Chapter 3. Affected Environment and Environmental Consequences

3.1 Introduction

This chapter describes current conditions and trends in the Plan area and analyzes the environmental consequences expected to result from adopting a plan based on one of the action alternatives (Alternative B, C, D, or E), or taking no action (Alternative A). Each of the national forest activities and uses likely to have an effect on a given resource is discussed in general terms. Together, these descriptions form the scientific and analytical basis for the comparison of effects table found at the end of Chapter 2.

It is important to keep in mind that this Environmental Impact Statement is programmatic in nature and discusses only the general types of effects that may occur during plan implementation. The environmental effects of specific actions or activities are not discussed. Future project-specific environmental analysis will disclose the specific effects of each project or activity. Analysis of site-specific variables is beyond the scope of this programmatic EIS.

3.2 Organization of the Analysis

The description of the affected environment and the analysis of direct and indirect effects are organized into sections based on the major resource areas contained in the Draft Plan. The resource areas included in this analysis are:

- Access & Travel Management
- Air Quality
- Aquatic Wildlife: Habitat and Species
- Botanical Resources
- Built Environment
- Climate Change
- Economics
- Fire and Fuels
- Forest Vegetation
- Cultural Resources & Tribal Relations
- Interpretive Services & Conservation Education
- Lands Special Uses
- Minerals
- Natural Hazards
- Noise
- Range
- Recreation
- Scenic Quality
- Terrestrial Wildlife: Habitat and Species
- Water Quality and Soil Erosion
- Water Quantity
- Watershed Condition
- Soil Resources
- Wilderness,

This chapter provides a summary analysis for each of these resource areas. In some instances there is a specialist report prepared for a resource which includes a complete analysis. Specialist reports are available in the project record. Cumulative effects for all resources are discussed in Section 3.5 of this chapter.

The analysis for each resource in Section 3.4 includes the following:

3.2.1. Introduction and Scope of the Analysis

The resource is introduced, the temporal and spatial boundaries of the analysis are set, and the rationale for choosing the boundaries is presented. For most resources, the time period for the analysis is the 10-15 years the Plan is expected to be in effect, but a longer time period is considered for some resources. The spatial boundary, or area of consideration, describes the area where the effects would occur, and varies with the resource.

3.2.2. Methodology

This section includes the indicators of effect plus brief descriptions of any models or other analysis tools that were used. The indicators of effect are the descriptions of the metrics used to illustrate the differences between alternatives. They provide the basis for the analysis of environmental consequences and for describing the differences between alternatives. They may be qualitative, quantitative or a mixture of both, depending on the resource.

3.2.3. Assumptions

This section lists assumptions specific to the analysis for each resource. For resources with no specific assumptions, this section is omitted. Assumptions common to all resources are listed below in Section 3.3.

3.2.4. Overview of the Affected Environment

This section provides a summary description of the existing conditions or status of the resource, focusing on aspects with the potential to be affected by implementation of the alternatives. Current trends are described where applicable.

3.2.5. Environmental Consequences

The direct and indirect environmental consequences to the resource are analyzed here. Each of the general types of national forest activities and uses likely to have an effect on the resource is discussed in terms of the indicators identified for that resource (see Chapter 2, Table 2.3 for a list of indicators by resource).

In some sections the environmental consequences are organized by activity area with a discussion of all alternatives grouped under the activity area subheading. In other sections the environmental consequences are organized by activity area and then further broken down by alternative.

To clarify the differences among alternatives, the consequences of actions are analyzed assuming full implementation of each of the alternatives. However, due to budgetary and other constraints not known at this time, it is very possible that not all the actions described in a given alternative would be implemented. Appendix O describes the limitations inherent at this level of forest planning.

In addition to the actions described in Chapter 2, the analysis of the No Action alternative (Alternative A) includes the consequences of ongoing activities and uses, providing a basis for comparison with the action alternatives (Alternatives B, C, D, and E). Ongoing activities and uses are the day to day management

activities and uses of NFS lands that occur apart from specific project work. They include things like the use and maintenance of picnic areas and facilities, and are listed in Table 3-1.

3.2.6. Analytical Conclusions

This section is included to provide a brief summary of the analysis and to clarify the conclusions of the environmental effects analysis for each resource. This section presents whether or not there are significant environmental impacts.

Table 3 1. Ongoing Activities and Uses

Activities & Uses*	Potential Actions	Unit of Measure	Quantity	Map
Recreation:				
Dispersed Recreation (Summer)	Non-motorized: Picnicking, dispersed camping, mountain biking, cross-country hiking, horseback riding, rock climbing, hunting, fishing, wildlife, plant and fish viewing (i.e., bird watching), barbequing, beach play, and water play. Motorized: Pleasure driving, off highway vehicle (OHV) use (e.g., quads, dirt bikes).	acres available	154,830	
Dispersed Recreation (Winter)	Non-motorized: Cross-country skiing, snowshoeing, back-country skiing, snow play, sledding, snow camping.	acres available	154,830	
Over Snow Vehicle Travel (dispersed in open areas, non-guided)	Snowmobiling	acres available	80, 458	X [1]
[1] See Snowmobile Guide				
Developed Recreation:	**Public and Private**			
Resorts and Lodges	Initial Site Construction (Grading of sites for campsites and parking spurs) Clearing of vegetation (Tree removal) Asphalt and concrete installation (non-permeable surfaces such as roads, parking lots and structures. Trenching for utilities, site maintenance and cleaning of structures and other improvements, Adding additions to the structures. Adding additional structures, roadways, landscaping, water diversions and wells, and septic systems.	number/acres	7/365	X
Campgrounds	Campground expansion: Initial site construction (Grading of sites for roads, campsites and parking spurs) Clearing of vegetation (Tree removal) Asphalt and concrete installation (non-permeable surfaces such as roads, parking lots, and structures. Trenching for utilities, site maintenance and cleaning visitor uses such as: camping, campfires, lights, picnicking, hiking and biking around developed sites, noise, pets, collecting rocks, plants and creatures.	Campgrounds/ Campsites	9/423	X
Winter – Outfitter Guide	Snowmobiling, cross country skiing	miles of trails (XC)/ miles of trails (OSV)	35.7 and 7 Miles	X

Activities & Uses*	Potential Actions	Unit of Measure	Quantity	Map
Winter – Ski Areas **Heavenly** **Homewood/ partial** **Diamond Peak/ partial** **Alpine Meadows/ partial**	Maintenance of cleared slopes (annual brushing, mowing, grubbing; removal of hazard trees); Erosion control activities (culverts, culvert maintenance, slope contouring, sediment basin installation/maintenance, water bar maintenance and installation); Snow-blowing (including generator operation); Grooming of snow-covered slopes (including operation of heavy equipment during the day and at night); Snow-making (including development/maintenance of water storage ponds and water diversions); Night lighting of slopes; Summer use activities (hiking, mountain biking events); Operation and maintenance of facilities on site (restaurants, ski lift towers/terminals, administrative offices, radio towers, etc.); back country gates allow access (cc skiing, downhill skiing, snowboarding, etc.) outside operational and permit boundaries.	number of facilities and areas & acres	4/3,997	X
Winter – Snow Parks	Snow play, sledding, cross country skiing, snowshoeing, back country skiing, snowmobiling (functions as trailhead for snowmobiles).	Sites	2	
Recreation Residences	Recreation residence tracts generally consist of small privately owned cabins situated on National Forest System lands. They are often situated in or near riparian areas. Use of public land by the cabin owners is authorized by permit for up to 20 years. Cabins are intended for weekend, vacation, or seasonal recreation use but not for full time residency. Activities, other than occupancy, related to the cabin and surrounding lands that can occur include: maintenance of the structures and other improvements, adding additions to the structure, adding additional structures and roadways, landscaping, water diversions and wells, and septic systems.	number of residences	594	
Organization Camps and Clubs	Organization camps are both under permit on National Forest System lands and on adjacent private lands. Organization camps and clubs concentrate use and impacts in a small area, similar to campgrounds.. A typical organization camp includes a number of facilities including cabins, platform tents, administrative offices, kitchen/dining building, bathrooms, parking areas, swimming pools, ball fields, buildings for activities (crafts, nature, etc.), stables for horses, a campfire ceremony amphitheater, archery/rifle ranges, tennis courts, hiking trails, horseback trails, mountain biking trails, water play areas. Camp capacities range from 70 to 300. Most operate seasonally, generally in summer. Camps and clubs may accommodate conferences and meetings as well as family camping and employ a year-round on-site manager. Outdoor education programs for school groups also use organization camps and clubs on the National Forest for their programs.	number of camps and clubs	4	

Activities & Uses*	Potential Actions	Unit of Measure	Quantity	Map
Outfitting and Guiding Service and Events (Non-winter)	Outfitting-guiding activities and recreation events are authorized by special use permit. Limitations on activities that potentially damage or disrupt sensitive species and habitat areas are generally included as conditions for permit approval. Many outfitting-guiding and recreation events operate on existing trails or National Forest System roads. Activities involved under this category include running events, walk-a-thons, ski races, weddings, , horse pack trips (day trips or overnight camping); horseback rides (part or full day), guided fishing and hunting trips, orienteering, and guided mountain bike tours.	number of permits for outfitter guide/ number of permits for recreation events	8/10	
Day Use Sites	Activities associated with the use, maintenance or construction of day use and other developed recreation sites (i.e., picnic areas, trail heads) includes: initial site construction, clearing of vegetation, grading of sites, asphalt and concrete installation (non-permeable surfaces); site maintenance and cleaning; visitor uses such as camping, BBQ's, lights, picnicking, fishing, water play, photography, playing of radios/music; pets; hiking and biking in and around the developed site.	number / acres	7/199	
Infrastructure:				
Administrative Facilities	Meyers work center, SO, fire stations. Activities: parking/vehicle storage, general facilities maintenance and repairs (tree removal, general storage, landscaping), noise.	number of facilities	31	
Access & Travel Management:	(see motor vehicle use guide)			
Level I Roads Closed Road	Maintenance activities are generally not required for level 1 road. These are administratively closed roads.	miles	30	X
Level II Roads High Clearance Vehicle Road	Maintenance activities would include use of heavy equipment to grade, clean drainages, replace culverts, replace bridges, and could include importing materials.	miles	148	X
Level III Roads Passenger Car Road Low User Comfort	Maintenance activities would include use of heavy equipment to grade, clean drainages, replace culverts, replace bridges, and could include importing materials.	miles	64	X
Level IV Roads Passenger Car Road Moderate User Comfort	Maintenance activities would include use of heavy equipment to grade, clean drainages, replace culverts, replace bridges, and repaving or resurfacing.	miles	20	X
Level V Roads Passenger Car Road High User Comfort	Maintenance activities would include use of heavy equipment to grade, clean drainages, replace culverts, replace bridges, and repaving or resurfacing. This is the highest maintenance level for NFSR roads. The LTBMU does not have any of this maintenance level on the forest.	miles	0	X
Motorized Use of Roads	Open to motor vehicles	miles	115	

Activities & Uses*	Potential Actions	Unit of Measure	Quantity	Map
Trails				
Motorized Use of Trails	Maintenance activities would include primarily be accomplished with hand crews and could include use of motorized borrows, mini excavators or comparable equipment.	miles	15	X
Mechanized Use of Trails	Maintenance activities would include primarily be accomplished with hand crews and could include use of motorized borrows, mini excavators or comparable equipment.	miles	217	X
Non-motorized, Non-mechanized Trails	Maintenance activities would include primarily be accomplished with hand crews and could include use of motorized borrows, mini excavators or comparable equipment.	miles	92	X
Permitted Uses – Lands				
Communication Sites	Ongoing maintenance with vehicle access, vegetation clearing. Fencing around facilities.	number of sites	8	X
Utilities	Trenches for underground utilities, vegetation clearing for overhead lines, vehicular access for maintenance and inspection of overhead lines, digging of wells, diversion of springs, water storage, fencing.	authorizations	8	
Urban Stormwater Treatment	Soil removal and vegetation clearing for new basins and other structures, alteration of natural water flows, fencing.	authorizations	30	
Community Use and Public Information	Ongoing maintenance with vehicle access, vegetation clearing. Fencing around facilities.	Authorizations	5	
Production Livestock Grazing	Fence installation, salting, herding, upland water source development, spring development, water drafting, hazard tree cutting.	authorizations	0	
Research and Monitoring	Digging of monitoring wells, vehicular access during installation of equipment.	authorizations	9	
Permitted Temporary Activities	Artificial lighting (temporary during filming), noise from participants and spectators, temporary fencing	authorizations (average per year)	5	

* Definitions of suitable uses and management activities are located in Revised Forest Plan, Part 2. Strategies.

3.3. Assumptions Common to All Alternatives

The relationship between possible future actions and their consequences is not always known or quantifiable, especially in a programmatic analysis such as this one. A set of assumptions is used to reduce the unknowns in this analysis. Assumptions common to all resources and alternatives are listed below; assumptions specific to a given resource are listed in the effects section for the resource.

