will be able to maintain a level similar to this into the future without identifying a network of specific roads that could change.

R-10: The Forest Service should increase open roads suitable for OHV use.

The primary statement in the letter with regards to this comment was that the FS should not require an open designation for legal use of OHVs. The Travel Management Final Rule published in the Federal Register on November 9, 2005, and the Code of Federal Regulations, Title 36, Part 212 require that each national forest or ranger district designate those roads, trails and areas open to motor vehicles, that the designation include class of vehicle and, if appropriate, time of year a route is open to motor vehicle use; that the public be allowed to participate in this designation; provides general criteria for designation pertaining to protection of natural and cultural resources, public safety, access needs, conflicts among uses, provision of recreation, and need for maintenance; and that these designations be published on a motor vehicle use map made available to the public.

We currently have about 1,000 miles of road open or seasonally open on the Forest. Given resource impacts from roads (on water quality, soil erosion, wildlife disturbance), the cost to maintain roads and limited budgets, we do not believe that we will be able to increase the miles of open road on the Forest. In fact, it is likely that more roads that are open year round will be managed as seasonally open in the future. However, we will strive to maintain the best access we can in a sustainable manner.

R-11: The Forest Service should have less ATV and OHV use.

Comments were received both in favor of and opposed to increasing areas and/or miles available for ATV and OHV use. Several letters were received that described the difficulty OHV users experienced in their attempts to work with local district offices to establish the type of OHV opportunities desired. Others stated that no provision should be made on the forest for ATV and OHV riding due to environmental concerns and impacts of noise on other recreationists. The final selected alternative provides for continued use of existing, designated ATV/OHV areas, including maintaining, improving and expanding the trail systems within the areas as needed to meet demand to the extent feasible; but no new ATV areas are proposed and the Archer Run trail system identified in the 1993 plan will not be developed. In addition, outside of the designated ATV/OHV areas, high clearance roads will remain available at current levels (over 1,000 miles), but there will not be featured or designated OHV routes on the forest.

R-12: The Forest Service should incorporate direction to allow continued use of motorcycles.

The use of motorcycles will continue to be allowed on all open roads (for street legal motorcycles), and non-street legal motorbikes can be operated on the designated ATV trails. However, there are currently no single track trails on the GWNF. The ATV Use Areas, management prescription 7C, includes a standard to construct trail and road systems that include both single track, narrow trails for the motorcycle and ATV user as well as roads that may be used for larger 4-wheel drive vehicles and for timber removal.

R-13: The Forest Service should identify the need to provide a primitive recreation experience in part of the Forest.

A primitive recreation setting, according to the Forest Service Recreation Opportunity Setting guidance, is an area at least 5,000 acres in size that is more than 3 miles from a road. We have no areas on the Forest that meet this definition. The only way that a primitive opportunity could be provided would be to close some major access roads on the Forest. Given the high level of concern for access to the Forest, this level of road closure would meet with significant opposition and not be supported by local communities. Alternative C provides the most remote settings, but even it is unable to provide a true primitive opportunity. The selected alternative does provide for a concentration of remote settings in the Shenandoah Mountain area. We do agree that large areas that provide solitude are important and our Recommended Wilderness Study Areas and Recommended National Scenic Areas recommendations were made to keep large areas in remote conditions.

R-14: The Forest Service should adopt ROS classes as in the Jefferson and the current GW plan.

We used the ROS inventory to assist in making land allocation decisions for each alternative. Rather than adopting a ROS class in the plan, the management prescription area direction determines how the area will be managed with respect to the Recreation Opportunity Setting. The analysis in EIS Chapter 3 identifies the amount of land that will or will not be managed to maintain current levels of each ROS class. Semi-primitive settings are not as extensive on the Jefferson, so the Jefferson Forest Plan used a different approach.

R-15: The Forest Service should increase the amount of the forest managed for remote settings in core areas.

As documented in EIS Chapter 3, about 85 to 90 percent of the inventoried SPNM areas are allocated to prescriptions that will assure that these conditions will be retained. However, it is likely that even more will be retained. The 1993 plan adopted SPNM settings for 150,000 acres of land, yet the recent inventory of current settings shows that 198,000 acres of land meet the definition of SPNM.

The final plan identifies and provides for recreation in remote settings where users can find solitude and will need to rely on their own skills and abilities. This type of setting and opportunity is provided in designated Wilderness, Recommended Wilderness Study areas, Remote Backcountry management prescription areas and, to a somewhat lesser degree, in Dispersed Recreation management prescription areas. Although not necessarily by design, this type of setting can also be found within the Special Biological Areas and many areas within the mosaics of wildlife habitat.

R-16: The Forest Service should allow timber cutting for early successional habitat in Remote Backcountry Areas.

From an ecological standpoint, timber harvest in Remote Backcountry Areas would be an important benefit to a number of species. However, the majority of Remote Backcountry areas are Inventoried Roadless Areas. While habitat management is not restricted in IRAs, harvesting timber and constructing roads is prohibited (with limited exceptions) by standards in the Revised Plan and the 2001 Roadless Areas Conservation Rule. For those Remote Backcountry areas not within IRAs, timber harvest requires road access and these areas are established to emphasize their remote settings, so timber harvest is not allowed. However, to provide for habitat improvement, prescribed fire is allowed in these areas. Wildlife openings and old field habitats can be maintained to the extent that no new road construction is required.

R-17: The Forest Service should enhance management to encourage tourism.

We agree with comments to enhance tourism opportunities and this was an important consideration in the design and selection of the alternatives.

R-18: The Forest Service should increase recreation opportunities.

The final Forest Plan was established to provide a diverse set of recreation opportunities and to increase a number of these opportunities. However, it needs to be done in a financially sustainable manner.

R-19: The Forest Service should develop strategies to address increasing recreation demands and education.

The final Forest Plan was established to provide a diverse set of recreation opportunities and to increase a number of these opportunities. In regard to education, we agree that increasing outdoor and environmental education opportunities is important, but these types of activities are not part of the Forest Plan decision making process.

R-20: The Forest Service should better address the issues associated with developed recreation.

Developed recreation was not included as a significant issue in the EIS. Providing developed recreation opportunities continues to be a very important component of managing recreation use on the Forest. However, given past and expected budgets, we do not see realistic opportunities for significant expansion of our developed recreation facilities. Maintaining the existing level of developed recreation and focusing more of our attention on dispersed recreation also fits in better with our role in providing recreation opportunities. The scoping process did not identify a need to address a wide range of options to address developed recreation. The only alternative that is substantially different is Alternative A. This alternative was developed when there was more emphasis on developing future desired conditions that were not constrained by budget expectations. They were based on assumptions that the Forest should play a greater role in providing developed recreation opportunities, so it represents a much greater emphasis on facility construction.

R-21: The Forest Service should manage recreation areas to minimize impacts on wildlife species.

We agree with the emphasis on promoting bear safety measures in our campgrounds and that, in general, we highlight safety concerns with wildlife. However, specifying certain signs and methods of promoting safety is beyond the scope of decisions to be made in a Forest Plan.

R-22: The Forest Service should not allow prescribed fire and timber harvest in dispersed recreation areas.

The high use areas are identified as developed recreation areas. Around some of our developed recreation sites we have allocated lands to Dispersed Recreation and in some of these areas timber management and prescribed fire use are allowed. These activities would be allowed where their use can enhance the recreation experience and would only be implemented if they could be done safely and with minimal impact on users.

R-23: The Forest Service should protect the Great Eastern Trail corridor and other trail corridors from development.

The Appalachian National Scenic Trail is the only trail that has a corridor established as a management prescription area. Other trails were included in the development of scenic objectives and these objectives can limit activities that would adversely affect the trail users or the trail environment.

R-24: The Forest Service should make some minor modifications in management of the AT.

The Forest Plan identifies that Scenic corridors, like the one adjacent to Mt. Pleasant, will be unsuitable for wind development. The Plan also added a standard regarding commercial events.

R-25: The Forest Service should increase trails.

The Forest Plan allows for additional trail construction, but no net increase in trail maintenance costs. In regard to the comments on a cap of 30 miles of trail construction, this is not a limit; it was just an estimate of how much trail construction might occur so that environmental effects could be estimated.

R-26: The Forest Service should adopt additional standards for trail construction.

We have a number of guidance documents such as the Trail Management Handbook that provide direction on trail construction. The Forest Plan contains a forestwide standard that new trail construction and reconstruction will be physically and environmentally sustainable, however, the Plan does not include new standards that address how this is to be achieved specifically.

R-27: The Forest Service should better address the effects of management on bike use.

The reason bicycles and motorcycles were considered together in the wilderness analysis reflects that wilderness designation would restrict any mechanized use of trails. There are many opportunities on the Forest for backcountry trail use by bicycles. These trails and trail systems vary by recreation opportunity settings, challenge level and distance or scale.

R-28: The Forest Service should increase horse trails, ATV trails, and primitive camping areas.

The Forest Plan does allow for more horse trails as long as trail maintenance costs can be kept at current levels. It also allows for some increase in ATV trails, as long as they are within the existing ATV Use Areas. There are extensive primitive camping opportunities on the Forest.

R-29: The Forest Service should consider management actions in relation to the Blue Ridge Parkway.

We agree. The Blue Ridge Parkway corridor has its own management prescription with desired conditions, standards and scenery integrity objectives.

ROADS

RO-1: The Forest Service should improve its analysis of road access needs.

A statement has been added to the roads discussion in Chapter 3 of the Final EIS indicating that there may be additional road decommissioning in Alternative C. The road access needs for each alternative are displayed in Table 3C8-1. This table has been updated in the Final EIS. Table 3C8-4 has been added to provide estimates of the miles of closed and open roads in each alternative.

RO-2: The Forest Service should not construct more roads.

The Forest Plan anticipates the need to construct up to about 15 miles of new permanent roads during the next 10 years to meet the needs of vegetation management and recreation. It also anticipates the closure of about 160 miles of existing roads for a net decrease in roads.

RO-3: The Forest Service should not build any more logging roads.

The Forest Plan anticipates the need to construct up to about 15 miles of new permanent roads during the next 10 years to meet the needs of vegetation management and recreation. Some of these roads will be for timber harvest. This harvest is needed to increase openings and open woodland conditions on the Forest for many species that need this type of habitat. While timber harvest activities are concentrated in areas that already have substantial road systems in place, some additional sections of road will need to be constructed. In addition, temporary roads will also be needed to access log landings in timber sale areas.

RO-4: The Forest Service should minimize road construction.