- Alternatives are implemented in compliance with all
    - Forest Plan Standards and Guidelines,
    - Best Management Practices (BMPs),
    - Policies (Forest Service Handbooks and Manuals, others)
    - Regulations
    - Laws
- The above will be followed and will be effective.
- The timeframe for analysis is the next 15 years (planning horizon established by NFMA for Forest Plans). Other timeframes may be analyzed depending on the resource; for example vegetation modeling and climate change consider longer time periods.
- Site specific activities would only be conducted after appropriate project level NEPA analysis, as required.
- Wilderness recommendations in Alternatives C and D are assumed to have been adopted by Congress for this analysis.
- Best available science would be used to inform management decisions.
- Budget –
    - Appropriated funding will remain constant or decrease, consistent with historic trends.
    - Funding from the Sierra Nevada Public Lands Management Act (SNPLMA) will decrease rapidly and will likely be fully expended by the end of the planning period.
- Climate Change –Assumptions regarding climate change are described in detail in Appendix D – Climate Change.
- Demographics –
    - Visitation is expected to follow US census population trends. Based on this assumption, visitation is expected to grow 1.4% annually or 21% in the next 15 years.
- Range Analysis – A brief analysis of the effects of the alternatives on range resources is included. Consequences of grazing on other resources were not analyzed because all allotments are currently vacant and no applications are pending. A capability and suitability analysis as well as NEPA analysis would be required prior to issuing any term-grazing or special use grazing permits. NEPA analysis would not be required for grazing associated with outfitter-guide permits.
- Recreation Demand - Recreation visitation and resulting demand and use is anticipated to increase in all alternatives and none of the alternatives are anticipated to accommodate all the projected demand during peak use periods.

In addition to the above assumptions, this analysis assumes that projects in the planning or implementation stage or which have guaranteed funding would be implemented as described in the project documentation, regardless of which alternative is chosen. Current projects and commitments under the Environmental Improvement Program (EIP) would continue until completed. Projects for which funding has been approved under SNPLMA would be implemented as proposed, and any projects specifically funded by the Lake Tahoe Restoration Act (LTRA) would be implemented.

Projects would be planned and implemented as described, even if some aspects of the project conflict with one or more elements of the chosen alternative. All projects proposed after the Revised Forest Plan

would be designed to be consistent with the Forest Plan unless a site specific Forest Plan Amendment is approved.

3.3.1. Recreation Expansion under All Alternatives

Under all alternatives, the LTBMU recreation program will work towards the sustainable integration of environmental, social, and economic conditions. This is achieved in part by adapting to changing user demands, trends, and preferences, including modifying existing sites and infrastructure to improve natural resource conditions and recreation settings. During the Forest Plan scoping and public comment process, infrastructure expansion and permanent development of general forest areas were identified as an issue of concern. The EIS describes this issue as 'recreation expansion' and defines it as an increase of infrastructure in support of additional recreation opportunities over the Lake Tahoe Basin Management Unit landscape. Each alternative describes a range of recreation expansion by percentage. Alternative A, B, and C would allow for expansion up to 10%, 5%, 15% and respectively, whereas Alternative D would allow up to a 15% reduction. Alternative E would allow for expansion between 5 and 10%, as shown in SG 100in the Forest Plan. These percentages correspond to the following measurement indicators: recreation site acres, overnight accommodation units, day use parking spaces, and ski areas and slopes (operational footprint).

Using the above measurement indicators, the following management activities considered as recreation expansion are described in the Recreation Strategies section of the Forest Plan.

3.4. Affected Environment and Environmental Consequences by Resource Area

3.4.1. Access and Travel Management

3.4.1.1. Introduction

This section evaluates and discloses the potential environmental consequences from Alternatives A, B, C, D, and E on road and trail access and travel management. The LTBMU transportation system consists of a network of 257 miles of roads and 348 miles of trails, and serves the following purposes:

- Administration of Forest Service Lands
- Recreational use by visitors to the forest
- Access to isolated parcels of private land within the LTBMU
- Commercial use which may or may not be subject to cost recovery

The vast majority of use falls in the first two categories. With the exception of trailhead parking, recreational use is analyzed in Section 3.4.19 – Recreation.

Methodology

A qualitative analysis is used to compare the primary differences between alternatives that affect access and travel management. This is a broad overview of consequences to the Forest transportation system and access and travel management, and it is expected that these effects will vary with site-specific conditions.

This analysis describes how the various alternatives would affect these uses. The effects of the alternatives on road and trail access are evaluated against management activities which have the potential to alter these systems of designated routes. Each alternative is ranked with respect to a particular effect. A ranking of “more” relates to a relative anticipated increase in access and in the road/trail system. A ranking of “less” relates to a relative anticipated decrease in access and in the road/trail system. The primary metrics are miles by road maintenance level and miles of managed use for trails.

Road Maintenance Levels

The alternatives vary in the miles of road in each road maintenance level (Table 2-1). Road maintenance level is the metric for analysis of roads in this document. All levels of roads have drainage and erosion protection features that are maintained to protect water quality.

Maintenance levels are defined by the Forest Service Handbook (FSH) 7709.62 as the level of service provided by, and maintenance required for, a specific road. The maintenance level is determined by considering the purpose and need for the road, forest plan objectives, funding, and many other factors. A road may be constructed to serve at a maintenance level which fulfills an immediate need (operational maintenance level), but planned to be modified and converted to another maintenance level to fulfill a future need (objective maintenance level).The levels are summarized as follows:

- ML 1: basic custodial care (closed to motor vehicle traffic). Roads are closed to traffic for protection of a resource, maintenance cost, or other reasons and vegetation may be growing on the roadway.
- ML 2: suitable for high clearance vehicles. Roads are primarily one lane, low traffic, low speed roads and can range from native surface to pavement depending on resource protection needs.

- ML 3: suitable for passenger cars. Roads support higher traffic volumes and are constructed with wider surfaces and longer sight distances for higher speed traffic.
- ML 4: suitable for passenger cars, moderate degree of user comfort. Roads support higher traffic volumes and are constructed with wider surfaces and longer sight distances for higher speed traffic.
- ML 5: suitable for passenger cars, high degree of user comfort.

There are no ML 5 roads in the LTBMU (Table 3-2). All levels of roads have drainage and erosion protection features that are maintained to protect water quality.

Table 3 2. LTBMU Road System Description, by Maintenance Level

Maintenance Level	User Comfort	Lanes	Surface Type	Miles	Percent
ML1	Closed to motor vehicle access	NA	NA	26.6	10.3
ML2	High Clearance Vehicles	1	Native	143.3	55.7
ML3	Low User Comfort	1-2	Chip Seal, Aggregate or Native	66.8	25.9
ML4	Moderate Degree User Comfort	1-2	Chip Seal, Paved or Aggregate	20.7	8.1
ML5	High Degree User Comfort	2	Paved or Chip Seal	0	0

Managed Use -Trails

The alternatives vary in the miles of managed use for trails, shown in Table 2-1. Note that most trails are managed for more than one use, so the numbers in Table 2-1 do not add up to the total miles of trails on the LTBMU.

Trail Class is a concept similar to road maintenance level. The Trail Class is the prescribed scale of development for a trail, representing its intended design and management standards (FSH 2309.18). Trail Classes are general categories reflecting trail development scale, arranged along a continuum. Trails in all trail classes are designed and maintained to control surface runoff and resulting erosion and sedimentation.

- Trail Class 1: Minimally Developed
- Trail Class 2: Moderately Developed
- Trail Class 3: Developed
- Trail Class 4: Highly Developed
- Trail Class 5: Fully Developed

Because there is considerable overlap between the trail classes and the uses for which trails are managed (FSH 2309.18), miles by managed use is used as the metric for analysis of trails in this document (Table 3-3).

Table 3 3. LTBMU Trail System Description by Managed Use

Managed Use Type	Miles	Percent
Hiking and equestrian	337	59
Mechanized (mountain bike)	217	38
Motorized OHV*	15	26

* An additional 115 miles of roads are also open to motorized OHV use.

Background

While the Forest Service manages approximately 78% of the lands in the Lake Tahoe Basin, only 26% of the roads are NFS roads (Kjar 2011). The interconnected nature of the road system requires ongoing cooperation and collaboration among partners.

Table 3 4. Miles of road by jurisdiction in the LTBMU Administrative Boundary *(Kjar 2011)*

System	Miles of Road
National Forest	257
State	116
County, City	591
Private	40
Total	1,004

Access and Travel Management (ATM) planning is the strategy used for achieving sustainable travel routes under all alternatives to identify needed routes, BMP needs, and restoration and reroute opportunities that will protect and enhance natural resources.

ATM planning began for roads in 1998 and for trails in 2001. Road and Trail ATM Plans divide the Lake Tahoe Basin into planning areas called transportationsheds (10 for trails and 12 for roads). The LTBMU developed a Water Quality Risk Analysis Process in 1998 as part of the ATM planning process, and has been continuously evaluating roads for their potential to adversely affect water quality. Collaborative processes involved agencies, stakeholders, and the public in the development of alternatives. Project-level NEPA for each transportationshed lays out detailed proposed actions and analysis of effects. Work is undertaken after project decisions are signed.

The first round of ATM projects are complete for all LTBMU roads, and once complete for trails, routes will be revisited on a larger scale to determine the effectiveness of their implementation and to address new and remaining issues related to fuel treatments, water quality, recreation management, and utility and private lands access. A greater emphasis will be put on strategic road and trail planning during a second round of ATMs, by analyzing existing alignments for impacts to resources and identifying additional reroute opportunities that allow for more sustainable operation and management.

Implementation of the Roads ATM has decreased the LTBMU road system by approximately 30% and applied BMPs to 70% of the remaining system roads. Approximately, 106 miles of roads have been

decommissioned, and 12 miles of roads were converted to trails. Of the remaining 257 miles of roads in the current system, 180 miles have received BMP upgrades (Kjar 2011). Some roads have been relocated away from surface water and riparian zones.

In addition, through monitoring and evaluation, BMPs have been refined to increase maintenance frequency and improve effectiveness. By increasing the maintenance frequency the overall road system costs less to maintain and receives a water quality benefit from reduced sedimentation from reduced disturbance. The BMPs themselves have evolved to create a road system that mimics natural hydrology patterns by reducing storm water concentration and maximizing natural drainage within the landscape.

Implementation of ATMs has resulted in an overall reduction in impacts to natural and historic resources and has resulted in an improvement in the quality of recreation opportunities. In addition, road and trail facilities have become more logical and organized and management to standards is more attainable.

Regulatory Framework

The Travel Analysis process (36 CFR part 212 subpart A) provides the guiding framework for ATM planning for the roads in the National Forest transportation system while the ATM process provides site specific analysis for implementation. Travel Analysis utilizes an interdisciplinary process of analyzing the risks and benefits of each road in the system. Risks and benefits to the various resources and their management are considered.

LTBMU completed a Travel Analysis Process (TAP) document in 2011. Due to the extensive work already accomplished through the ATM process, the TAP concluded that while there will still be opportunities to convert roads to trails, future road decommissioning will likely be driven more by acquisition of land that includes duplicate or unneeded roads than by elimination of existing unneeded roads (Kjar 2011).

Off–Road Vehicle (ORV) use is regulated by 36 CFR 212 subpart B, which is enforced through the LTBMU Motor Vehicle Use Map, 2010 (MVUM).. Subpart B requires the establishment of the MVUM which established a “closed unless designated open” rule for motorized use. The updated regulations restrict motorized users to designed trails, roads, and open areas, providing protection of resources.

Use of over-snow vehicles (OSV) on national forests is governed by the travel management regulations at 36 CFR 212.80-81, also known as Subpart C. These regulations state “Use by over-snow vehicles on National Forest System roads and National Forest System trails and in areas on National Forest System lands may be allowed, restricted, or prohibited” (36 CFR 212.81). Areas open to use by over-snow vehicles on the LTBMU are shown on the Lake Tahoe Basin Management Unit Snowmobile Guide 2012/2013.

Analysis Assumptions

In the analysis for this resource, the following assumptions have been made:

1. Existing unauthorized roads or trails would be added to the system or closed and restored.
2. Existing unauthorized roads that provide needed access such as utility easements that are included under special use permits would be added to the managed road system in the future.
3. Opportunities for aquatic organism passage will be prioritized, inventorying all stream crossings and identifying the crossings that have the greatest impact for aquatic organism passage.
4. Opportunities for water quality protection through implementation of BMPs will be identified and prioritized for funding, analysis and implementation.

5. Changes to road maintenance levels would affect surface conditions and BMPs would be maintained regardless of changes to maintenance levels.

6. Roads and trails will be relocated out of sensitive areas (Stream Environment Zones, habitat Protected Activity Centers, known heritage resource sites, etc.) where possible.

7. Existing parking area capacities are estimated using counts from specific areas and projecting the use across the LTBMU.