The Forest Plan anticipates the need to construct up to about 15 miles of new permanent roads during the next 10 years to meet the needs of vegetation management and recreation. It also anticipates the closure of about 160 miles of existing roads for a net decrease in roads. Most of the new roads would be closed after their use. The spread of invasive species is a concern and we have developed strategies to reduce the impacts.

RO-5: The Forest Service should limit road access.

The Forest Plan anticipates the need to construct up to about 15 miles of new permanent roads during the next 10 years to meet the needs of vegetation management and recreation. It also anticipates the closure of about 160 miles of existing roads for a net decrease in roads. Most of the new roads would be closed after their use.

RO-6: The Forest Service should have no net increase in open road miles and decommission roads.

The objective for no net increase in open roads and the objective for decommissioning existing roads remains in the final Forest Plan.

R0-7: The Forest Service should decommission roads.

We agree, the Forest Plan has an objective to decommission about 100 to 200 miles of road in the next decade.

RO-8: The Forest Service should consider the benefits of closing roads.

We have considered the benefits of closing roads and this is the reason for the objective to decommission about 100 to 200 miles of road in the next decade.

RO-9: The Forest Service should decommission more than 160 miles of roads.

We have reviewed the objective for road decommissioning and given concern about reducing access to the Forest and expected opportunities and funding, we believe that 160 miles is an appropriate objective.

RO-10: The Forest Service should not limit the amount of road closures.

There is not a limit on the amount of road closures. The objective is an estimate of what will be accomplished.

RO-11: The Forest Service should limit permanent roads to the support of ongoing ESH habitat development.

The estimate of additional road construction needs under the Forest Plan assumes that most of the additional construction would be for vegetation management activities that would enhance early successional habitat.

RO-12: The Forest Service should turn any closed roads into trails for bikes or ATVs.

When site-specific decisions are made to close a road, the ultimate use of the old road will be addressed. Often these roads can be used as trails. The trail could be used for ATVs only if the closed road were located within one of the ATV use areas.

RO-13: The Forest Service should reduce the road network and use closed roads for non-motorized trails.

The Forest Plan anticipates the need to construct up to about 15 miles of new permanent roads during the next 10 years to meet the needs of vegetation management and recreation. It also anticipates the closure of about 160 miles of existing roads for a net decrease in roads. When site-specific decisions are made to close a road, the ultimate use of the old road will be addressed. Often these roads can be used as trails.

RO-14: The Forest Service should use closed roads as linear wildlife openings.

When site-specific decisions are made to close a road, the ultimate use of the old road will be addressed. Often these roads can be used as linear wildlife openings on either a temporary or permanently maintained basis.

RO-15: The Forest Service should coordinate any road decommissioning with state game agencies to minimize impacts to hunters.

Any decisions to close specific roads would be accompanied by a site-specific environmental analysis. The state game agencies, as well as the public, would be asked to provide input to the analysis.

RO-16: The Forest Service should adjust its minimum roads analysis to recognize increased demand.

The minimum roads analysis does consider increased demands for use, but is also constrained by expected budgets for road maintenance and the potential impacts on other resources like water quality if roads are not properly maintained. The increasing demands to maintain the roads along with expected budgets resulted in the conclusion that the minimum road system needed to manage the Forest includes fewer roads than currently exist.

RO-17: The Forest Service should not limit access through road decommissioning.

Implementation of the road objectives in the Forest Plan would result in fewer miles of roads. However, the roads analysis that informed the Forest Plan direction identified predominantly roads that are already closed to public use for decommissioning. While some roads currently available for public use may be closed, we will try to keep these to a minimum.

RO-18: The Forest Service should not reduce road access.

The Forest Plan anticipates the need to construct up to about 15 miles of new permanent roads during the next 10 years to meet the needs of vegetation management and recreation. It also anticipates the closure of about 160 miles of existing roads for a net decrease in roads. The roads analysis does consider increased demands for use, but is also constrained by expected budgets for road maintenance and the potential impacts on other resources like water quality if roads are not properly maintained. The increasing demands to maintain the roads along with expected budgets resulted in the conclusion that the minimum road system needed to manage the Forest includes fewer roads than currently exist. However, the roads analysis that informed the Forest Plan direction identified predominantly roads that are already closed to public use for decommissioning. While some roads currently available for public use may be closed, we will try to keep these to a minimum.

RO-19: The Forest Service should make all existing roads available for use.

Roads are closed for a variety of reasons including preventing soil erosion, preventing stream sedimentation, avoiding impacts to wildlife (such as turkey during nesting season), and preventing road maintenance hazards in bad weather.

RO-20: The Forest Service should coordinate seasonal road closures with user groups.

Any decisions to permanently change road access are based on site-specific environmental analyses that include opportunities for public involvement.

RO-21: The Forest Service should examine the timing of seasonal road closures.

The exact dates of seasonal closures are based on a variety of factors including weather conditions, wildlife needs, and user needs. These dates are not defined in the Forest Plan.

RO-22: The Forest Service should utilize seasonal road closure to protect wildlife.

We agree.

RO-23: The Forest Service should relocate roads in poor locations.

We agree and some of the miles of road construction would likely be due to relocation.

RO-24: The Forest Service should maintain roads for other activities.

We agree. There are many factors to consider in every decision regarding road construction, seasons of operation and decommissioning.

SOILS

S-1: The Forest Service should assure that there will be no permanent impairment of the productivity of the land.

Please refer to the Final Environmental Impact Statement, Chapter 3 Section A4-Soils. We identify soil productivity as the most important soil resource issue. We describe the possible impacts to soil productivity, the estimated areal extent and what the estimated percent of the Forest will be impacted for each alternative proposed. Estimated cumulative effects to soil productivity can be viewed in this Chapter as well. We have not said that we "will not remove timber from soils of low productivity", as stated in the comment. We will not remove harvest residue from soils of low productivity as in small diameter utilization. We will use geology, elevation and acid deposition data for broad scale assessment and at the project level we will use soil and site index to further refine the analysis. Many soils with low productivity and at risk of nutrient depletion are on upper slopes and ridges with sandstone and shale geology, higher elevations and are influenced by acid deposition due to low buffering capacity. Effects to soil productivity are assessed at the project level by determining activity areas where soils are most likely to be impacted and then estimating the areal extent of long term impacts. A percentage of the area impacted is estimated for the proposed project and also cumulative effects are estimated for the project area. We feel the EIS (FEIS Chapt. 3 Section A4) uses sufficient information to assess estimated impacts to soil productivity and the Plan contains adequate direction to protect soil and water resources.

S-2: The Forest Service should meet state regulations on erosion control and soil contamination.
The Forest Plan in Chapter 4, Forestwide Standards, states that we will follow state forestry best management practices and state erosion and sediment control handbooks and regulations. Timber harvesting is exempt from Virginia's erosion and sediment control regulations (Virginia Code Section 10.1-560, Exemptions to Land Disturbing Activity) as long as the land is regenerated with trees after harvest, which we do. In West Virginia the use of BMPs for erosion and sediment control is voluntary. The forestry best management practices are required in West Virginia and for us to implement on all timber harvest projects and are designed to control erosion on these site. All other projects disturbing more than 10,000 ft^2 will follow local and state erosion and sediment regulations. All soils/sites suspected of contamination will be evaluated and treated according to state and federal regulations as a standard operating procedure.

S-3: The Forest Service should manage in recognition of the impacts of acid rain on soils.
The Forest has used geology, elevation, water chemistry and acid deposition spatial data to produce mapping of broad areas at greatest risk to becoming increasingly acidic, having greater amounts of aluminum in rooting zones, and being stressed due to losses of beneficial plant-available soil nutrients. At the project level we assess soil and site index information. We do not allow removal of below ground biomass on any soils. Small diameter utilization on low productivity sites is restricted.

S-4: The Forest Service should use soils information in determining where to manage timber.
The Forest uses current soil survey maps and information to evaluate project proposals. Assessments of where to manage for timber use access, site index, management prescription of an area and other values are used to determine suitability for timber production. Of course, site index of the trees should reflect the productivity of the soils. Demand for products and product types also play a role in where timber is managed.

SPECIAL BIOLOGICAL AREAS

SB-1: Comment supports Special Biological Area designations.
We have maintained these designations in the final Forest Plan and added some additional areas.

SB-2: The Forest Service should create Special Biological Areas or other protective allocation to all areas identified by the state natural heritage programs.
The Forest Plan does create Special Biological Areas or other protective allocations for most of the areas identified by the state natural heritage programs. Special Biological Areas, including protection for the Cow Knob salamander in a number of management areas, increased from the current level of 54 areas (90,000 acres) to 120 areas (121,000 acres) in the revised plan. A few areas were identified by the state due solely to the presence of species, although the community itself is not rare. We utilize Special Biological Areas for rare communities; we can use other management tools to protect individual species that are not confined to rare communities. These areas identified by the State that were not used as Special Biological Areas include Paddy Run, Great North Mountain Forests, Lower Scotchtown Draft, Mountain Grove, Route 609 Roadbanks, Warwick Mountain, and Wilson Mountain North. There were some boundary adjustments made to the State recommendations on some of the other areas, but they were incorporated into Special Biological Areas or other protective prescriptions.

SB-3: The Forest Service should update its treatment of Special Biological Areas.
The Forest Plan does have an objective to develop specific strategies for each Special Biological Area. For those SBAs, the Key Natural Heritage Communities, and portions of the Shenandoah Crest that are in Inventoried Roadless Areas, standards have been added to manage the areas with appropriate restrictions on timber harvest and road construction.

SB-4: The Forest Service should develop better direction in Special Biological Areas to protect the habitat values.
The Special Biological Areas, key natural heritage community areas, and Shenandoah Crest areas in the final Forest Plan are unsuitable for timber harvest, allow vegetation management only if compatible with the needs of the rare community, and only allow road construction under limited circumstances. The tiger salamander habitat is now in Special Biological Areas.

SB-5: The Forest Service should provide better management direction for activities allowed in Special Biological Areas.
The Forest Plan does provide management direction for activities in Special Biological Areas and this direction has been updated in the final Forest Plan.

SB-6: The Forest Service should create management direction for each special biological area.
The Forest Plan does have an objective to develop specific strategies for each Special Biological Area.

SB-7: The Forest Service should make provisions for any new Special Biological Areas as they are identified.
The Forest Plan can be amended as new information is found about rare communities.

SB-8: The Forest Service should designate more Special Biological Areas.
More areas were identified in the final Forest Plan.