3.4.1.2. Overview of the Affected Environment

Current Conditions and Trends - Roads

The majority of the managed road system has been improved with additional BMPs through implementation of the Road Access and Travel Management Plan (ATM) that was completed in 1999. The Road ATM focused on water quality and the need for roads. A water quality risk assessment was completed before and after the road work; results are discussed in the Water Quality section of this document. The Road ATM inventoried, assessed, prioritized and implemented road projects for capital improvements and maintenance. The LTBMU was divided into 12 “Transportationsheds” for NEPA analysis, budgeting, and implementation.

Beginning in 2001, one or two transportationsheds were analyzed each year until the work identified in the Roads ATM was complete. Improvements on roads were designed to meet Forest Service, state and local standards for the protection of the clarity of Lake Tahoe and other forest resources. Actions from the Road ATM include:

- 180 miles of road were retrofitted to meet current BMP standards.
- 106 miles were decommissioned
- 12 miles were converted to trails

While the work identified in the Road ATM plan has been completed, there are issues that are unresolved, including utility access and private land access. Utility access is granted through easement or special use permits which have been inconsistently documented in the past. As a result there are discrepancies between where access is needed and where managed roads are located. Private land owners have a right to reasonable property access; however, it must be documented with a special use permit. Many of the private properties within the LTBMU do not have special use permits and the managed road system does not serve all of the private property access needs. In large part, existing roads are suitable; however, documentation of the access needs is a cumbersome process often involving legal counsel.

Current Conditions and Trends - Interagency Transit Planning and Opportunities

Public transit was in the early stages of development around the basin in 1988, during the previous forest plan. Today much of the basin is serviced by public transit. Demand, political willpower and changes in expectations are anticipated to fuel more efficient and higher capability public transit in the future. Many planning efforts have taken place that explore the potential for public transit development and key infrastructure such as bus turnouts, transit shelters, bike lanes, sidewalks, and bike paths are being added to communities to enable convenient and safe transit opportunities. The Forest has funded public transit to recreation sites around the lake. This has provided the existing public transit agencies the ability to offer this much needed service. Increased coordination with TRPA and the Tahoe Metropolitan Planning Organization (TMPO) to develop transit and increase non-auto mode share is expected

Current Conditions and Trends – Trails

The amount of overall use has changed substantially since the 1988 Forest Plan. Mountain biking has become a very popular form of recreation that has changed management needs. User conflicts, trail maintenance, and trail design are key issues. OHV use has experienced 274% growth from 1993 to 2003 according to the Off Highway Vehicle Recreation in the United States, Regions and States: A National Report from the National Survey on Recreation and the Environment (Cordell et al. 2005). Trail use by hikers is expected to continue to increase. Equestrian use in the basin remains relatively constant. Opportunities were identified in the 1988 Forest Plan to create trail loops and adopt approximately 78 miles of existing unmanaged trails into the managed trail system. Approximately 40 miles of trails have been adopted and upgraded to meet standards to date.

In 2001 the Trail ATM Planning process was initiated to assess the condition of the existing trail system and prioritize upgrades for analysis, budgeting, and implementation. Specifically, the ATM process has resulted in many unauthorized trails being obliterated, adopted and/or rerouted (including the 78 miles identified above). Additionally, system trails are being redesigned to meet Forest Service Standards defined by the Trail Management Handbook and Standard Specifications for Construction.

Beginning in 2003, trail transportationsheds were analyzed each year through the ATM process. Approximately 50% of the trail system has been analyzed and implemented. Improvements on trails were designed to meet Forest Service, state and local standards for the protection of the clarity of Lake Tahoe and other forest resources while providing for sustainable recreation access.

Actions from the Trail ATM include:

- 190 miles of trails were retrofitted to meet current BMP standards.
- 68 miles were decommissioned
- 12 miles of roads were converted to trails

Completed Trail ATM's include:

- Freel/Meiss
- High Meadows
- Angora Fire Restoration
- North Shore
- East Shore Beaches
- Daggett Summit
- Fallen Leaf Lake ATM is in the final stages of analysis and is included in the mileage above

Trail ATM's to be completed include:

- Desolation Wilderness Trails
- Incline Village Trails
- West Shore Trails
- Genoa Peak Trails

The LTBMU has collaborated with many trail users to establish the current trail system. Among those user groups are the Pacific Crest Trail Association, Tahoe Rim Trail Association, Tahoe Area Mountain Bike Association, League to Save Lake Tahoe, Tahoe Sierra Club, Back Country Horsemen, and the Blue Ribbon Coalition. The emergent trail system provides for recreation opportunities that reflect the values of the user groups in the Tahoe region.

The public needs of the trail system encompass multiple social and economic aspects. The need for forested mountain trails for rejuvenation, adventure, fitness, and health has always been a community

focus at Lake Tahoe and is a rising national priority. A connected trail system linked with transit provides the basis for an outdoor recreation-rooted economy to thrive.

Current Conditions and Trends – Trailheads and Parking

The 1988 Forest Plan called for improving trailheads to provide dispersed recreation opportunities outside of Desolation Wilderness. Most trails do not currently have planned trailheads or parking areas and many have native surface, user created parking. There have been strides to improve trailheads and many more opportunities for dispersed use trailheads exist. Where roadside parking is allowed there are dispersed use opportunities, however, roadside parking causes other problems such as congestion and erosion of road shoulders. Further, roadside parking areas tend to grow if barriers are not installed. Lastly, most roadside parking opportunities are not available during the winter season for dispersed use.

The Trail ATM does address summer needs for dispersed trailheads and Best Management Practices upgrades. The Trail ATM does not address winter trailhead needs or problems. There are many areas that are not accessible even after snow removal has been completed. Many county snow removal and winter parking ordinances do not allow for roadside parking when snow is present, which has limited many winter dispersed recreation opportunities such as backcountry skiing, snowshoeing, and snowmobiling.

Current Conditions and Trends - OHV

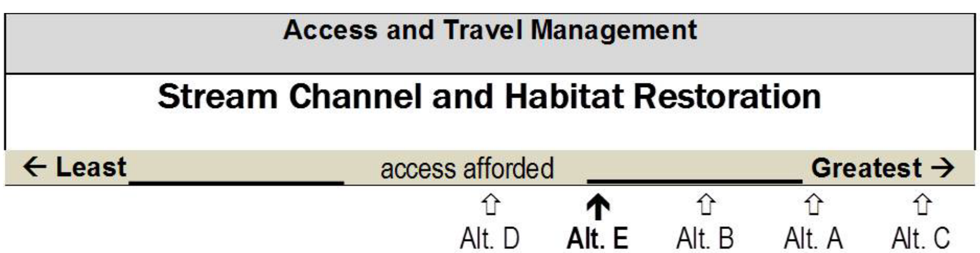
OHV routes include both roads (115 miles) and trails (15 miles). OHV use on the LTBMU has been restricted to designated routes and areas since the 1976 ORV Plan was completed. The LTBMU will continue to manage the OHV system as a designated route system. The current designated OHV system is shown on the LTBMU Motor Vehicle Use Map.
OHV use has increased dramatically since 1988. The overall result is an increased demand on forest roads and trails within the basin. As routes become more heavily used, maintenance frequency and maintenance standards may also need to increase for protection of forest resources.

Current Conditions and Trends - OSV

OSV use is described and analyzed in Section 3.4.19 – Recreation.

3.4.1.3. Environmental Consequences

Stream Channel and Habitat Restoration



Stream channel and habitat restoration management activities have the potential to reduce parking and forest access routes where existing routes or parking areas have adverse impacts that do not meet desired conditions. This could involve reduction in parking for access to both dispersed and develop recreation opportunities. In addition, restoration could include decommissioning of unauthorized routes and reroutes of authorized routes.

Restoration management activities under Alternative D would result in the most roads and trails rerouted or decommissioned. Alternatives A, B, and E would result in less roads and trails rerouted or

decommissioned than D and more than C. Alternative C would result in the least amount of roads and trails rerouted or decommissioned. In Alternative C, roads and trails would be upgraded in place except where mitigation does not offset impacts to the degree necessary to meet resource protection objectives

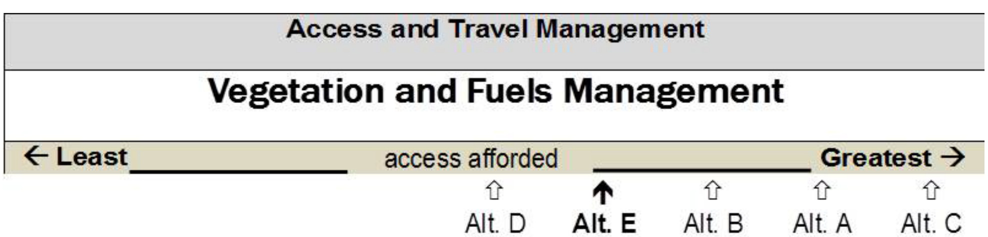
Vegetation and Fuels Management

The effects from vegetation and fuels management activities on forest access will be an opening of the forest which may increase roadside pullouts as a result of vegetation management and may affect the distribution of road maintenance levels across the forest. Vegetation and fuels management work access needs have changed. The level of road development or road maintenance level may change as a result of access needs for vegetation and fuels management, in addition to recreation access needs. . Treated areas will be much more open and "cross country" travel through the forest will become easier in areas that are treated. Projects include measures to restore areas impacted by equipment and discourage establishment of user-created roads and trails.

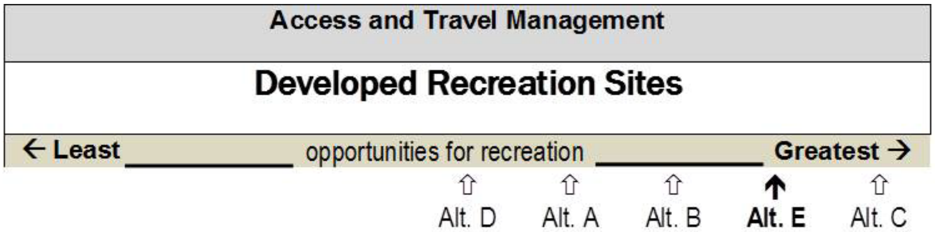
Alternatives A, B, and E would have similar effects on road building and road use and would be similar to those that are currently occurring for mechanized fuel treatments.

Alternative C would result in slightly more temporary road building and could result in larger or additional landings in order to accomplish greater vegetation management objectives. More roads would be operated at higher maintenance levels providing for more road access to licensed motor vehicles. In addition, this alternative would require greater road maintenance as a result of additional road use (hauling) to support fuels treatments and biomass removal. Temporary roads would be restored to pre-project conditions following fuels management activities. Treatments will require a variety of methods including the use of skidding, helicopter removal, forwarders, yoders and cut to length. All methods have different access needs and would require modification of the existing road system or existing landings.

Alternative D would require more access for hand treatments and for pile burning activities than other alternatives and would not require the same degree of road or landing construction and maintenance. The effect would be less maintenance needs to roads due to less hauling on roads. In addition, the road system would be operated to a lower standard and provide less motorized access for passenger vehicles and more motorized access for high clearance and unlicensed motor vehicles (Off Highway Vehicles, not requiring motor vehicle license).



Developed Recreation Sites

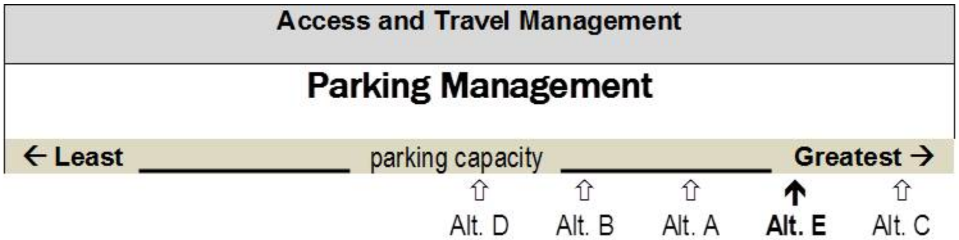


In general, developed recreation sites would tend to shift towards consolidated access routes and parking facilities that would incorporate mode transfer (i.e., bus to bike, shuttle to foot, car to foot, etc.) to promote use of transit or bike path systems over the private automobile. In areas where roadside parking is reduced or eliminated the parking demand could be absorbed within managed recreation sites and creating associated parking facilities and the amount of new parking is dependent upon the chosen alternative. All alternatives would result in a reduction in overall unmanaged roadside parking and would encourage development in support of transit and bike path systems. Alternative C would result in greater opportunities over other alternatives to maximize trail access to developed recreation sites by upgrading trails and constructing new trails. Developed recreation sites would have similar connections under all alternatives; however, the level of trail development would be greater under C and provide for the greatest trail access. Upgrades could include trail widening, trail surfacing, directional signage, trailhead development and other site specific upgrades.

Alternative D would result in a reduction in developed recreation sites which could result in reduced parking facilities and vehicle access to sites that are removed.

Alternative A would maintain existing developed recreation levels and its associated road and trail systems. Alternatives B and E would result in slight increases in developed recreation and slight increases in their associated road and trail systems.

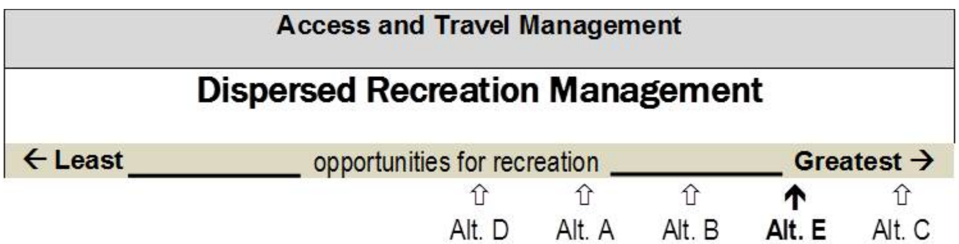
Parking Management



Alternative C would accommodate the most managed parking and Alternative D would accommodate the least. Parking is expected to continue to shift towards managed parking in areas of high use under all of the alternatives. Alternative C would provide for the most managed parking and Alternative D would provide the least

Parking capacity in Alternatives B and E would remain the same as Alternative A, however, more of that parking would be managed in the future. Parking capacity in Alternative C would increase over Alternative A, with a shift to more managed parking in the future. Parking capacity in Alternative D would reduce over Alternative A with a shift to more managed parking in the future. While more areas could be converted to managed parking or added as managed parking to address changes in developed recreation in the future, Alternative D would add the least.

Dispersed Recreation Management



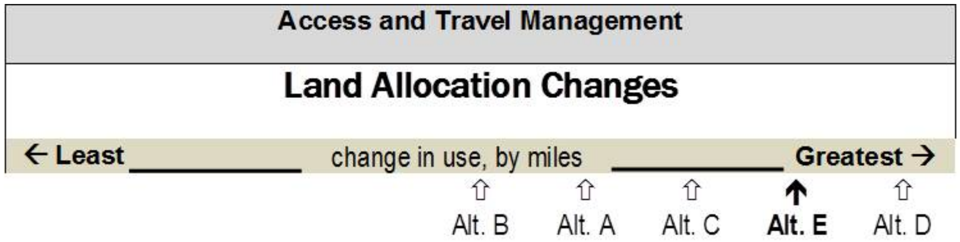
Dispersed recreation management is closely tied to the degree of designated backcountry and recommended Wilderness. Alternatives C and D increase Wilderness areas and have the greatest potential changes to access. Specifically, the changes to access would be a reduction in motorized and mechanized trail access (see table 2-3).

Alternatives A and B would continue the current trend of dispersed recreation management. Approximately 40 miles of trails would be adopted for management under this alternative as Trail ATMs are completed. Road and Trail ATMs would additionally address parking where dispersed parking is causing impacts that do not meet management objectives. Alternative E is similar to Alternative B, however more area is designated as backcountry. Construction of new road would not occur in backcountry, although trails could be authorized if consistent with area ATMs.

Alternative C would provide more access for passenger vehicles by increasing maintenance levels of more miles of roads and by providing more managed parking than other alternatives.

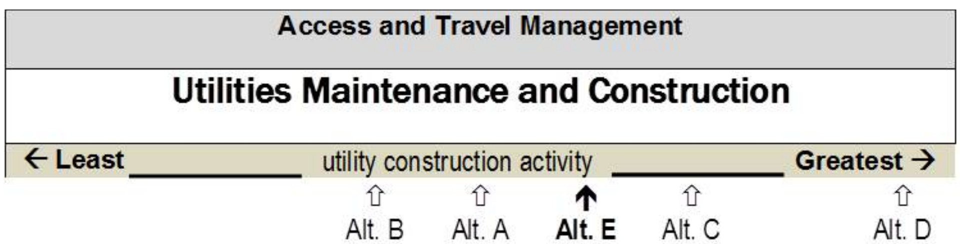
Alternative D would provide more mileage of roads open to OHVs and high clearance vehicles, and decrease access for passenger vehicles by reducing road maintenance levels.

Land Allocation Changes



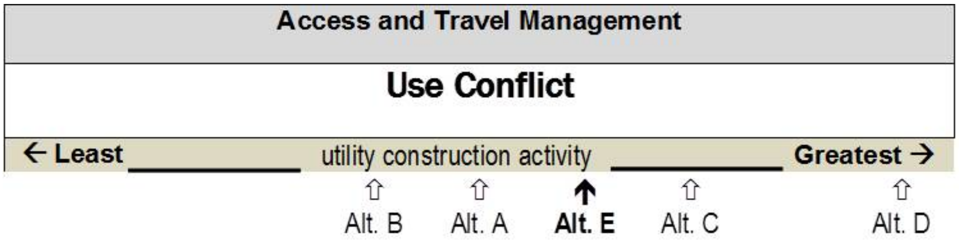
Land allocation changes have the greatest cause and effect relationship with modes of access to the National Forest. The cause of designation of additional Wilderness areas would have the effect of closing those areas to mechanized and motorized uses thus changing the mode to pedestrian and equestrian modes. The effects are not upon the miles of roads and trails, but upon the modes allowed. Additional Wilderness designations would eliminate current mechanized trail users in Alternatives C and D. Alternative D would also increase miles of roads open to high clearance vehicles and OHVs as a result of downgrading road maintenance levels (i.e., Maintenance level 2 roads are open to both licensed and unlicensed OHV, maintenance level 3 and higher roads are open to highway legal vehicles only). Additional backcountry areas in Alternatives D and E would reduce the miles of OHV trails open to motorized users and not allow for future road building within those areas

Utilities Maintenance and Construction



The alternatives could affect utilities maintenance and construction depending upon the degree of permanent road building needed to support the infrastructure. The alternatives could create situations where land that is currently suitable for utility location becomes unavailable due to management area designation such as backcountry or Wilderness. Alternative D would be the most restrictive for new utilities with Alternatives A and B being the least restrictive. Under Alternative D some sites currently suitable for cell tower development may not be suitable due to Wilderness or Backcountry designation.

Use Conflict



Effects upon use conflict would be relatively consistent between alternatives. In Alternative A, B, and E use conflict would continue along current trends and may decline as miles of unauthorized trails decrease. More use would be focused on managed trails, however those trails have informational signage and trail designs that minimize conflict. Trails are designed to minimize conflict by using contouring trails, establishing adequate clearing limits, and by meeting recreation use needs.

Alternative D would focus mountain bike and OHV use into less area as a result of Wilderness designation. In addition, fewer developed parking areas would provide less opportunity for education about trail sharing and etiquette. Alternative C would increase road maintenance levels and reduce the number of roads open to OHVs which would increase OHV use of the remaining roads. Increasing the concentration of use could cause an increase in use conflict. Alternative C would also allow for more managed parking areas and more educational opportunities to mitigate use conflicts.

3.4.1.4. Analytical Conclusions

Effects upon access between alternatives are primarily a result of changes to the Land Management Areas and creation of new Backcountry and Wilderness areas. Alternative D would have the greatest impacts to access if additional Wilderness would be designated; this would mainly limit mechanized (mountain bike) access.

Comparison of Consequences by Alternative

Alternative A

Alternative A would continue the existing trends of access on NFS lands.

Alternative B

Similar to Alternative A this alternative would continue along existing trends with minor changes to the road system and an increase in mechanized trail access. This alternative balances public access needs with resource goals. Alternative B would manage currently unmanaged parking areas which would provide an opportunity for interpretation and conservation education.

Alternative C

Alternative C would increase passenger vehicle road access, develop the highest degree of transit facilities and provide the most developed trail system. The most managed parking would be added in this alternative.

Alternative D

This alternative would restrict passenger vehicles the most, however, OHV opportunities on roads would increase, and roadside parking would decrease in high use areas.

Alternative E

Similar to Alternatives A and B, this alternative would continue along existing trends with minor changes to the road system and an increase in mechanized trail access. This alternative balances public access needs with resource goals. Alternative E would manage currently unmanaged parking areas which will provide an opportunity for interpretation and conservation education.

How the Alternatives Maintain or Achieve the Desired Conditions

All alternatives would meet the desired conditions however there are differences in timing, and the extent to which the desired conditions would be met.

Alterative A is trending towards meeting desired conditions.

Alternatives B and E both balance resource protection with access and recreation desired conditions.

Alternative C would meet the desired conditions for more managed recreation most quickly; however, other alternatives address public access needs more efficiently by providing a balance between resource protection and access.

In Alternative D, more areas would have the potential for Wilderness designation which would further restrict mechanized and motorized use. While there are no public motorized roads or trails in the recommended Wilderness, there are administratively accessed areas for forest and utility access that could be affected. This alternative would also take longer to meet the desired condition for managing parking. Alternative D would decrease road maintenance levels.

3.4.2. Air Quality

3.4.2.1. Introduction

This report evaluates the potential environmental consequences on air quality resources that may result with the adoption of a revised land management plan. It examines, in detail, five alternatives for revising the 1988 Lake Tahoe Basin Management Unit Land and Resource Management Plan. Planned Forest activities will result in the generation of varying amounts of pollutant emissions. Air Quality is affected via two types of pollutants, viz., primary, secondary, and greenhouse gases that can pollute the air for human health, forest health, visibility, acid deposition, and climate change. Primary pollutants such as particulate matter (PM), volatile organic compounds (VOCs), carbon monoxide (CO), nitrogen oxides (NOx), and sulfur oxides (SOx) that can affect human health, are directly generated from sources such as industrial facilities, autos and other mobile sources, and forest processes and activities including fire. Secondary pollutants, for example ozone (O_3), are chemically transformed from the primary pollutants VOCs and NOx. Forest fire emissions in addition to primary pollutants that affect human and forest health, also include the carcinogenic air toxics like acrolein, benzene, mercury, and formaldehyde. Black carbon (BC) and Greenhouse Gases (GHGs) including carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O) impact climate. Pollutants are easily transported long distances away from the point of origin which adds complexity to when attempting to restore non-attainment areas to attainment and improving visibility for Class I areas.

Different air regulatory agencies, viz., federal, state, and local, have created laws, rules and regulations for control and reduction of the air pollutants. Pollutants like sulfate (SO_4), nitrate (NO_3), organic, and elemental carbon (soot) reduce visibility. The EPA requires all states to develop attainment plans (State Implementation Plans - SIPs) to improve air quality in non-attainment areas and improve visibility in Class I areas. California has developed SIPs for ozone and $PM_{2.5}$ non-attainment areas and visibility for all 29 Class I areas that are located in the state. The EPA approved the visibility plan submitted by CA state in April 2011. The LTBMU has one Class I area (Desolation Wilderness) and is in nonattainment for ozone (Eldorado and Placer county areas). The forest is required to comply to both SIP requirements for all its projects and plans (see Table of Issues and Indicators).

Forest conditions in the Lake Tahoe Basin before Euro-American settlement were strongly shaped by fire. Historic ecological data on these fire-adapted forests provide a highly useful template for designing future forest conditions (structures, compositions, processes, etc.) that are more likely to be resilient to warming climates and intensifying wildfire activity (Section 3.4.11 Forest Vegetation). Jeffrey pine-dominated forest types in the Lake Tahoe Basin have experienced 100+ years of heavy logging, grazing, and fire exclusion (Sugihara et al. 2006). Fuel loads are extremely high in the forests of the Lake Tahoe Basin in large part because of the suppression policy followed by the agency during the early twentieth century. Wildfires are increasing in intensity and size. Estimated pre-1800 fire emissions of carbon dioxide from forests in California range from 23.1 to 62.6 terragrams (Tg) of carbon dioxide per year (Stephens et al. 2007). The average annual estimate of carbon dioxide emissions from fire in California from 2001 to 2008 was 17.8 Tg carbon dioxide per year. However, 2008 had substantially higher emissions (54.5 Tg carbon dioxide) as a result of a large number of lightning-ignited fires (Wiedinmyer and Hurteau 2010). Although recent annual fire emissions are either below or within the range of historical emissions of carbon dioxide in California, they are well below the upper bound.

To reduce the intensity and size of future wildland fires, fires burning within historic normal are needed to protect public and forest health and reduce the overall contribution of GHG emissions to climate change from the high amounts of smoke and pollutants that are generated during high intensity wildland fires.

Wildland fires can be a major source of air pollution emissions. The EPA has set standards for criteria pollutants (that include PM_{10}, $PM_{2.5}$, CO, NOx, SOx, VOCs, ozone, and lead) to protect public health.

Wildland fires are also a source of black carbon, which is known to contribute to increased melting of glaciers and polar ice.

Off road recreational vehicles like snowmobiles can contribute to some criteria pollutants and CO2 in winter. The state of California is in the process of adopting new emission standards for recreational engines and vehicles that will reduce future emissions. The new requirements vary depending on the kind of engine or vehicle. The emission standards apply to all new engines sold in the state and any imported engine manufactured after these standards begin.