SB-9: The Forest Service should create a Special Biological Area for the wood turtle.
The wood turtle is not restricted to any rare community and Special Biological Areas are established to protect rare communities. The Forest Plan does contain specific guidance for managing the wood turtle. The status of the wood turtle has been upgraded, but the designation of sensitive species is made through a process outside the planning process. Regardless of its status as sensitive, habitat for the wood turtle was addressed in the Forest Plan.

SB-10: The Forest Service should designate shale barrens and certain wetlands as Special Biological Areas.
Shale barrens and wetlands that support populations of Threatened and Endangered Species are all identified as Special Biological Areas, or more restrictive allocations.

SB-10: The Forest Service should not include so much suitable land in special biological and geologic areas.
We examine each of the Special Biological Areas very carefully when allocating Special Biological Areas and consider the needs of the natural community and other needs in the area. This consideration is what results in some areas recommended by the State being adjusted.

SB-11: The Forest Service should expand the Special Biological Area along the Coal Road.
We greatly expanded the Special Biological Area at the Coal Road in the Draft Forest Plan and this has been retained.

SCIENCE

SC-1: The Forest Service should recognize the importance of using science in its decision-making.
We utilized the science in analyzing the options available for management and in choosing the land allocations and management direction. Examples of current science used in our analysis include the LANDFIRE ecological analysis, recent models of the ecological systems on the GWNF, and the Template for Assessing Climate Change Impacts and Management Options.

TIMBER

T-1 & T-2 & T-3: The Forest Service should harvest timber at the level in the Alternative G. The Forest Service should harvest timber at the level in the stakeholder's agreement. The Forest Service should increase the level of timber harvest.

Forest Plan Objective OBJ TIM-1 identifies a desire to harvest timber an average of 1,800 to 3,000 acres per year over the next decade. The lower range of this objective represents an increase over the current actual timber harvest program. The upper end of this range represents a slight increase over the harvest levels identified in the current Forest Plan. This is the level described for Alternative G (and for the selected alternative) and is within the scope of levels supported by many involved in the stakeholder's agreement. It should be noted that "the various stakeholders could not come to agreement on the desired level of timber harvest" but support varying ranges of timber harvest. The FEIS examined alternatives that harvested annual averages from 0 to 5,000 acres. However, we do not believe an average annual timber harvest objective beyond 3,000 acres is reasonably attainable. Table 3C6-5 of the FEIS indicates the highest annual acreage harvested since 1993 has been 3,300 acres and only twice did we achieve more than 3,000 acres. An average of the 10 highest acreages harvested since 1993 results in just over 2,000 acres annually. We simply do not envision an annual average of acres harvested over the next decade above 3,000 acres as reasonably attainable.

T-4: The Forest Service should show how it could increase timber harvest, since it has not been able to meet the objectives of the current plan.

The forest has harvested slightly more than 3,000 acres in a given year twice since 1993 (Table 3C6-5 of the FEIS). An average of the 10 highest acreages harvested since 1993 results in just over 2,000 acres annually. We have demonstrated that an objective of 1,800 to 3,000 acres per year is possible. Certainly decreased budgets and staffing will provide a significant challenge to achieving this objective in the future. However, through increased partnerships and cooperation with various State agencies, Non-Governmental Organizations, and other stakeholders, we believe timber harvesting on the Forest can be more efficient and it is possible that we can achieve the stated objective despite the budgetary and staffing challenges.

T-5: The Forest Service should increase harvest of timber by small-scale local firewood vendors.

We agree. The Final Plan now includes recognition of the role that small-scale firewood vendors can play in achieving silvicultural objectives such as thinning. A statement of this recognition has been added to the Management Approach for Timber Management in Chapter 3 of the Forest Plan. Appendix B of the FEIS describes the analysis process and indicates that thinning silvicultural prescriptions were constrained to be between 200 and 400 acres annually. In other words, the Spectrum model "forced" a scenario that would thin at least 200 acres annually which is slightly higher than the current 3 year average of actual acres thinned. Table 3C6-14 of the FEIS indicates that as many as 400 acres per year may be thinned over the next decade. Much of this thinning would be ideally suited to the small-scale local firewood vendor.

T-6 & T-7: The Forest Service should increase the level of clearcutting. The Forest Service should only use clearcutting in extreme circumstances.

The creation of wildlife habitat is a primary purpose of timber harvesting in addition to the production of wood and fiber for society. Silvicultural practices (e.g. the choice of cutting method) are very often tailored to achieve a desired wildlife habitat condition. When we compare Tables 3C6-5 and 3C6-14 of the FEIS we see that the current 3 year average annual clearcut harvest is about 60 acres and the projected clearcut harvest would be roughly 90 acres per year over the next decade. However, much of this increase in the clearcut harvest method results from the overall increase of harvesting projected; the percentage of clearcut acres would drop from 8.5% to 2.6% of the total annually harvested acres.

It is also important to note that the concept of any given acre providing only one habitat component is no longer strictly valid. For instance, Oak Forests and Woodlands as described in Chapter 3 of the FEIS can provide both hard mast (traditionally attributed to mid-late successional forests) as well as herbaceous understories and browse habitat (traditional attributed to grass/forbs openings and early successional habitat, respectively). The projected increase in percent of open canopy Oak Forests and Woodlands from 2% currently to 12% at the end of the next decade indicates that we can achieve many of the positive habitat components formerly attributed to clearcutting and shelterwood with reserves harvest, while maintaining a mid-late successional partial canopy on the same acres (Table 3B1-1 of the FEIS). This shift in use of cutting method and habitat objective is also reflected in Table 3C6-14 of the FEIS with the increasing use of thinning, and shelterwood methods as well as Objective OBJ ESD-6 of the Forest Plan.

T-8 & T-9: The Forest Service should harvest less than Alternative G and should have additional standards. The Forest Service should harvest approximately 1,000 acres per year.

The FEIS examined alternatives that would harvest from 0 to 5,000 acres annually averaged over a ten year period. Alternatives C and F were constrained to harvest less acres than Alternative G. The lower bound of the range of harvest for Alternative F was 1,000 acres. Table 3C6-14 of the FEIS indicates that the annual harvest for both alternatives C and F were projected at 0 and 1,200 acres, respectively. Generally speaking, Alternatives C and F did not move toward the desired condition for important habitat conditions as well as the alternatives that harvested more acres (Table 3B1-1, FEIS). For instance, Alternative F is projected to provide only 2% in regenerating forests and 12% in open canopy forest in the Oak Forests and Woodlands, by far the dominant ecological system on this forest. This compared to Alternative G's and H's and I's 5% and 12%, respectively, for regenerating and open forest conditions. Meanwhile Alternative F provides slightly more mid-late successional forest than desired while Alternatives G, H, and I provide slightly less. For these reasons, harvest levels higher than current actual harvest levels and higher than 1,000 acres are favorable over the lower harvest levels assigned to Alternatives C and F.

We believe the standards that apply to timber harvesting are sufficient to protect various resources from adverse impacts. One should understand that the standards listed under Timber Management are not the only standards relating to timber harvesting. Soil, Water, and Scenery all contain forest-wide standards that relate to timber harvesting. In addition, several Management Prescriptions contain standards relating to timber harvesting that further protect various resources. Comments focused on standards pertaining to logging systems on "steep" slopes. The 35% slope designation for use of advanced logging systems in FW-125 of the Plan relates directly to Virginia Best Management Practices (BMPs, Virginia Best Management Practices, Fifth Edition, March 2011). Skidders are said to be "a flat ground system, but with winches can be can be effectively used on flat to moderate slopes" (page 32). Table 6 of the same document describes the slope component of the skidder's "niche" as <35%. Presumably, anything below a 35% slope is considered flat or moderate slope insofar as Virginia BMPs are concerned.

T-10: The Forest Service should only harvest timber if there are standards to assure sustainability and other resource protection.

A determination of sustained yield is required by law. As described in Appendix B of the FEIS, a Long Term Sustained Yield (LTSY) constraint is applied to the Spectrum model. The LTSY is computed for each alternative and is displayed in Table 3C6-10 of the FEIS. For the selected alternative the LTSY is computed at 6.4 MMCF per year and the Allowable Sale Quantity is computed at 5.5 MMCF per year. Therefore, LTSY is maintained. Please also see the response to Statement T-9 above for more discussion of standards that protect various resources. Finally, timber sale contract provisions provide for a determination and penalty for excessive or negligent damage incurred by the purchaser.

T-11: The Forest Service should harvest timber.

The Organic Act of 1897 created National Forests for the "purpose of securing favorable conditions of water flows, and to furnish a continuous supply of timber for the use and necessities of citizens of the United States". The selected alternative of the FEIS contributes to this purpose in many ways, including the harvest of timber on an estimated 34,000 acres over the next decade (Table 3C6-14, FEIS). The Forest Plan includes an Objective to harvest an average of from 1,800 to 3,000 acres annually over the next decade. Please see also the responses to Statements T-1, T-2, T-3, T-6, and T-7 above.

T-12 & T-13: Timber harvest is not important on the national forest. The Forest Service should not harvest timber.

A comparison of the ecological systems indicators in Table 3B1-1 of the FEIS for Alternative C (no harvest) versus any other alternative leads us to believe that timber harvest is important as a mechanism to create some wildlife habitat components. Commercial timber harvests allow us to create these habitat components in a cost effective manner. We acknowledge that the Forest does not play a critical role in the supply of wood products to the local market. Table 3C6-12 of the FEIS indicates that the ASQ under the selected alternative would only meet 22% of the market demand. Yet a vast majority of this volume on National Forest is greater than 19 inches in diameter and greater than 60 years old, resulting in the opportunity for this Forest to play a more important role in supplying large diameter high quality hardwood sawtimber. Please also see the response to Statement T-11 above.

T-14: The Forest Service should leave areas unharvested for carbon sequestration, protecting water quality and old growth.

Impacts to carbon sequestration are disclosed in Section A3 of Chapter 3 of the FEIS. While it is recognized that harvesting of old growth forests is not an effective carbon sequestration strategy, the overarching aspect in affecting carbon sequestration is that we keep forests as forests. All alternatives, including the selected alternative, do this. All alternatives increase the ability of the forest to sequester carbon while enhancing other ecosystem services that serve to create more resilient ecosystems. Approximately 60% of the Forest will be allocated to Management Prescriptions that do not allow harvesting (Forest Plan Appendix C). Increased riparian buffers are adopted in the selected alternative to help protect water quality (Forest Plan Appendix A). Approximately 428,000 acres of future old growth will be provided for in key management prescriptions that will provide most large blocks of old growth (Table 3B3-6).

T-15: The Forest Service should increase acreage of active timber management.