The concept of carbon carrying capacity, the amount of carbon that can be stored in a system by watershed condition units (HUC6) as a function of prevailing climatic conditions and natural disturbance regimes, has been proposed as a potential foundation for carbon management plans (Keith et al. 2009, 2010, Hurteau et al. 2010). Managing within the carbon carrying capacity for forests requires incorporating an understanding of fire and stand dynamics (North et al. 2009). Altering forest structure by thinning smaller trees and then carrying out prescribed burning aggregates carbon into fewer larger trees and reduces the potential for high-severity fire (Stephens and Moghaddas, 2005; Finkral and Evans, 2008; Hurteau and North, 2009; North et al., 2009). These actions may reduce the amount of standing carbon in trees, but they will improve the stability of these carbon stocks over time. Management objectives (to achieve fire resiliency) in this context could be focused on achieving a balance between carbon stock size and carbon stabilization that falls within the carbon carrying capacity of the forest.

Regular prescribed fires or other management fires are necessary following thinning treatments to manage surface fuels and maintain high-severity fire resistance (Hurteau and North 2009). Although understanding the short-term effects of fire on a system and the emissions associated with fire are important for managing air quality, these effects need to be viewed over the long term to better account for the effects of fire on carbon stocks (Hurteau 2011). Over the long term, fire effects on terrestrial carbon stocks are a function of the balance between carbon loss from direct fire emissions and decomposition and carbon gain from vegetation regrowth. If the successional pathway that resulted in the pre-fire forest remains unchanged, the recovering forest will transition from a carbon source to a carbon sink, and with sufficient time, the forest will re-sequester all of the carbon lost from both direct and indirect sources. Another Forest Service practice of slash-for-fire to slash-for-Biochar could be considered because it sequesters carbon over a longer time period and minimizes the risk of release through forest fires. In addition, Biochar can alter soil structure, soil productivity, and nutrient and water retention.

If milling waste is used as biofuel to generate electricity, the carbon contained in this material can be used to offset fossil fuel based energy.

Since the original Forest Plan was written, many new laws, regulations, and rules have been implemented that impact the management of air quality and forest ecosystems. Forest actions must comply with these new regulations. A new regional fuel strategic plan (under development) seeks to treat half a million acres out of 20 million acres managed by FS in California per year. Public support for planned and unplanned fires is essential to reduce the health impacts of smoke. Revising the Forest Plan provides the opportunity to incorporate policies and practices directly into the guiding documents supplying goals, strategies, objectives, and standards and guidelines based on new science and regulations not available when the 1988 Forest Plan was developed.

Issues, Indicators, and Methodology

For air quality analysis and understanding, NEPA documents need to describe the laws, rules, and regulations released by the air regulatory agencies. Air emissions do not stop at jurisdictional boundaries, but are transported long distances from their point of origin. Released pollutants can impact human

health, forest health, visibility, climate change and aerosol deposition. The air quality issues, indicators, and methodology are as follows:

Air Quality Issues

Key issues related to air quality impacts include the following:

1. Human health impacts.
2. Forest health impacts.
3. Climate change (GHGs emissions and CO_2 sequestration, black carbon).
4. Impacts to visibility.
5. In addition, effects of acid, N compounds, and mercury deposition on terrestrial forest health are of concern; however, the alternatives would not materially affect deposition because the major sources of deposition are coming from outside. So the issue is not analyzed in detail.
6. Conformity (for nonattainment areas) with SIPs.
7. Ozone injury.

Air Quality Indicators

The following Indicators are used to quantify impacts for each issue (Table 3-5**)**.

1. Amount of pollutant emissions resulting from prescribed burning and wildland fire.
2. Amount of black carbon emissions resulting from prescribed burning and wildland fire.
3. Amount of greenhouse gas emissions resulting from prescribed burning and wildland fire.

   3a. Amount of pollutant emissions resulting from snowmobiles. Amount of pollutant emissions from other off-road vehicles would not be of magnitude greater than snowmobiles.

4. Amount of emissions averted.
5. Amount of carbon sequestered.
6. Tons of biomass removed for potential wood products, bioenergy, and/or biochar production.
7. State Implementation Plan for ozone and visibility, and ozone injury trend.
8. Amount of emissions averted by the forthcoming state rules with projected phase into100% of new non-road recreation vehicles by 2020 (CARB 2013b).

Table 3 5. Summary of Air Quality Issues and Indicators

Issues	Indicators
1. Human health	1,4,5,3a,8
2. Forest health	1,3,4,5,6
3. Climate change	2,3
4. Visibility	1,4,5,6,3a,8
5. Deposition	External sources
6. Conformity	7
7. Ozone injury	7

Methodology

The management of air quality involves the identification of the sources of pollutants emitted into the air, the quantitative estimation of emission rates of the pollutants, the understanding of the transport from the source, and the knowledge of the physical and chemical transformation processes that can occur during the transport. These elements can then be combined to produce a mathematical model that can be used to estimate the changes in observable air borne concentrations that might be expected to occur if various actions are taken. The atmosphere is a very complex system and it is necessary to greatly simplify some processes in order to produce a mathematical model capable of being calculated on the largest and fastest computers. These steps and simplifications lead to further uncertainties.

The emissions from forest fires were estimated on the basis of forest biomass burned or removed. The largest uncertainties relating to emission calculations are fuel loading and burn efficiency. The formula used to calculate emissions, assumptions made, and mitigation measures for the air quality analysis are given below.

Formula

The biomass data (bone dry tons) utilized under different alternatives for each treatment was supplied by the Regional Analyst/Modeler (see Section 3.4.10 - Fire and Fuels for description of modeling). Emissions for criteria pollutants, greenhouse gases, and air toxics are calculated from the provided data using the following formula (based on the work of CARB (2013b), Hardy and Others (2001) and Ahuja (2006)):

$$\mathrm{PE}_i = \mathrm{DBC} \times \mathrm{EF}_i \times {}^{1}\!/_{2000}$$

PE_i = Pollutant emissions of type *i* (tons)

DBC = Dry biomass consumed (bone dry tons) supplied by Regional Analyst/Modeler

EF_i = Emissions Factor for *i* species in lbs/ton of biomass consumed

1//2000 factor is to convert emissions from lbs to tons.

The emissions from snowmobiles are estimated based on engine type (2 or 4 stroke), hp and number of hours the vehicle used (EFMAC 2013).

Assumptions

The following assumptions with uncertainties as described above were made in this air quality analysis:

- Emissions are based on modeled outputs for biomass consumed or removed.
- This section analyzes the effects of alternative strategies, and not site-specific project designs; fuel treatments are assumed to be effective at conditions for which they were designed. Therefore, unless otherwise specified, treated biomass is assumed to be as effective as treated biomass in any other alternative.
- Weather, resource availability, smoke dispersion, and other conditions necessary for implementation of a prescribed fire are based on models that have associated uncertainties. Any project acres of prescribed or wildland fire managed to meet resource benefits or objectives are based on the assumption that the smoke management plan/burn plan has been submitted and authorization has been received from the applicable regulatory agency.
- For site specific projects, outputs from models like PFIRS and Blue Sky (available from Desert Research Institute (DRI), University of Nevada Reno) are utilized to determine plume location and pollutant concentration and released to the public and various agencies to reduce impacts on public and forest health.
- Passive monitoring every 3-5 years is conducted to monitor trends of ozone, acid and nitrogen (N) deposition. The biomass removed for bioenergy and wood products is used to calculate GHGs and black carbon emissions averted.
- Mitigation measures to minimize adverse air quality impacts are determined during project planning for application during project implementation.
- Watershed assessments, to prioritize restoration actions over time, are done and improvements evaluated.
- The IMPROVE monitoring site at Bliss is maintained to monitor visibility for the Desolation Wilderness (a Class I area) as required under the state SIP.
- An accounting for watershed (HUC6 units) carbon budget for GHGs released vs. sequestered is tracked and compared over time to calculate the carbon footprint and the possibility for offset credits with collaborators under cap-and-trade. A trade-off between emissions produced with and without application of emission reduction techniques (ERTs) is calculated and utilized for a change in management strategies.
- Emissions shown for prescribed burn include all planned ignitions. Wildfire emissions are from unplanned ignitions.
- Exhaust emissions are calculated for snowmobiles. Evaporative emissions are assumed to be small and insignificant and are not included in the data. The engine standards being adopted by the state will further reduce evaporative emissions.

Mitigation

In addition to the modeling assumptions outlined above, the air quality analysis assumes that the mitigation measures described would be implemented.

Mitigations common to all alternatives are:

- Fuel load reduction.
- Appropriate fuel moisture content.

Mitigations for minimizing PM_{10}/ $PM_{2.5}$ emissions are:

- Dust abatement during project implementation.
- Allowing for adequate cure time before igniting slash material.
- Covering of hand-piled slash for more efficient burning conditions.

Mitigation measures for fugitive dust:

- Water application.
- Use of dust abatement surfacing material application.

Mitigation measures for greenhouse gases:

- Emissions or sinks for GHGs at the forest level are too small to provide meaningful information to translate the information into global climate change. Mitigation strategies that the agency can use include the following:
- Overstocking reduction.
- Encourage species that are tolerant to climate change.
- Degraded ecosystem restoration.
- Increase carbon sequestration through the implementation of applicable ERTs.
- Consider non-burning alternatives for fuel reduction when possible (mechanical treatment, biomass for co-generation, and biochar where economically viable and technically feasible).
- Consider harvesting timber for wood products that increases residence time of sequestered carbon. The strategies that have been proposed for using forests to slow the amount of CO_2 entering the air (Ryan et. al, 2010) include avoidance of deforestation, afforestation, forest management (decreasing carbon loss, increasing forest growth, thinning to reduce fire threat), urban forestry, biomass energy production, carbon storage in forest products.
- An evolving practice that needs more research and equipment development is slash-for-biochar in place of slash-for-burn (Hurteau et al. 2011, Hurteau et al. 2009, Hurteau et al. 2008). Emissions from fossil fuels are the largest contributors to the anthropogenic greenhouse effect. The process that reduces CO2 must be long term and substantial, must be accountable, and must have a low risk of large-scale leakage (Lehmann, J. 2007). Biochar-sequestration can meet these criteria. When combined with bioenergy production, it is a clean energy technology, which reduces emissions as well as sequesters carbon.

Mitigations for Black Carbon:

- Mitigation measures that are applicable to GHG reduction also help in reducing black carbon production. The largest forest generated emissions of black carbon are from wildland fire (Bond et al. 2004). These emissions are typically generated in the summer and fall. The short residence time (2 weeks) of BC and the timing of emissions minimize the impacts of BC emissions to climate change and enhanced snowmelt.

Mitigations for Snowmobile Emissions

- The state of California is adopting new standards for several types of off-road recreational vehicles (including snowmobiles) that will reduce future emissions. No mitigations are proposed. The forest also has authority to limit the numbers of vehicles during permit issuance. Emissions from snowmobiles are generated during winter when there is snow on the ground and temperatures are low. This limits the formation of unhealthy ozone from NOx emissions. However any entrapped emission constituents are released during snow melt, including black carbon. These may get deposited in the soil or discharged into the lake (McDaniel and Zielinska 2013, and McDaniel 2013).

3.4.2.2. Overview of the Affected Environment

Existing Regulatory and Ambient Air Quality

Jurisdictional

The LTBMU area falls under the jurisdiction of both California and Nevada. For air quality management, California is divided into fifteen air basins, the boundaries of which are based on geographical and meteorological considerations, and follow political boundaries to the extent practicable. Several jurisdictions are responsible for the management and enforcement of air quality standards for the LTBMU. The California portion of the LTBMU is in two air basins, viz. Lake Tahoe (parts of the Eldorado and Placer counties) and Great Basin (parts of Alpine county).

The Nevada portion of the LTBMU falls in Washoe, Douglas, and Carson City counties. For purposes of the SIP, Nevada is divided into three jurisdictions: Nevada Division of Environmental Protection (NDEP), Clark County (which houses Las Vegas), and Washoe County (which houses the Reno-Sparks metropolitan area). The Clark County Department of Air Quality and Environmental Management, as well as the Washoe County District Health Department Division of Air Quality Management, have been delegated the responsibility to complete SIP requirements for their respective county areas. NDEP is responsible for the rest of the state of Nevada. Figure 3-1 shows the Lake Tahoe area with the air quality management jurisdictional boundaries.