The selected alternative increases both the number of acres available for active timber management (suitable for timber harvest, Section C6 of the FEIS) and the upper bound of the range for timber harvesting (OBJ TIM-1) as compared to the current Forest Plan. While two other alternatives analyzed identified even more acres suitable for timber production, we believe the selected alternative provides adequate acres available for timber management to enable us to enhance and maintain resilient ecosystems and increase timber harvest levels. Please also see the response to Statements T-1, 2, and 3 above.

T-16: The Forest Service should reevaluate its identification of lands suitable for timber production.

The identification of lands suitable for timber production was reviewed between draft and final. Minor adjustments to acreage of suitable/unsuitable land were made due to mapping errors. Some comment concerns for "errors" in identification of lands suitable for timber production centered on Stage II analysis including costs and prices that factor into that analysis. The Stage II information was reviewed; however, no changes to lands suitable for timber production were necessary as a result of the Stage II analysis. In the final analysis, approximately 452,000 acres were determined to be suitable for timber production.

T-17: The Forest Service should reduce the area suitable for timber production.

Appendix B of the FEIS describes the process for determining lands unsuitable for timber production (FEIS, B-14 to 16). This process is mandated by law (16 USC 1604(k); 36 CFR 219.14) and is a fairly straightforward process. The acreage that is considered suitable for timber production is simply what is "left over" from the identification of unsuitable lands. It is not driven by the allowable sale quantity (ASQ). The largest factor influencing the amount of land suitable for timber production is the Stage III suitability analysis and the allocation of management prescriptions in various alternatives. The availability of Potential Wilderness Areas, designation of wider stream buffers, and allocation of new Special Biological Areas area all were accounted for in the analysis. Furthermore, sustainability is assured through the long term sustained yield constraint imposed during modeling exercises (see the response to Statement T-10 above). The alternatives examined resulted in from 0 to 495,000 acres suitable for timber production (FEIS Table 3C6-6). We believe the selected alternative is the best mix of multiple uses meeting the mission of the Forest Service, resulting in approximately 452,000 acres suitable for timber production. While it may be true that all of these acres are not needed to meet the ASQ, it does provide for flexibility in implementing habitat management and provide different habitats in the areas they may truly be needed.

T-18: The Forest Service should make it clear which areas are suitable for timber harvest.

The Forest Service has clearly described which areas are suitable/unsuitable for timber production as required by NFMA. Appendix B of the FEIS, Tables 3C6-2 and 3C6-6, Appendix C of the Forest Plan, and Table 3-6 and 3-7 of the Forest Plan all describe lands that are suitable/unsuitable for timber production. It is important to understand that suitability for timber production is ultimately a stand level determination as is made apparent by the discussion of the Stage I and III suitability discussion in Appendix C of the Forest Plan. For this reason, even in those Management Prescriptions identified as suitable for timber production in Table 3-5, portions of those Management Prescriptions remain unsuitable due to various stand characteristics such as site productivity, species composition, accessibility, slope, etc. Suitability is not strictly a function of Management

Prescription alone, however certain Management Prescriptions are deemed unsuitable for timber production in whole as a result of the Stage III analysis (Forest Plan, Appendix C).

T-19: The Forest Service should be cost effective in its timber program.

The Forest Service agrees and continually strives to improve the cost efficiency of the timber program. However, because we are managing public lands we must comply with several laws and regulations to ensure protection of the natural resources we manage as we plan and administer a timber program. However, we do recognize that through working with various partners and stakeholders in a collaborative approach to planning timber activities has the potential to reduce costs to some extent. Utilizing new authorities, such as Stewardship Authorities, may also increase the cost effectiveness of our timber program. We look forward to exploring these potentials as we implement the Revised Forest Plan.

T-20: The Forest Service should meet the ASQ to increase income.

The economic impacts of the alternatives analyzed are disclosed in Chapter 3 Section C12 of the FEIS. Table 3C12-21 of the FEIS indicates that the timber program under the selected alternative would result in approximately $3 million dollars of annual income in the first decade. This amount is a moderate amount as compared to the other alternatives, which range from 0 to $6 million. However, there are certainly challenges in meeting the ASQ as recent history has demonstrated (see also the response to Statement T-19 above). It is important to understand that the ASQ functions more as a "ceiling" for the timber program than as a "target attainment" goal. In the end, budget and staffing will limit what may actually occur. However, as discussed in the response to T-19 above, we foresee a potential to increase efficiency of the timber program and stretch our limited resources further.

T-21: The Forest Service should create brood habitat with timber sales.

The impacts of the alternatives analyzed on terrestrial habitat components and wildlife species can be found in Chapter 3 Section B2A of the FEIS, as well as Appendix E of the FEIS. The requirements for "brood range" differ somewhat depending upon the species. Generally speaking we understand this to include grassland habitat (turkey and ruffed grouse) and regenerating forested stands that contain a significant herbaceous component (ruffed grouse) (adapted after pages 3-190 through 198 of the FEIS). It is important to recognize that brood range can be created through several tools, including prescribed fire, mechanical methods, and not simply timber harvesting. Table 3B2-11 provides a summary of the project acres and percentages of various habitat types under each alternative analyzed. The selected alternative is projected to produce about 18,000 to 30,000 acres of early successional habitat from timber harvesting (some portion of which would serve as brood range for ruffed grouse). Another 6,700 acres of grassland/shrubland would also be maintained. The Forest Plan identifies objectives OBJ SPD-2 through SPD-5 to create habitat components that would serve as brood range. Certainly timber harvesting is expected to contribute significantly to these objectives.

T-22: The Forest Service should harvest timber and provide provisions for small game habitat.

The analysis of impacts to Demand Species can be found in Chapter B section 2C of the FEIS. Small game species discussed in detail here include wild turkey, ruffed grouse, bobwhite quail, and woodcock. Key habitat components for these species include the creation of early successional habitat through timber management, creation and maintenance of grass/shrub habitat, and/or creation of open woodland habitat. Table 3B1-1 displays the percentage of these habitat components by alternative within ecological systems at the end of the first decade. We expect to maintain or increase the percentage of these habitat components in the Oak Forests and Woodlands system, the largest component on this Forest. Small game habitat is expected to increase under the selected alternative. Objectives ESD-1 and ESD-6 of the Forest Plan support this conclusion. From 18,000 to 30,000 acres of regenerating forest are desired and 90,000 acres are desired in an open canopy condition.

T-23: The Forest Service should not rely on thinnings to improve wildlife habitat.

Timber Stand Improvement (TSI) thinnings are but one of many tools that integrate into a complete package that can benefit many species of wildlife. TSI alone is certainly not relied upon or emphasized to provide all habitat components. Forest Plan objectives OBJ SPD-1 through SPD-13 demonstrate an emphasis on early successional and grassland/shrubland habitat, while no mention of TSI is made. No other objectives in the Forest Plan relates to TSI. While it may be true that thinning does not create the herbaceous understory that some wildlife species prefer, TSI is utilized to manipulate tree species composition. Oak and other hard mast species are favored and released so that they may attain a dominant/codominant position in the canopy. Many species of wildlife depend upon hard mast production to thrive.

T-24: The Forest Service should assure adequate regeneration of desired species.

A finding that assures that lands can be adequately restocked is required by law (NFMA) for all proposals that involve vegetative manipulation. Forest-wide Standard FW-131 relates to this requirement and provides minimum, desired, and maximum levels of trees per acre needed to satisfy this requirement. Adequate natural regeneration of a majority of our ecological systems arises from three main sources; existing advanced regeneration (seedlings or seedling sprouts in the understory of sufficient size), viable seed stored in the soil litter layer, and stump sprouting. While stump sprouting is a common source of regeneration, especially on the dry and xeric oak found on lower productivity sites, it is not the only source. Further, cutting of low stumps forcing low origin sprouts greatly mitigates the incidence of rot in the resulting stem. While oak species do dominate much of our forests and provide a very valuable hard mast food resource for wildlife, we also recognize a need for diversity of species in regeneration, especially as we consider future episodes of gypsy moth defoliation (see FEIS Chapter 3, section B5). Unfortunately, on our most productive sites, oak regeneration is often outcompeted by yellow poplar. This can result in a loss of quality hard mast production on these productive sites. This is the concern that leads to the identification of a need for research in regenerating oak species on productive sites. There is little concern for difficulty in regeneration of oak species on moderate to lower site productivity lands.

T-25: The Forest Service should recognize that oak die back is the result of diminished nutrition.

Oak decline is discussed in Chapter 3 section B5 of the FEIS. Oak decline is indirectly related to site productivity. The ratio of site index, a measure of site productivity, to age is a useful indicator for the risk of oak decline. Less productive sites with older trees are at a higher risk of incidence of oak decline. However, low site productivity, or "diminished nutrition" is not the cause of oak decline. As described in the FEIS, oak decline is a complex native disease involving interactions between environmental and biological stresses and subsequent attacks by insects and pathogens of opportunity. Chapter 3, Section A4 of the FEIS discusses expected impacts to soil movement and nutrient cycling. It is important to note that soil is not lost, although it may move from one area to another. Thus, natural regeneration does not result in a "constant loss of soil". While harvesting may remove organic matter from the nutrient cycling system, the FEIS concludes "...research has shown that removal of the tree main stem alone will not reduce long-term soil productivity. Most tree nutrients are in smaller branches and leaves, which normally remain on site after a timber harvest. Short-term losses are made up by leaf fall, atmospheric additions and weathering of parent material."

T-26: The Forest Service should use selective cutting of mature trees.

"Selective cutting" is not an officially recognized harvest method in the Southern Region. However, group selection and single tree selection are accepted harvest methods for managing uneven-aged stands. Appendix C of the Forest Plan describes the conditions under which various harvest methods are Possible, Recommended, Recommended with Conditions, or Not Recommended and why. Group selection is either Possible or Recommended with Conditions except for the Southern Appalachian Montane Pine Forest and Woodland ecological system where it is Not Recommended. Single tree selection is predominantly Not Recommended except in the Central and Southern Appalachian Spruce-Fir Forest. The primary reason for not recommending the uneven-aged management harvest methods is related to the shade tolerance of many of the preferred species in our ecological systems. Many of those species that are most beneficial to wildlife species (e.g. hard and soft mast producers) are of moderate or lower shade tolerance. The uneven-aged harvest methods, especially the single tree selection method, are not favorable to the regeneration and perpetuation of these species. Some exceptions are the northern hardwood, white pine, and spruce-fir forest types; these types can benefit from uneven-aged management techniques.

The term “selective cutting” may also refer to partial harvests where varying amounts of residual trees are left to create a partial or open canopy structure. In this more generic sense, partial harvests are expected to be the predominant method of harvest under the revised Forest Plan. Table 3B1-1 of the FEIS displays the projected percentage of forests in an open canopy mid-late successional stage. Relatively large percentages of this open canopy condition are projected for many of the ecological systems and especially the most common systems found on this Forest. Harvesting, prescribed fire, or both are expected to be used to achieve this condition. The Forest Plan includes objectives ESD-1through ESD-6 for ecological diversity on. Objectives to create open canopy conditions on almost 90,000 acres are described.

T-27: The Forest Service should identify how much of the timber harvest is for saw logs and how much is for building board or paper.

Table 3C6-9 has been added to Section C6 of Chapter 3 of the FEIS to address this concern. Historically about 30% of the volume sold is sawtimber, 50% is pulpwood, and 20% is fuelwood. The fuelwood component is predominantly sold through personal use "dead and down" fuelwood permits.

T-28: The Forest Service should not manage for a mono-culture of oak.

Table 3B1-2 of the FEIS discloses that some 756,000 acres of the GWNF is comprised of Oak Forests and Woodlands. Oak species also occur as a component of a few other ecological systems. Oak is a very important vegetative component of our forests. The importance of the oak community types is reiterated on page 3-348 of the FEIS when we disclose that 77% of the forested acreage is of an oak type. While oak species do dominate much of our forests and provide a very valuable hard mast food resource for wildlife, we also recognize a need for diversity of species in regeneration, especially as we consider future episodes of gypsy moth defoliation (see FEIS Chapter 3 section B5). Some comments focused on a statement found in the DEIS on page 3-348: "...we attempt to salvage the dying trees prior to the oak losing their capability to stump sprout and regenerate the next stand to a desirable oak component to meet future conditions." This discussion does not portray an intention to create a "mono-culture" of oak, but a recognition that two major threats exist to this important community type. One of many viable strategies for perpetuating this resource that exists on a vast majority of the forest is to cut damaged trees in order to stimulate stump sprouting once gypsy moth defoliation has occurred or the early onset of oak decline is noted.

T-29: The Forest Service should correct the analysis for the allowable sale quantity.

Appendix B of the FEIS describes the process for determining the allowable sale quantity (ASQ). The ASQ is correct for the inputs into the Spectrum model as described in Appendix B. The discussion describes timber yields and addresses the focus of this comment. Only sawtimber and pulpwood volumes comprised the yield data that was input into the Spectrum model (B-21). Product smaller than 4" in diameter, the traditional merchantability limits for this Forest, were not modeled or included. Thus, small diameter utilization, what many people refer to as "biomass", did not contribute to the yield component or the computation of ASQ in any way. The discussion in Chapter 3 section C6 of the FEIS relating to the supply and demand comparison and small diameter utilization supports the comment that estimates of available wood biomass energy are not realistic: "This puts the almost 9 million ton figure identified as a maximum into perspective; it is probably not realistic."

T-30: The Forest Service erred in identifying past levels of timber harvest.

Table 3C6-5 of the FEIS displays the acres harvested by method of cut since 1993, the beginning of the last Forest Plan cycle. The GWNF has averaged 511 acres of regeneration harvest acres per year for the past 10 years. Table 3C6-13 of the FEIS identifies Alternative A as representing the 1993 Forest Plan as well as Alternative A1 as representing historic values. So the alternatives analyzed can be compared with both the 1993 Plan and actual historic harvest levels.

T-31: The Forest Service should improve the analysis of forest health.

The Forest Health discussion focuses on non-native invasive plants, insects, diseases, and other organisms that influence the health of our forested ecosystems. We agree that there are many other aspects of forest health and these are addressed under various other headings in the FEIS. A statement has been added to the introductory discussion of Forest Health in the FEIS that directs the reader to the Ecological Systems section of Chapter 3 of the FEIS to find discussions on many of these other aspects (page 3-257).

T-32: The Forest Service should not identify any areas harvested since the 1960s for Recommended Wilderness Study or other allocations unsuitable for timber management.

The alternatives analyzed in detail include a wide range of 1.1 million to 618,000 acres designated as unsuitable for timber production. However, all alternatives necessarily include some areas that have been harvested in the 1960s in unsuitable designations. Some older harvest units currently exist within already Congressionally Designated areas (Mount Pleasant National Scenic Area). Others occur within inventoried Roadless Areas or Special Biological Areas. Agency policies result in these areas being designated as unsuitable under Stage III suitability analysis as described by the National Forest Management Act. The decision on how to manage Potential Wilderness Areas (that were not Recommended for Wilderness Study) incorporated past investments in the areas through timber harvest history, usually occurring along existing roads. This resulted in 23% percent of the PWAs (that are not Inventoried Roadless Areas) being allocated to management prescriptions suitable for timber management. The selected alternative does increase the acres suitable for timber production as compared to the 1993 GWNF Forest Plan. We believe the selected alternative provides adequate acres available for timber management to enable us to enhance and maintain resilient ecosystems and increase timber harvest levels.

TROUT

TR-1: The Forest Service should use trout as an indicator species.
Wild brook trout are listed as a Management Indicator Species in Section B2E of the FEIS, and FEIS Table 3B2-16. There is an extensive discussion on brook trout in the FEIS and in the Aquatic Ecological Sustainability Report (Appendix G).

TR-2: The Forest Service should provide management direction to improve habitat for trout.
Management direction for trout is generally provided in the riparian corridor management prescription (Rx 11) on Forest Plan. Specific direction for trout is found in Standard 11-010: In cold water stream habitat, activities that unfavorably affect trout spawning should be avoided from October 1 to April 1 in brook trout and brown trout streams and/or March 15 to May 15 in rainbow trout streams. Any necessary in-stream disturbance activities within these time limits must have consultation with state and Forest biologists; and Standard 11-057: Impoundments will generally be designed to allow complete draining, with minimum flows, cold-water releases, and re-aeration in trout waters and other specific waters when needed. Furthermore, discussion regarding chemical mitigation from impacts such as acid deposition, strategies in light of climate change, and working with partners to maintain instream habitat are included in the FEIS pages 3-246, 3-84, and 3-241 respectively.

UTILITIES

U-1: The Forest Service should use utility corridors to provide wildlife habitat.
We agree and include open sections of utility corridors in our estimates of shrubland habitat.

U-2: The Forest Service should expand current utility corridors to allow for additional corridors.
The Forest Plan does expand most of the existing utility corridors to 500 feet in width to allow opportunities for potential expansion. These are the corridors that we are identifying for potential future energy needs.

U-3: The Forest Service should address energy transmission rights of way.
Rights of way for utility transmission are considered a special use and addressed in the special use sections of the EIS and Forest Plan.

VISUAL RESOURCES

V-1: The Forest Service should better address scenic resources.
Protection of the scenic values of the GWNF has been a high priority for many years. Because of this priority we did not expect that the alternatives would vary substantially in how they would address scenery management. In the course of preparing the management prescriptions we relied heavily on the prescriptions used in the Jefferson Forest Plan. When we did this we inadvertently lowered the Scenic Integrity Objectives on the GWNF. This was due to the manner in which the 1993 GW Forest Plan was prepared; it overrode the scenic inventory and adopted a higher standard for scenery on much of the Forest. In the final Forest Plan we adjusted the Scenic Integrity Objectives for Management Prescription Area 13-Mosaics of Habitat to increase the protection of scenic values. Now the final Forest Plan has more acres with an objective for a High Scenic Integrity than the current plan.

V-2: The Forest Service should reduce impacts of timber harvest on scenic resources.
Each management prescription area has a standard that includes a Scenic Integrity Objective (SIO) to be met for all projects. During project level planning, the design of management activities is crucial in meeting the SIOs. To help assure SIOs are met, Chapter 3 contains a Scenery Treatment Guide in Table 3-3 which provides recommended mitigations specific to each type of management activity for the High, Moderate and Low SIOs. The intent of this Scenery Treatment Guide is to reduce impacts of timber harvesting and other management activities on the scenic resource. In addition, the final Forest Plan made changes in Scenic Integrity Objectives

to increase protection of visual quality, particularly for the areas where most timber harvest will occur. The Final Plan changed the Scenic Integrity Objectives within Mosaics of Habitat from Low to Moderate within Scenic Classes 3-5.

WATER

WA-1: Alternative G adequately addresses water issues.

We agree. The expanded corridor widths and the protection of ephemeral channels in Alternative G will amply protect water quality and riparian areas. These corridor widths were used in the final Plan.

WA-2: The Forest Service should examine the impacts of Alternative G in having the second highest amount of ground disturbance.

We reviewed the soil disturbance table (Table 3A6-3) and found some errors in that estimates of annual soil disturbance were added to estimates of decadal soil disturbance. These errors have been fixed. While Alternative G (and H and I) remains second in highest acres of disturbance, it is very similar to the levels in Alternatives A, B, and E. The reasons Alternatives G, H, and I have relatively high levels are that these alternatives continue to harvest timber and construct some access roads. With the standards of the Forest Plan, particularly the riparian standards, the potential for this soil disturbance to reach stream channels is small. In addition, while these alternatives have the second highest levels, the total area of disturbance is low (0.03% of the Forest).

WA-3: The Forest Service should make water and forest health as the first priorities.

Chapter 2 of the Plan ("Vision") states that maintenance and restoration of healthy, diverse, and resilient watersheds is a high priority in our management activities. Priority watersheds and Public Water Supply watersheds are identified for restoration and protection. Standards provide for added protection through wider riparian corridors.

WA-4: The Forest Service should protect water quality.

The Revised Plan is designed to protect water quality through forest-wide standards, riparian corridor direction, and identification of public water supply watersheds and priority watersheds. Wider riparian corridors are specified.

WA-5: The Forest Service should protect water quality for fisheries.

The Revised Plan is designed to avoid and minimize effects on aquatic resources through forest-wide standards, riparian corridor direction (management prescription 11), and identification of priority watersheds.

WA-6: The Forest Service should maximize water absorption in the soil.

In timber harvests, the conductivity of the soil is maintained except in areas of high compaction, such as landings and skid trails. Compacted areas are ripped and seeded to help mitigate the effects of compaction. Standards require the use of Best Management Practices and the revegetation of disturbed areas. Soil disturbance must be less than 15% of an activity area.

WA-7: The Forest Service should protect watersheds.

The Revised Plan is designed to protect watersheds through forest-wide standards, riparian corridor direction, and identification of public water supply watersheds and priority watersheds. Wider riparian corridors are specified.

WA-8: The Forest Service should protect watersheds by allowing no drilling, tree cutting or bull dozing.