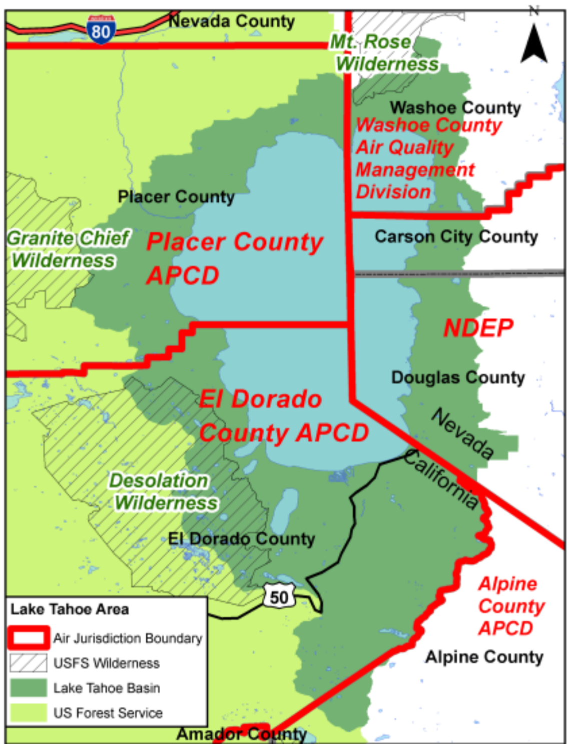


Figure 3-1. Air Quality Jurisdictions for LTBMU Area

Pollutants from anthropogenic and natural sources are ubiquitous to the air resource. Typically, anthropogenic sources such as vehicle exhaust and industrial emissions have the most adverse effects to human and ecosystem health. Wildland fire can be an important contributor to exposure for the public, particularly those that recreate in or live near the forest. Public health effects are dependent on pollutant type and concentration (dose) and on the sensitivity of the person (receptor). The primary regulated

pollutants are: Particulate Matter (PM10/2.5), Ozone (O_3), Carbon Monoxide (CO), Nitrogen Dioxide (NO_2), Sulfur Dioxide (SO_2), Lead (Pb), Sulfate (SO_4), Hydrogen Sulfide (H_2S), Vinyl Chloride, and Toxic Air Contaminants (TAC).

National Ambient Air Quality Standards (NAAQS)

To protect human health and welfare, the EPA established primary and secondary NAAQS for the six Criteria Pollutants: Particulate Matter (PM_{10}, $PM_{2.5}$), Ozone (O_3), Sulfur Dioxide (SO_2), Nitrogen Dioxide (NO_2), Carbon Monoxide (CO), and Lead (Pb).

Federal and California standards for these pollutants are shown in Table 3-6.

Table 3 6. National and State Ambient Air Quality Standards (µg m^{-3} (ppm))

Primary Standards			
Pollutant	**Averaging Time**	**Federal**	**State**
PM_{10}	Annual	-	20
	24 hour	150	50
$PM_{2.5}$	Annual	12	12
	24 hour	35	-
CO	8 hour	10 mg/m^3 (9)	10 mg/m^3 (9.0)
	1 hour	40 mg/m^3 (35)	23 mg/m^3 (20)
	8 hour (Lake Tahoe)	-	7 mg/m^3 (6)
NO_2	Annual	100 (0.053)	57 (0.030)
	1 hour	188 (0.100)	339 (0.18)
SO_2	24 hour	-	105 (0.04)
	3 hour	1300 (0.5)	-
	1 hour	196 (.075)	655 (0.25)
Pb	30 day average	-	1.5
	Calendar Quarter	1.5	-
	Rolling 3-mo ave.	0.15	-
O_3	1 hour	-	180 (0.09)
	8 hour	147 (0.075)	137 (0.070)
Sulfates	24 Hour	**For California Only**	25
Hydrogen Sulfide	1 hour	**For California Only**	42 (0.03)
Vinyl Chloride	24 hour	**For California Only**	26 (0.01)
Visibility Reducing Particles	8 hour	**For California Only** Extinction coefficient of 0.23 per km - visibility of ten miles or more (0.07-30 miles or more for Lake Tahoe) due to particles when relative humidity is less than 70%	

- *Annual standards are never to be exceeded. Other standards are not to be exceeded more than once a year* CARB (11/17/2008)

Key- PM_{10}/$PM_{2.5}$= Particulate Matter ; **CO**=Carbon Monoxide**;** **NO_2=**Nitrogen Dioxide ; **SO_2=**Sulfur Dioxide ; **Pb**=Lead **;** **O_3=**Ozone

Nonattainment Area and Conformity

If federal standards are violated in any area, that area is designated as “non-attainment” for that pollutant and the state must develop a plan for bringing that area back into “attainment.”

El Dorado and Placer counties are designated 8-hour ozone nonattainment areas for both the federal (Figure 3-2 and California standards Figure 3-3). The federal agencies must make conformity determinations for projects to be implemented in nonattainment areas.

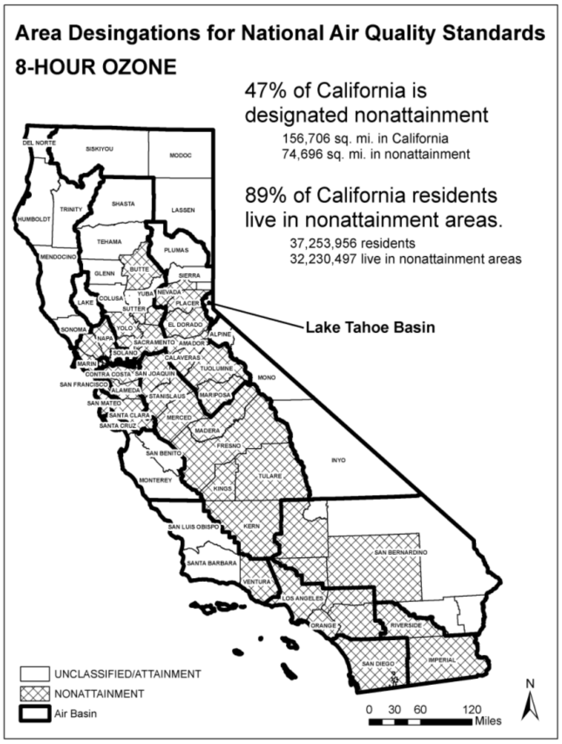


Figure 3-2. Area designations for federal 8-hour ozone

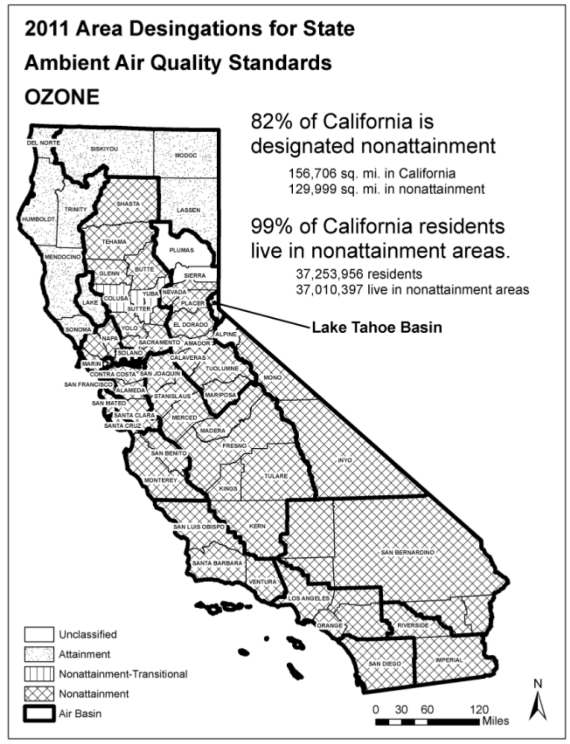


Figure 3-3. Area designations for state 8-hour ozone

Prescribed and Wildland Fire and Conformity

The Lake Tahoe Basin Management Unit follows Title 17 of the California Code of Regulation – Subchapter 2, Smoke Management Guidelines for Agriculture and Prescribed Burning. Implementation of prescribed burning will only occur after approval from the appropriate state or county air regulator. The new conformity rule states that “*the prescribed burns conducted in accordance with a smoke management program (SMP) which meets the requirements of the EPA’s Interim Air Quality Policy on Wildland and Prescribed Fires or an equivalent replacement EPA policy" are considered as "presumed to conform.*" The EPA has approved California's revised Title 17 regulations as an equivalent of a SMP. Therefore, the projects will fall under "presumed to conform" for implementing prescribed burning. Therefore, the conformity determination requirement will be met for all burns under these conditions.

The most recent large wildfire in the Lake Tahoe Basin occurred in 2007 (Table 3-7).

Table 3 7. Wildland fire acres in the Lake Tahoe Basin from 2001 to 2010

Year	Acres
2007	3,128
2008	5
2009	8
2010	8

Smoke impacts were widespread historically in California with smoke impact in recent years well below typical (Stephens et al. 2007).

Naturally Occurring Asbestos (NOA)

Figure 3-4 shows the areas most likely to contain Naturally Occurring Asbestos (NOA) in areas of California nearest to the Lake Tahoe Basin. The nearest NOA area is 22 miles from the forest boundary.

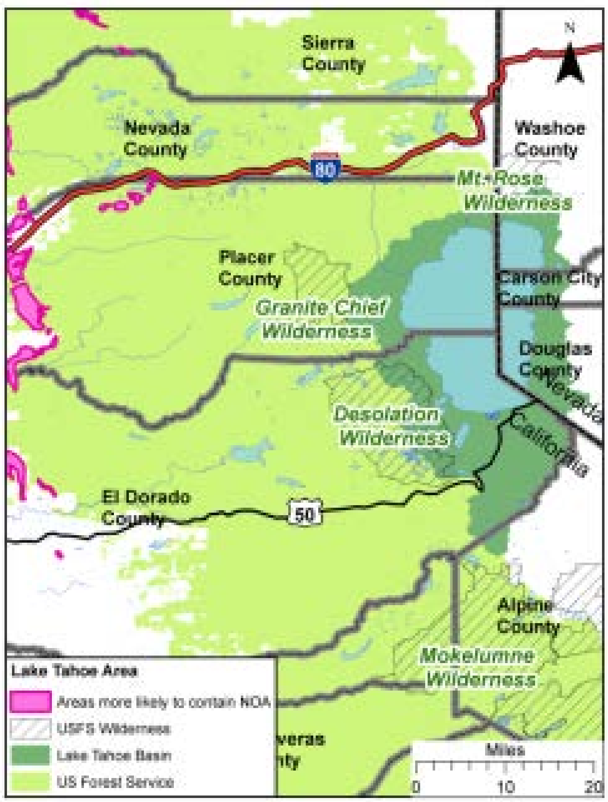


Figure 3 4. Areas likely to contain NOA in the Lake Tahoe Area

Existing Emissions

Emissions are tracked by county, air basin, and state. Statewide (CA), Lake Tahoe Air Basin, the El Dorado portion of the Lake Tahoe Basin, the Placer County portion of the Lake Tahoe Basin, and Alpine County (Great Basin Valleys Air Pollution Control District) estimated annual average emissions in tons

per day for natural sources (including wildfire) are shown in Table 3-8 (CARB, 2009b). Emissions are shown for Total Organic Gases (TOGs), Reactive Organic Gases (ROGs), Carbon Monoxide (CO), Nitrogen Oxide (NOx), Sulfur Oxide (SOx), Particulate Matter (PM), Particulate Matter less than 10 micron (PM_{10}), Particulate Matter less than 2.5 micron ($PM_{2.5}$).

Table 3 8. 2010 Estimated annual average emissions (tons/day) for natural sources (including wildfire)

Area	TOG	ROG	CO	NOx	SOx	PM	PM_{10}	$PM_{2.5}$
Statewide (CA)	2563.9	2226.2	2481.7	79.4	24.5	263.7	253.4	215.0
Lake Tahoe Air Basin	3.0	2.8	0.9	0.0	0.0	0.1	0.1	0.1
El Dorado County*	2.2	2.0	0.8	0.0	0.0	0.1	0.1	0.1
Placer County*	0.8	0.8	0.2	0.0	0.0	0.0	0.0	0.0
Alpine County*	9.1	8.6	0.1	0.0	0.0	0.0	0.0	0.0

*portions of individual counties that are in the Lake Tahoe Air Basin.

Concentrations and Deposition

Table 3-9 compares the years 2002, 2006, and 2010 passive sampling in the Lake Tahoe Basin for O_3, NH3 and HNO_3. The results for 2010 were lower than in previous years. The reason may be that 2010 summer was cooler than the typical summer. Comparison of HNO_3 concentrations showed that HNO_3 concentrations for 2002 and 2010 were similar while the highest levels were in 2006. NH_3 concentrations were lower in 2010 than in 2006. NOx concentrations were similar for the Basin and ranged between 2 and 26ug N/m^3 Bytnerowicz et al. (2013). NO/NO_2 ratio ranged from 1 to 8. High NO/NO_2 ratio indicates that N pollution in the Basin originates from the local emission sources (mobile sources). The 2010 concentrations are lower than 2002 and 2006 (attributable to the fact that summer of 2010 was much cooler than a typical year). It is assumed that deposition for the constituents will be proportional to the concentrations.