Although these activities (drilling is only allowed on existing federal gas leases and for private mineral rights), are allowed in the Revised Plan, the Plan is designed to protect watersheds through forest-wide standards, riparian corridor direction, and identification of public water supply watersheds and priority watersheds. Wider riparian corridors are specified.

WA-9: The Forest Service should place greater emphasis on drinking watersheds.

Public Water Supply watersheds, as designated by the State of Virginia, are recognized in the Forest Plan. Three watersheds were added to the list of priority watersheds, so that now all Forest Service watersheds encompassing Public Water Supply watersheds are priority. In the Final Plan, a standard was added that provides for wider lakeside management zones around municipal water supply reservoirs.

WA-10: The Forest Service should update its list of drinking water supplies.
The list of drinking water supplies within or downstream of the Forest was updated to include drinking water supplies in Maryland and the District of Columbia.

WA-11: The Forest Service should describe how the priority watersheds were selected.
Chapter 3 of the Plan states that priority watersheds were selected with an emphasis on watersheds with sensitive aquatic species, watersheds with impaired streams, and watersheds providing drinking water. A more detailed description of the selection process was added to Appendix D, Priority Watersheds.

WA-12 & WA-13: The Forest Service should identify all (or more) drinking water supply areas as priority watersheds and develop more standards for priority watersheds.
Three watersheds were added to the list of priority watersheds, so that now all Forest Service watersheds encompassing Public Water Supply watersheds, as designated by the State of Virginia, are priority. These Public Water Supply watersheds are the water supplies whose water quality is most likely to be affected by activities on the Forest. Additional drinking water watersheds were identified in comments (as those in Wild Virginia's The State Of Our Water report), based on water supply intakes on rivers in the vicinity of the Forest, and having part of their watersheds on the Forest. The water quality for these water supplies is much more dependent on private land uses and conditions. Thus these watersheds are not included as priority. Priority designation was also based on other factors, such as impaired waters indicating a risk to biologic resources, and the presence of threatened or endangered, sensitive, or locally rare aquatic or riparian species. If all of the additional drinking water watersheds were added as priority, 62% of Forest land would be included in priority watersheds. The focus on restoration and protection would be diluted if such a large percentage of the Forest were listed as "priority". All watersheds in the Forest are protected through forest-wide standards and riparian corridor direction. Riparian corridors are wider than in the 1993 Plan. Also, in the Final Plan, a standard was added that provides for wider lakeside management zones around municipal water supply reservoirs.

WA-14: The Forest Service should enhance protection of water supplies through expanded buffers, limits on road construction and decommissioning of roads.
Riparian corridors are wider than in the 1993 Plan. Also, in the Final Plan, a standard was added that provides for wider lakeside management zones around municipal water supply reservoirs. Plan strategy states that "Road management decisions regarding . . . decommissioning and construction will all be done after careful consideration of potential impacts to water quality." The Plan includes an objective to decommission 100 to 200 miles of roads over the next 10 years. Priorities for decommissioning are roads causing resource damage and roads in priority watersheds. All public water supply watersheds are included in the priority watersheds.

WA-15: The Forest Service should protect water in Davis Mill Creek.
All watersheds in the Forest are protected through forest-wide standards, riparian corridor direction and the identification of priority watersheds. The watershed encompassing Davis Mill Creek is a priority watershed in the Forest Plan.

WA-16: The Forest Service should not allow geologic carbon sequestration or hydraulic fracturing of the Marcellus formation in the Pedlar watershed.
There is no Marcellus shale underlying the Pedlar watershed. There are no proposals for geologic carbon sequestration; moreover, the geologic environment of the Pedlar watershed is not known to be suitable for geologic carbon sequestration.

WA-17: The Forest Service should keep the North Fork of the Shenandoah watershed pristine.
All watersheds in the Forest are protected through forest-wide standards, riparian corridor direction and the identification of priority watersheds. Three watersheds were added to the list of priority watersheds, so that now all watersheds encompassing the Public Water Supply watersheds of Woodstock, Strasburg, and Winchester (as designated in Virginia's Water Quality Standards) are priority.

WA-18: The Forest Service should have strict compliance with BMPs.
Standard FW-1 states that Forest practices will meet or be more stringent than Virginia and West Virginia Best Management Practices. A standard was added to clarify that, at public water supply reservoirs, wider lakeside management zones will be applied, in compliance with Virginia's BMPs. The Virginia Department of Forestry has confirmed that this meets the intent of their Streamside Management Zone BMP for Municipal Water Supplies.

WA-19: The Forest Service should increase widths for riparian buffers.
Riparian corridor widths were increased to 100 feet for perennial streams and 50 feet for intermittent streams, with greater widths for slopes above 10%. These widths can be varied where site-specific analysis indicates the need. Channeled ephemeral streams are protected with a 25-foot zone on each side, as well as upslope from the head of the channel. To conform to Virginia Best Management Practices for Municipal Water Supplies, a standard was added, implementing wider riparian areas around public water supply reservoirs. These riparian corridor widths protect water quality and aquatic and riparian habitat.

WA-20: The Forest Service should examine the standards for riparian areas.
Standards provide for wider riparian corridors and for protections of ephemeral streams. Livestock access to streams is limited. For existing allotments, grazing in riparian corridors can be reauthorized only if there would be no unacceptable resource damage to riparian resources. New grazing allotments or new permits for inactive allotments must exclude the riparian corridor. In the Final Plan, riparian standards clarify that, while roads, pipelines, and utilities associated with access to lease operations may be allowed to cross riparian areas, well pads and associated well development infrastructure are not allowed in riparian areas.

WA-21: The Forest Service should correct some specific items in the DEIS.
While there will be continued natural and man-caused stresses on watersheds, it is still appropriate to speak of "the continued natural recovery of watershed conditions." Over time, watersheds are recovering naturally from the degraded conditions that much of the Forest experienced prior to Forest Service ownership.

WA-22: The Forest Service should correct an error in the DEIS about streamflow.
The commenter states that absorption is a major use of precipitation and thus streamflow is not simply precipitation minus evaporation and use by vegetation. Absorption can be considered a component of water storage. Over a number of years, changes in storage average to near zero, and thus can be viewed as a minor component of precipitation use, when compared to evaporation and use by vegetation.

WA-23: The Forest Service should analyze the effects of its activities on sediment production.
There are many difficulties associated with modeling sediment. Even the best of models have many limitations, and numerous assumptions must be made. Site specific conditions are very difficult to model at the Forest scale. The results will be, at best, within plus or minus 50% of the true value. Thus there is no reason to believe that sediment numbers derived from a model would provide a better indication of the relative effects of the alternatives on sediment and water quality than would the acres of disturbance that were used in the EIS analysis.

WA-24: The Forest Service should consider the value of preserving water quality in its net public benefits analysis.
The high value of water quality is an emphasis in all of the alternatives. While it is difficult to place a monetary value on the water on the Forest, the importance of maintaining high quality water is recognized through land allocations and standards for implementation.

WA-25: The Forest Service should discuss clearcutting and flooding.
The discussion of flooding in the EIS was expanded to address the impacts of forest harvesting on flooding.

WA-26: The Forest Service should consider that watershed management can allow for some ground disturbing activities.
We agree. With the application of Best Management Practices and other standards, water quality can be maintained with some ground disturbing activities that are managed and controlled.

WA-27: The Forest Service should use best science in watershed management.
See response to Comment SC-1. Riparian corridor widths are the same as those in the Jefferson National Forest Revised Plan, which were developed using best available science from numerous sources.

WA-28: The Forest Service should recognize the flood control dams and their management.
The Forest Plan includes the following statement in the desired conditions for lands and special uses: “Existing flood control dams are maintained in good working order per provisions in the special use permit.”

WA-29: The Forest Service should incorporate national direction on Watershed Condition Framework.

National direction in the Watershed Condition Framework is being followed by the Forest. Forest Plan Appendix D - Priority Watersheds has been revised to show the Watershed Condition Class for each Forest Plan Priority Watershed. Watershed Condition Class is one factor considered in the designation of priority watersheds. Watershed Condition Framework Priority Watersheds for 2011 are identified in Appendix D.

WA-30: The Forest Service should discuss how the plan interacts with the Chesapeake Bay.

A discussion was added to the Forest Plan, describing the Forest's support for Chesapeake Bay initiatives, including Executive Order 13508, EPA guidance, and the Chesapeake Bay Total Maximum Daily Load analysis.

WA-31: The Forest Service should provide opportunities for municipal wells on the Forest.

The Forest Plan does not prohibit municipal wells on the Forest. Any proposal for municipal wells would be considered on a case-by-case basis, with site-specific analysis of effects.

WA-32: The Forest Service should recognize that fungi can be used in restoration to improve water quality.

The use of fungi for restoration is a site-specific decision to be considered in project development and is outside the scope of the Forest Plan.

WA-33: The Forest Service should improve watershed direction in the forest plan.

The desired conditions for watersheds describe the overall vision for these areas. Desired conditions for riparian corridors (Management Prescription Area 11) augment the desired conditions for watersheds. Some comments requested more stringent standards for certain watersheds. Protection of water quality is essential in all watersheds and we have provided a set of standards to provide this high level of protection across the GWNF.

WA-34: The Forest Service should have a management prescription area for source watersheds.

Source water supplies are protected with other Plan direction. We examined the options of using a management prescription for source watersheds. Protection of water quality is one of the highest priorities of the Forest Plan as noted in the riparian standards. With this level of protection for the sensitive areas along all water bodies, the use of a management prescription area for watersheds becomes unnecessary. We have identified the source watersheds, they are used in identification of priority watersheds and they were used in the analysis of lands available or suitable for oil and gas leasing.

WA-35: The Forest Service should correct some specific items in the draft plan.

The comment concerns the statement under "Desired Condition for Soils": "Forest streams located in watersheds of base-poor bedrock and soils are not being negatively impacted by acid deposition." This is not a statement about the existing condition, but rather a statement of the desired condition. The sentence is modified in the Final Plan to make this clearer.

WA-36: The Forest Service should monitor sediment.

Collecting sediment samples can be difficult and expensive. Because of the high degree of natural variability of sediment, it is very difficult to show a statistically significant change. Moreover, there is no consensus on how much of an increase in sediment is too much. For these reasons, aquatic macroinvertebrate sampling was adopted as the main tool for effectiveness monitoring. Macroinvertebrates integrate the physical, chemical, and biological components of aquatic systems and have been successfully used as biological indicators of change and impacts.

WA-37: The Forest Service should follow state and federal regulations.

The Forest will follow all applicable state and federal regulations. The Forest Plan under "Standards Overview" states: "In addition to the standards found in this Revised Plan, the Forest is required to comply with applicable laws, executive orders, and regulations, manuals, and handbooks."

WA-38: The Forest Service should determine if its roads are point sources of pollution.

The Clean Water Act (Act) requires that National Pollutant Discharge Elimination System (NPDES) permits be secured before pollutants are discharged from any point source into the navigable waters of the United States. One of the Environmental Protection Agency's (EPA) implementing regulations, the Silvicultural Rule, specifies which types of logging-related discharges are point sources. 40 CFR §122.27(b)(1). These discharges require

NPDES permits unless some other federal statutory provision exempts them from coverage. One such statutory provision exempts "discharges composed entirely of stormwater," 33 U. S. C. §1342(p)(1), unless the discharge is "associated with industrial activity," §1342(p)(2)(B). Under the EPA's Industrial Stormwater Rule, the term "associated with industrial activity" covers only discharges "from any conveyance that is used for collecting and conveying storm water and that is directly related to manufacturing, processing or raw materials storage areas at an industrial plant." 40 CFR §122.26(b)(14). In Northwest Environmental Defense Center v. Brown, 640 F.3d 1063 (9th Cir. 2011) ("NEDC"), the Ninth Circuit Court of Appeals held that stormwater runoff associated with two logging roads that flows into systems of ditches, culverts, and channels before being discharged into forest streams and rivers is a point source discharge for which a National Pollutant Discharge Elimination System (NPDES) permit is required. The Court of Appeals then remanded to the district court for further proceedings consistent with its opinion. The State of Oregon and other parties filed petitions for certiorari with the U.S. Supreme Court to review the Ninth Circuit's decision.

On December 7, 2012, EPA issued a final rule (Federal Register 77 FR 72970) that clarifies that stormwater discharges from logging roads do not constitute stormwater discharges associated with industrial activity and that a NPDES permit is not required for these stormwater discharges. The final rule also clarified that, for the purpose of assessing whether stormwater discharges are "associated with industrial activity," the only facilities under SIC code 2411 that are "industrial" are: rock crushing, gravel washing, log sorting and log storage.

On March 20, 2013 the Supreme Court upheld EPA's policy for regulating stormwater runoff on logging roads. They ruled that the preamendment version of the Industrial Stormwater Rule, as permissibly construed by the EPA, exempts discharges of channeled stormwater runoff from logging roads from the NPDES permitting scheme. The regulation is a reasonable interpretation of the statutory term "associated with industrial activity," §1342(p)(2)(B),and the agency has construed the regulation to exempt the discharges at issue here. When an agency interprets its own regulation, the Court, as a general rule, defers to it "unless that interpretation is 'plainly erroneous or inconsistent with the regulation.'" Here, it was reasonable for the EPA to conclude that the conveyances at issue are "directly related" only to the harvesting of raw materials, rather than to "manufacturing, processing, or raw materials storage areas at an industrial plant." 40 CFR §122.26(b)(14). The regulatory scheme, taken as a whole, leaves open the rational interpretation that the regulation extends only to traditional industrial buildings such as factories and associated sites and other relatively fixed facilities.

WIND

WI-1: The Forest Service should follow the wind direction in Alternative G.

The final Forest Plan generally follows the wind direction in Alternative G, but added Scenic Corridors to the list of management prescription areas unsuitable for wind energy development.

WI-2: The Forest Service should adopt Alternative G or an alternative that expands the available areas that assure that a reasoned discussion will occur about wind energy development.

The final Forest Plan generally follows the wind direction in Alternative G, but added 7B-Scenic Corridors to the list of management prescription areas unsuitable for wind energy development.

WI-3: The Forest Service should expand the list of areas where wind energy development would not be allowed.

The final Forest Plan generally follows the wind direction in Alternative G, but added 7B-Scenic Corridors to the list of management prescription areas unsuitable for wind energy development. 4D1-Key Natural Heritage Community areas were on the list in the Draft Plan as well as in the final Plan. We did not expand the list to include water supply watersheds, as we do not believe that we can conclude that the impacts of wind energy development would be incompatible with these areas (e.g., road access could be predominantly outside the watershed with just turbines in the watershed). We did not expand the list to include the Great Eastern Trail, since the Appalachian National Scenic Trail is the only trail which has its own management direction.

WI-4: The Forest Service should not allow wind energy development at specific sites.

The final Forest Plan makes much of Shenandoah Mountain unsuitable for wind energy development, except for the portions of Shenandoah Mountain just south of Highway 250. The final Forest Plan added Scenic Corridors to the list of management prescription areas unsuitable for wind energy development.

We did not make all of the National Forest System lands in Bath County as unsuitable for wind energy development. We understand the County's concern about impacts to the tourism industry and to their viewsheds. However, it is difficult to manage the National Forest based on county boundaries. Should we receive any applications for wind energy development on lands in Bath County, we would carefully consider the viewpoint of the Bath County Board of Supervisors, and any decisions would be based on an environmental analysis with public input.

WI-5: The Forest Service should not allow the development of wind energy on the forest.
We understand the concerns about the potential impacts of wind energy development on birds, bats, other animals, sensitive ridgetop ecosystems, and scenery. We also understand the concerns about the economic viability of wind energy development on these ridgelines. However, federal lands may be important to the development of a diverse set of energy options in the U.S. and National Forest System lands are one of the few opportunities in the east. We have identified some lands as available for further study if a proposal should be made.

WI-6: The Forest Service should allow wind energy development in more areas than identified in Alternative G.
We reviewed the information regarding the areas where wind energy development would not be allowed in Alternative G. We believe that the resource values in these areas could be substantially degraded by the activities of developing wind energy and so we carried all of them forward into the new selected alternative. In some of the areas identified in comments like Mount Pleasant, wind energy development is prohibited by law. Most of the 12D-Backcountry Recreation Areas are Inventoried Roadless Areas and road construction (essential to wind energy development) would be prohibited by the 2001 Roadless Rule. The scenic resources of the Blue Ridge Parkway would be diminished if wind energy development would be allowed in its corridor.

WI-7: The Forest Service should allow the development of wind energy on the forest.
The Forest Plan does allow for consideration of wind energy development in some portions of the Forest.

WI-8: The Forest Service should examine the potential to construct wind generators without extensive road improvements.
This would be examined in any proposal made to develop wind energy on the Forest.

WI-9: The Forest Service should allow the development of wind energy on the forest if other resources are protected.
The Forest Plan does allow for consideration of wind energy development in some portions of the Forest. The Forest Plan identifies areas where we do not believe that we could protect other resources as unsuitable to this development.

WI-10: The Forest Service should require NEPA review of any wind energy development projects.
Any wind energy development projects would be subject to site-specific environmental analysis and public involvement under the requirements of NEPA.

WI-11: The Forest Service should consider all aspects of wind energy development including the adverse effects.
The effects analysis for wind energy has been updated to consider more aspects.

WI-12: The Forest Service should consider the economics of wind energy development.
The economics of any wind energy development would be considered as part of the environmental analysis associated with any site-specific proposal.

WI-13: The Forest Service should recognize and utilize the expertise of other agencies if reviewing wind energy projects.
During the site-specific analysis of any energy development proposal, we will seek out expertise from other agencies.

WI-14: The Forest Service should not impair adjacent landowners' development of wind energy on their property.
There is nothing in the Forest Plan intended to affect how adjacent landowners manage their lands. However, these comments refer to a possible need for road improvements on National Forest System lands to facilitate

development on adjacent private lands. Management of special uses and road improvements are part of each management prescription. In the case of these comments the adjacent management prescription area is 8E7-Shenandoah Mountain Crest and the direction is dependent upon the conservation agreement covering the Cow Knob salamander.

WI-15: The Forest Service should incorporate additional direction for wind energy development in the plan.
The specific requirements to be included in any environmental analysis of a wind energy development project would be determined during the scoping for a site-specific project.

WI-16: The Forest Service should review the Wyoming analysis of wind energy development.
We did review the Wyoming report. We incorporated some of the ideas from the report in that we identified areas of the GWNF that would be most sensitive to impacts from wind energy development and made them unsuitable for wind energy development. This included inventoried roadless areas as identified in the report. Many of the other recommendations in the report related to site-specific mitigation which would be considered if we receive an application for a project.

WI-17: The Forest Service should react to each wind energy development project rather than making a plan decision.
The decisions in the Forest Plan are to identify areas where wind energy development would conflict with other resource needs. In other areas, the direction is to react to each individual project with site-specific analysis.

WILD & SCENIC RIVERS

WSR-1: The Forest Service should have an alternative that maximizes designation of eligible rivers.
We evaluated rivers for their eligibility under the National Wild and Scenic Rivers Act (Forest Plan EIS Appendix D). All of the eligible sections of river are managed to protect their qualities that make them eligible.

WSR-2: The Forest Service should modify management direction for wild and scenic rivers.
The standard about managing fire use was changed in the final Forest Plan.

WSR-3: The Forest Service should evaluate all rivers eligible for wild and scenic river designation.
The evaluation of rivers is found in the Final EIS Appendix D. In addition to the rivers evaluated in 1993, we did examine other rivers but we did not identify outstandingly remarkable values in these other rivers.

COMMENT LETTERS RECEIVED FROM GOVERNMENT ENTITIES

This section reproduces comment letters on the Draft Forest Plan and DEIS from government entities in their entirety (FSH 1909.15.24.13). This section only contains those comment letters that were submitted during the formal Draft Forest Plan and DEIS comment period (June 3, 2011 to October 17, 2011). Table N-3 shows the list of letters received from government entities and the letter number they are filed under at the Supervisor's Office in Roanoke, Virginia. The comment letters are reproduced in this section in the order that they are listed in Table N-2.

Table N-2. Government Entities that Submitted Comment Letters on the Draft Forest Plan and DEIS.