Table 3 9. Average concentration of NH3, HNO3, and O3 for 2002, 2006, and 2010

Site	2002			2006			2010		
	O_3	NH_3	HNO_3	O_3	NH_3	HNO_3	O_3	NH_3	HNO_3
Valhalla	45.7	ND	0.9	46.4	3.2	2.5	41.7	2.82	1.01
Sugar Pine	42.8	ND	0.7	42.7	3.4	3.0	35.9	2.01	1.23
Crystal Towers (ICN)	52.5	ND	0.9	51.3	3.0	2.9	51.5	1.13	2.40
Cave Rock	51.7	ND	1.1	55.3	2.7	2.6	46.4	1.58	0.84
White Cloud	66.1	ND	1.7	ND	ND	ND	41.7	1.57	0.86

Predictive spatial representation by Kriging for the 2-week period ending on August 1 shows the highest concentrations during this period west of the Lake Tahoe Basin with higher concentrations located on the south and east of Lake Tahoe in the most developed areas (Figure 3-5).

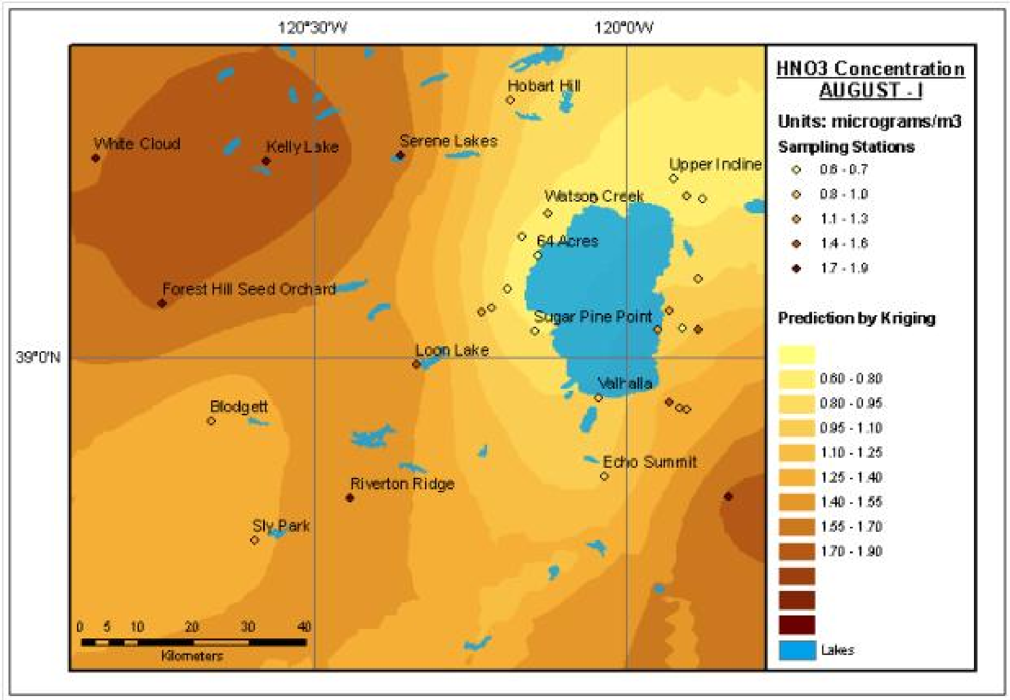


Figure 3 5. Concentration of HNO3 for 2 weeks period ending Aug. 1, 2002 (Adapted from Bytnerowicz 2004)

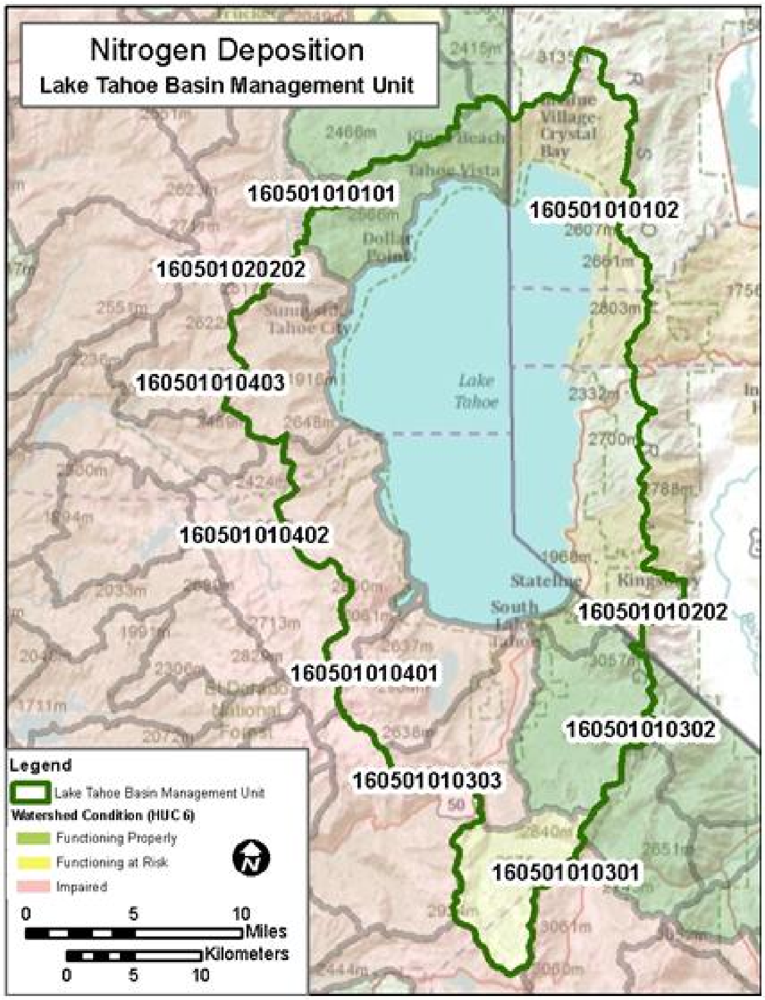


Figure 3 6. Watershed condition for HUC6

Current levels of N deposition to the terrestrial catchments in the valley are not leading to 'N saturation' of the terrestrial watersheds and thus do not induce elevated levels of nitrate runoff. However, N deposition and gaseous N pollutant exposures within and immediately upwind of the mountainous area are within the range at which strong nutrient enrichment-induced changes in epiphytic lichen communities occur in the Sierra Nevada (Fenn et al., 2008). Anthropogenic emissions of nitrogen are currently the largest contributor to N deposition in LTBMU and will remain the primary driver and concern for N deposition more so than any change in nitrogen deposition from the alternatives. Hydrologic Unit Code 6 (HUC6) watersheds in the Lake Tahoe Basin range in size from 235 to 25,963 acres. The assessment of the condition of the watershed to handle N deposition ranges from functioning properly to impaired (Table 3-10 and Figure 3-6).

Table 3 10. LTBMU acreages by Watershed Assessment Units (HUC6) and condition for grouping for N deposition

HUC 6	HUC6 Name	Acreage	Condition Grouping
1605010**20202**	Squaw Creek-Truckee River	4,290	Impaired
1605010**10102**	Incline Lake-Frontal Lake Tahoe	235	Unclassified
1605010**10301**	Big Meadow Creek-Upper Truckee River	17,496	Functioning at risk
1605010**10302**	Trout Creek	25,963	Functioning properly
1605010**10303**	Angora Creek-Upper Truckee River	19,182	Impaired
1605010**10401**	Fallen Leaf Lake-Frontal Lake Tahoe	20,205	Impaired
1605010**10402**	General Creek-Frontal Lake Tahoe	24,958	Impaired
1605010**10202**	Zephyr Cove-Frontal Lake Tahoe	3,881	Functioning properly
1605010**10403**	Ward Creek-Frontal Lake Tahoe	19,106	Impaired
1605010**10101**	Burton Creek-Frontal Lake Tahoe	20,292	Functioning properly

Atmospheric deposition is the dominant if not the sole source of inorganic N in Sierra Nevada lakes and therefore a concern at the LTBMU. A critical load of 4.0 kg per ha per year for acidification was exceeded in western mountains in only a few places (Williams and Tonnesson 2000, Fenn et al. 2003). Atmospheric N deposition that exceeds the nutrient enrichment critical load of 1.0 to 3.0 kg N per ha per year is more widespread.

A model was recently completed which estimates the nitrogen-critical loads for lichens (Geiser et al. 2010) along with a monograph on nitrogen-critical loads by ecological region (Pardo et al. 2011). The model contains recommended parameters for applying the model to other EPA Level I ecological regions of the US to assess the impact of nitrogen deposition on lichens at the 6th level HUC. This paper describes the process used for the analysis.

- Good if Maximum Total Nitrogen Deposition < CLmax - 1
- Poor if Maximum Total Nitrogen Deposition > CLmin + 1
- Fair, anything between the good and poor ratings above.

Some watersheds are listed with an “Unknown” rating because there is no critical load (CL) model available for those Eco-regions. Although the CL model was not applied to the North American Deserts region by Pardo et al. (2011), a CL of 3 kg N/ha/y provided by Pardo et al. (2011) based on other eco-regional studies was used here. Using this analysis, most of Lake Tahoe Basin is in “fair” condition for nutrient nitrogen critical load.

Ozone injury to Jeffrey and Ponderosa Pine

Forest health, resiliency, and sustainability in the LTBMU is dependent on multiple factors. Anthropogenic emissions impact human health (i.e., unhealthy criteria pollutants), forest health through physical damage (i.e., ozone), changes to nutrient cycles (i.e., nitrogen deposition), and altering climate (i.e., CO_2 emissions).

The Watershed Condition (HUC6) or the southern and most of the western units in terms of O_3 damage is Functioning at Risk while the north portion of the Lake Tahoe Basin is Functioning Properly. There is clear separation of O_3 concentration distribution on the western side of Desolation Wilderness due to emissions coming from the California Central Valley. There is also high O_3 concentration on the Nevada side of the Lake Tahoe Basin. High concentrations were at high elevations, both on the Genoa and Heavenly elevational transects. Ozone concentration was high in the middle of the lake, which could be due to high concentrations of O_3 precursors, a high rate of photochemical reactions (increase in solar radiation from reflection off the lake surface), and possibly a lower rate of titration of NO (Bytnerowicz, A. 2011).

The Project Forest Study showed Ozone increases occur north to south in Sierra Nevada forests. Chlorotic mottles (as an ozone injury indicator) on ponderosa and Jeffrey pine needles (Figure 3-7) were used to assess ozone injury in study plots throughout the Basin (Miller et al.1996 and Takemoto and Procter 1996) Ozone damage to plants reduce terrestrial productivity leading to increased carbon dioxide in the atmosphere thus increasing GHGs indirectly. This perturbation increases in ozone affect the climate system on considerably longer timescales than the ozone atmospheric lifetime of only a few weeks (Unger and Pan 2012).

Figure 3 7. Ozone damage to pine needles

Visibility for Class I Areas (Desolation Wilderness)

The EPA established the Regional Haze Rule (RHR) in 1999, a major effort to improve air quality in national parks and wilderness areas. The RHR calls for state and federal agencies to collaborate to improve visibility in federal Class I areas. The RHR specifies a default method to track progress towards the national visibility goal of no anthropogenic visibility impairment. The RHR focuses on reducing pollution on the 20% worst visibility days each year while allowing no degradation of the 20% best visibility days. Central to the RHR is the concept of the uniform rate of progress (URP). The URP is the yearly rate of change required to achieve natural deciview (a measurement scale representing perceptible changes in visibility) conditions by 2064 in a linear fashion beginning in 2004. The URP provides a reference to evaluate progress made in the context of the change required to reach natural conditions in 60 years (IMPROVE 2011).

The IMPROVE (Interagency Monitoring of Protected Visual Environments) is a cooperative measurement effort between the EPA, federal land management agencies, and state agencies. The network is designed to establish current visibility and aerosol conditions in the 156 mandatory Class I

areas, identify chemical species and emission sources responsible for existing anthropogenic visibility impairment, document long-term trends for assessing progress towards the national visibility goal, and, with the enactment of the RHR, provide regional haze monitoring representing all visibility-protected federal Class I areas where practical.

The Haze Algorithm differentiates between large and small aerosols, with large organic aerosols having slightly more than twice the capacity to extinguish light than the smaller organic aerosols CARB 2009a. Potential sources for are wildfires, prescribed fires, agricultural fires, and other biomass combustion sources, including residential wood smoke. Industrial areas and motor vehicle sources contribute VOCs. Natural biogenic emissions by plants contribute to the primary and secondary aerosol loadings; any of these can be transported from outside the immediate area. The wind pattern moves pollutants along the Willamette Valley, offshore, and back on-shore through the San Francisco Bay Area, across the Central Valley and up into the Sierra Nevada mountain range. Vehicle transportation corridors follow river valleys, which also serve as inter-basin transport corridors. “Backslider” circulation patterns occasionally rotate Nevada air into the Sierra Nevada Mountains.