Government Entity	**Letter Number**
Federal Agencies	
United States Army Corps of Engineers	485
United States Department of Interior - Bureau of Land Management	479
United States Department of Interior - National Park Service	40
United States Department of Interior - Office of Environmental Policy and Compliance	158
United States Environmental Protection Agency	494
United States Geological Society	456
Federal Elected Officials	
US Congress, House of Representatives - Connolly	464
US Congress, House of Representatives - Cummings	464
US Congress, House of Representatives - Edwards	464
US Congress, House of Representatives - Griffith	251
US Congress, House of Representatives - Moran	464
US Congress, House of Representatives - Norton	464
US Congress, House of Representatives - Sarbanes	464
US Congress, House of Representatives - Scott	464
US Congress, House of Representatives - Van Hollen	464
Tribal Officials	
Eastern Band of Cherokee Indians	234
State Agencies	
Virginia Department of Conservation and Recreation	513
Virginia Department of Environmental Quality	513
Virginia Department of Forestry	513
Virginia Department of Game and Inland Fisheries	513
Virginia Department of Health	513
Virginia Department of Historic Resources	513
Virginia Department of Mines, Minerals and Energy	393, 513
Virginia Marine Resources Commission	513
West Virginia Division of Natural Resources	232
West Virginia Geological and Economic Survey	469

State Elected Officials	
Virginia General Assembly, 26th District House of Delegates - Wilt	203, 564
Virginia State Governor - McDonnell	628
County Officials	
Augusta County Board of Supervisors	253
Augusta County Service Authority	37
Bath County Board of Supervisors	256
Botetourt County Board of Supervisors	272
Central Shenandoah Planning District Commission	513
Fairfax County Water Authority	378
Headwaters Soil and Water Conservation District	275
Interstate Commission on the Potomac River Basin	468
Roanoke Valley-Alleghany Regional Commission	513
Rockbridge County Board of Supervisors	270
Rockingham County Board of Supervisors	545
City Officials	
City of Lynchburg, Virginia	261
City of Roanoke, Virginia	200

APPENDIX O – CHANGES BETWEEN DRAFT AND FINAL

In response to comments on the Draft EIS and Draft Revised Plan, a number of changes were made. These changes included the development of two new alternatives (Alternative H and Alternative I), additional analyses, improvement to analyses conducted for the draft, and corrections to fix errors. The following is a summary of the major changes.

NEW ALTERNATIVES: CHANGES FROM ALTERNATIVE G TO ALTERNATIVES H AND I

Land Allocation

Added Special Biological Areas and adjusted boundaries of Special Biological Areas for a total increase of about 3,000 acres of Special Biological Areas

Adjusted the northwest boundary of Southern Massanutten Remote Backcountry area to include the entire Inventoried Roadless Area

Adjusted the boundary of Church Mountain Special Geologic Area based on further analysis by the Virginia Department of Conservation and Recreation and reduced the area by about 350 acres

Established boundaries and recommended the Beech Lick Knob area for Wilderness Study (5,700 acres), an addition to the Rough Mountain Wilderness (1,000 acres), and a Recommended National Scenic Area on Shenandoah Mountain (67,000 acres)

Changed portions of the Hog Pen Remote Backcountry area to Mosaics of Habitat and Dispersed Recreation management prescription areas, adjusted the northwest boundary of the Benson Run Remote Backcountry area to Mosaics of Habitat, and adjusted portions of the boundary of the Beech Lick Knob Remote Backcountry area to Mosaics of Habitat, for a reduction in Remote Backcountry of about 4,100 acres

Adjusted the boundary of the Appalachian Trail Corridor near Pedlar Reservoir to reflect a new trail relocation

Added a new communication site on the James River Ranger District. Designated two additional sites on the Warm Springs Ranger District and one on the James River Ranger District that have existed for several decades

Desired Conditions

Made small changes to update desired conditions or emphasis statements in: Forestwide Minerals Resources, Forestwide Road operational maintenance levels, Forestwide Drinking Water (added to list of water supplies), Recommended Wilderness Study, Mount Pleasant (to more closely tie to the establishing legislation), Highlands Scenic Byway, Developed Recreation, and Pastoral Landscapes

Added statements in the Recommended Wilderness Study and Remote Backcountry sections to better define boundaries in relation to roads

Management Approach and Objectives

Updated the management approach for wood biomass energy in relation to soil productivity, pastoral landscapes (grazing allotments), gas leasing, recreation facilities, and scenic integrity (including an update to the Scenery Treatment Guide)

Changed the non-native invasive species (NNIS) treatment objectives (from 5,000-10,000 to 2,000-5,000 acres per year), the objectives for scenic integrity, the table of Lands Suitable for Key Activities on the GWNF, and the list of areas unsuitable for wind energy

Standards

Added direction for a Recommended National Scenic Area on Shenandoah Mountain

Divided the Dispersed Recreation Management Prescription Area into two subcategories, one that has lands suitable for timber production and one that has only lands unsuitable for timber production

Added or modified forestwide standards relating to water diversions, municipal reservoirs, soil productivity, northern flying squirrel, old growth, the CMAI age for cove hardwoods, recreation, the effects of fire on scenery, geologic hazards, oil and gas, and disclosure of hazardous materials

Deleted two Forestwide standards that applied to adopted Recreation Opportunity Spectrum settings

Changed standards in management prescription areas from being "available" for gas leasing under certain conditions to being "suitable" for leasing

Added direction to the Appalachian National Scenic Trail Corridor, Special Biological Area, and Shenandoah Crest management prescription areas to cover the portions of those areas that are within Inventoried Roadless Areas and where timber harvest and road construction activities are limited

Changed gas leasing suitability in the following management prescriptions to No Surface Occupancy: Eligible Scenic Rivers, Eligible Recreational Rivers, Geologic Areas, Special Biological Areas, Indiana Bat Secondary Conservation areas, and Shenandoah Mountain Crest (Cow Knob salamander)

Updated one Wilderness standard about fire and two about trails

In Recommended Wilderness Study areas updated standards regarding firelines

Added standard about group activities on the Appalachian National Scenic Trail

Added standards to Special Biological Areas, Cultural Areas, Highlands Scenic Byway, ATV Use Areas, and Mosaics of Habitat regarding new trails and facilities

Added standard to Communication Sites to encourage colocation of facilities

Added standard to Utility Corridors to evaluate herbicide use within Special Biological Areas

Added standard to Scenic Corridors and Viewsheds making them unsuitable for wind energy development

Changed gas leasing standard in Research Natural Areas to be not suitable for leasing

Changed two standards in Riparian Corridors regarding mineral development facilities

In Mosaics of Habitat, Scenic Integrity Objectives were increased from low to moderate in scenic classes 3, 4 and 5

Added direction to Key Natural Heritage Community Areas to allow for the reestablishment of motorized access to Forest Road 173 on Peters Mountain

Monitoring

Added monitoring questions about soil productivity and climate change

Gas Leasing Decision – Alternative H

Reduced the total area available for gas leasing by focusing the land available for leasing to the areas underlain by formations with a high potential for gas production and adjusted the areas available under various stipulations

Changed to identify 471,000 acres of land as available for gas leasing: 238,000 under standard stipulations, 92,000 acres under controlled surface use stipulations and 141,000 under no surface occupancy stipulations for both vertical drilling and horizontal drilling

Approximately 128,000 acres were administratively unavailable for leasing (Recommended Wilderness Study, Recommended National Scenic Area, Laurel Fork, Indiana Bat-Primary Conservation Area, and Public Water Supply Watersheds) and 51,000 were legally unavailable for leasing (Wilderness and National Scenic Area)

Added control measures to reduce or eliminate many of the resource impacts from hydraulic fracturing and horizontal drilling

Gas Leasing Decision – Alternative I

The approximately 10,200 acres of mineral rights under current federal oil and gas leases will continue to be legally available for federal oil and gas leasing

This decision does not affect the approximately 167,000 acres of subsurface mineral rights owned by private parties (also called outstanding or reserved)

All other areas of the GWNF are unavailable for federal oil and gas leasing

The plan identifies suitability for oil and gas leasing that will be used for the lands with existing leases once they expire or for areas that could become available under future availability decisions

The plan identifies standards for oil and gas development that will be used for development of the lands with existing leases or for areas that could become available under future availability decisions

OTHER CHANGES

Added analysis for two federally listed species: Endangered Virginia Northern Flying Squirrel *(Glaucomys sabrinus fuscus)* and Threatened Madison Cave Isopod *(Antrolana lira)*

At the time of the draft only about 60 percent of the ecological zones on the GWNF had been classified and mapped and this information was used to extrapolate estimates for the entire GWNF. We completed the mapping of ecological zones on the GWNF and all of the tables in the EIS and Plan that relied on this information were updated. This includes Tables 2-5, 3B1-1, 3B1-2, 3B2-2, 3B2-3, 3B2-12, 3B2-13, Appendices E and F, and the desired conditions for ecological systems diversity in Revised Plan Chapter 2 and the objectives for ecological systems and species diversity in Revised Plan Chapter 3. We also reran the Spectrum models for all alternatives and updated the Allowable Sale Quantity for Alternatives B through G.

We corrected an error in the estimate of the acreage of soil disturbance in Table A6-3.

We updated the acreage of lands suitable for timber harvest in relation to land allocation changes and a correction to the old growth data. This affected Tables C6-2, C6-6, the timber suitability summary in Chapter 3 of the Revised Plan, and Appendix C of the Revised Plan.

We modified the old growth analysis in Section B3 of the EIS and Appendix B of the Revised Plan.

We updated the budget needed to implement the alternatives, changing a number of tables in the economic analysis.

We updated the roads analysis with new information changing the analysis in Section C.8 of the EIS.

The recreation market area information in Section C.1 and the social and economic affected environment discussions in Section C.12 of the EIS were updated to reflect newly available 2010 Census data.

In the Draft EIS, the IMPLAN model study area included a number of additional counties beyond those that contained GWNF lands. Upon further review, it was determined that this was too large of an area to use to estimate local social and economic impacts. The model area was adjusted in the Final EIS to only include those counties within which GWNF lands occur. This model also replaced the 2009

IMPLAN data with 2011 IMPLAN data that was updated with regional business data and more current census data. Estimates related to Forest Service budgets and revenues for natural gas production were also updated. The amount of natural gas production was also improperly calculated for the Draft EIS. The assumptions of 1,000,000 MCF total gas production over the life of one vertical well and 3,000,000 MCF over the life of one horizontal well were used for the Final EIS.

The potential wilderness area evaluations in Table C-1 of the EIS were updated to replace estimated percent of boundary adjacent to private with numbers generated by GIS.

A number of changes were noted during the comment period and were corrected in *Errata* that were posted on the website and discussed in an August 12, 2011 letter from the Forest Supervisor. These corrections included: a) an error in the level of regeneration harvest in Alternative A; b) the ASQ displayed for Alternatives A and D; c) language to state that harvest levels meant regeneration harvest in several references; d) acres suitable for timber production, regeneration, and age class distribution in Alternative G; e) acres of regeneration for Alternative F; f) acres by Scenic Integrity Objective for Alternative A; g) recreation objectives for Alternative A; h) the narrative description of Alternatives; i) Tables B2.5, B2.9, B5.5, C6.4; j) land allocation in Alternative F regarding national scenic areas; k) number of geologic areas in Alternative G.