An IMPROVE site (BLIS1) is located at Bliss State Park. The Bliss IMPROVE site covers Desolation Wilderness. The monitor is located at 38.9761 north latitude, 120.1035 west longitude, near the western shore of Lake Tahoe at an elevation of 2,131meters (6,992 ft), about 219 (719 ft) meters above the shore of Lake Tahoe and near the lowest elevations on the eastern slopes of Desolation Wilderness (Figure 3-8). The collected samples are analyzed for PM_{10}, $PM_{2.5}$, SO_4, NO_3, organic carbon, dust, and soot. The data helps identify sources that generate pollutants for visibility degradation.

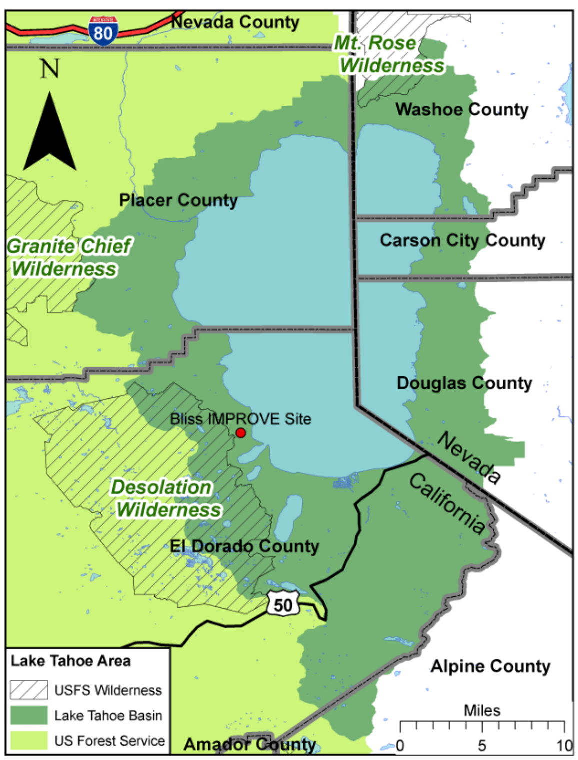


Figure 3 8. Bliss IMPROVE site location

The BLIS1 IMPROVE site is more susceptible to local trapped emissions in the Tahoe Basin that do not extend to higher Desolation Wilderness elevations. It is most representative of Desolation Wilderness locations on the lower eastern slopes facing Lake Tahoe that may be the worst case conditions overall

during conditions of uniform regional haze. The closest source region with emissions that could contribute to haze in the Desolation Wilderness is the Lake Tahoe Basin. The more distant Central Valley of California near Sacramento, from which emissions could be transported to Desolation Wilderness, is about 50 miles southwest, linked to Desolation Wilderness by the American and Rubicon Rivers. The Reno, Nevada area is about the same distance to the northeast but is generally downwind for prevailing wind directions and in a distant air shed. Potential emission transport from source regions in the California Central Valley occur mainly in the summer. Locally, eastern wilderness locations may be predominantly influenced by emissions within the Tahoe Basin. Highest summertime measured concentrations at BLIS1 are associated with regional forest fire events. In the absence of such regional events there is likely to be a significant contribution from vehicle traffic in the Tahoe Basin to aerosol measures at BLIS1. In the fall and winter there may be wood smoke impacts associated with prescribed burns and residential burning in the Tahoe Basin (CARB 2009b).

Natural visibility represents the visibility condition that would be experienced in the absence of human-caused impairment. Based on EPA guidance, CARB calculated the natural visibility for the BLIS1 monitor at 0.4 deciviews for the 20% best days and 6.1 deciviews for the 20% worst days. It is possible that the natural conditions deciview value for 2064 could change in the future as more is learned about natural plant emissions and wildfire impacts.

Baseline visibility was determined from BLIS1 IMPROVE monitoring data for the 20% best and the 20% worst days for the years 2000 through 2004. The baseline visibility for the BLIS1 monitor is calculated at 2.5 deciviews for the 20% best days and 12.6 deciviews for the 20% worst days. Figure 3 9 shows the uniform rate of progress or “glide slope.” The glide slope is the rate of reduction in the 20% worst days deciview average that would have to be achieved to reach natural conditions at a uniform pace in the 60 years following the baseline period.

The EPA approved the California haze plan in April. Comprehensive SIP revisions are required every 10 years. The initial planning period of the Regional Haze Rule is 2008 through 2018. The first benchmark along the path towards achieving natural conditions occurs in 2018. The glide slope shows that the 2018 benchmark for the 20% worst days is 11.10 deciviews. According to the Regional Haze Rule, the 20% best days baseline visibility of 2.5 deciviews must be maintained or improved by 2018, the end of the first planning period.

Each pollutant species (PM_{10}, $PM_{2.5}$, SO_4, NO_3, Organic Carbon, dust, and soot) causes light extinction but contribution differs on best and worst days. Figure 3 10 shows the contribution of each species for the 20% best and worst days in the baseline years at BLIS1.

As shown in Figure 3 10 and Table 3 11, organic matter, sulfates, and elemental carbon have the strongest contributions to degrading visibility on worst days at the BLIS1 monitor. Organic matter dominates the worst days, while the best days are dominated by sulfate.

Figure 3 10 depicts the individual species contribution to worst days in 2002. (The Base line is based on the data 2000 to 2003). Organic matter increases in the summer while sulfates increase slightly in the spring. The occurrence of elevated elemental carbon concentrations is sporadic throughout the year. Organic matter (om) clearly dominates the other haze species on worst days, but sulfates (so4, nitrates (no3), elemental carbon (ec), and coarse mass (cm) also contribute to the worst days. Sea salt has a very small contribution to haze at the BLIS1 monitor. Marine shipping and other long-range transport sources affect SOx contributions but are “uncontrollable” by California.

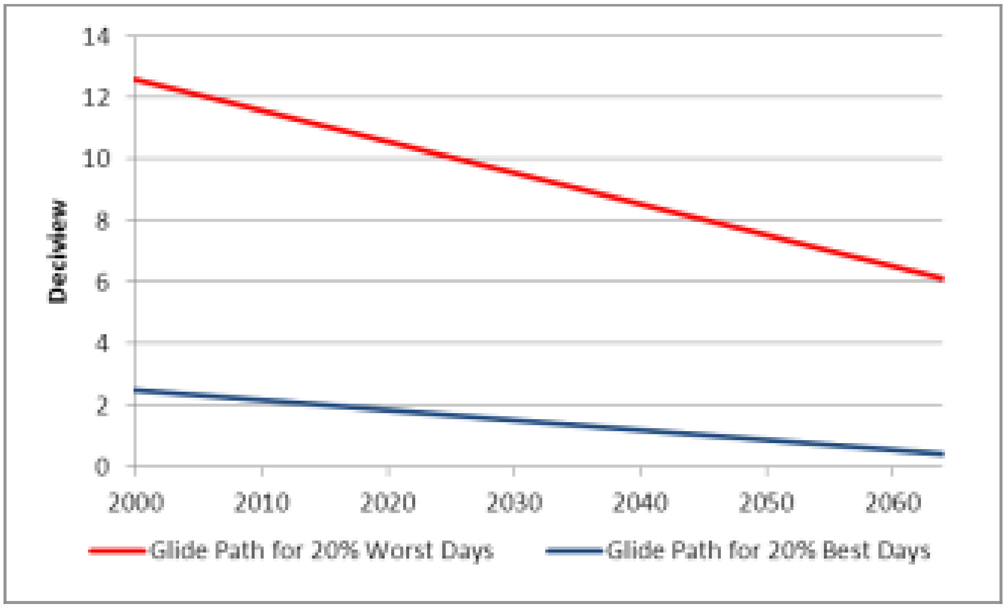


Figure 3 9. Glide path proposed in the visibility SIP

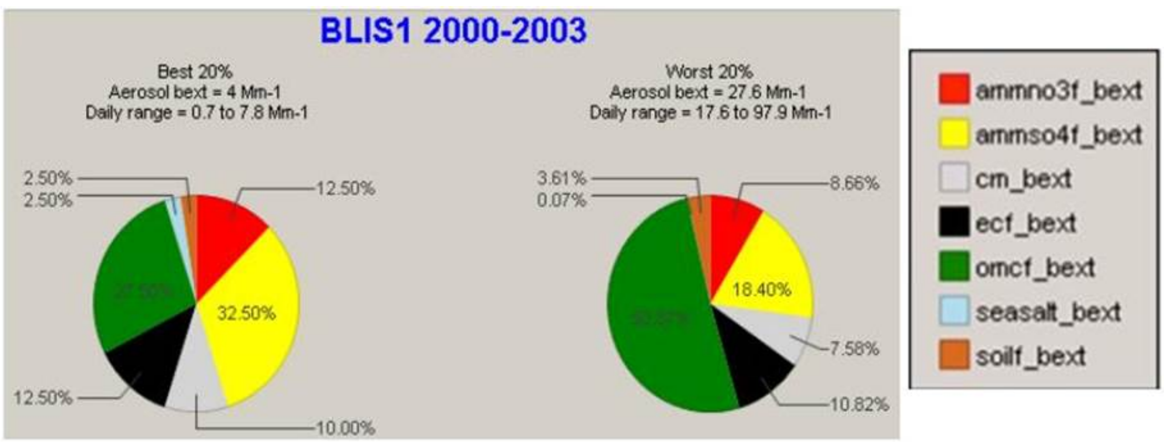


Figure 3 10. BLIS1 pollutant species for the best and worst 20%

Table 3 11. Baseline (2000-2004) vs. 2005-2009 data from the Bliss IMPROVE site showing the trend for worst visibility days

	Sulfate B_{ext}	Nitrate B_{ext}	POM B_{ext}	EC B_{ext}	Soil B_{ext}	Coarse Mass B_{ext}	Sea Salt B_{ext}
2000-2004	5.1	2.4	14.1	3	1	2.1	0
2005	6.9	1.8	11.3	3.1	0.5	1.9	0.1
2006	6.3	1.4	14.4	2.8	0.9	2.4	0.1
2007	5.8	3.7	22.7	3.9	0.8	2.2	0.1
2008	6.3	2.1	49.2	6.3	0.9	2.3	0.1
2009	4.9	1.7	13.5	2.4	0.7	2	0.1

*Light Extinction (Bext) is the attenuation of light due to scattering and absorption as it passes through a medium.

Particulate organic matter mass concentration (POM) is the main contributor to worst visibility days (Figure 3-11 and table 3-12). The Basin was impacted by wildfires in 2007 and 2008 that are the source of worst visibility days. Historic and projected deciview for the worst 20% days is shown in Figure 3 13.

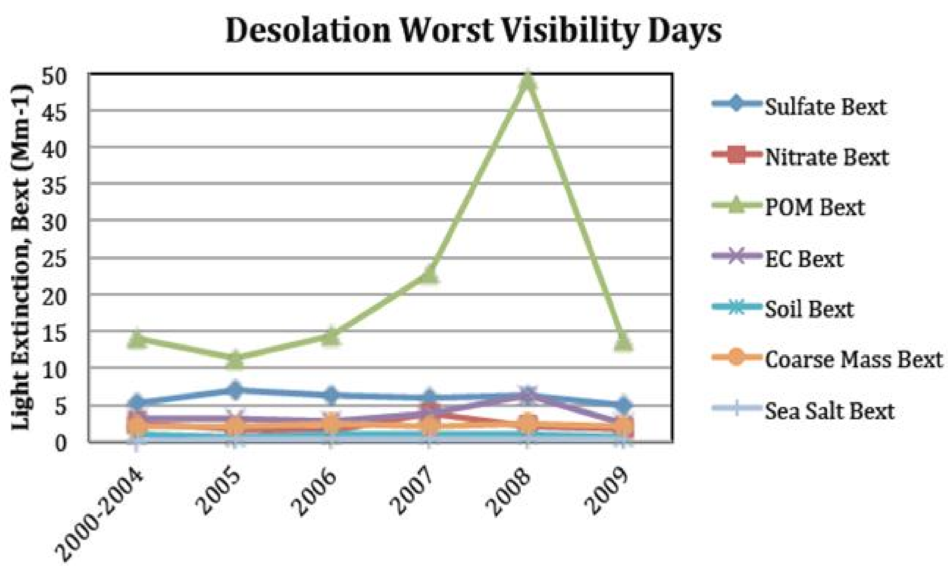


Figure 3 11. Light extinction from each pollutant on worst visibility days at BLIS1

Table 3 12. Baseline (2000-2004) vs. 2005-2009 data from the Bliss IMPROVE site showing the trend for the best visibility days

	Sulfate B_{ext}	Nitrate B_{ext}	POM B_{ext}	EC B_{ext}	Soil B_{ext}	Course Mass B_{ext}	Sea Salt B_{ext}
2000-2004	1.3	0.5	1.1	0.5	0.1	0.4	0.1
2005	1.4	0.4	0.9	0.3	0.1	0.3	0.1
2006	1.4	0.3	0.7	0.3	0.1	0.4	0.1
2007	1.5	0.5	1.1	0.3	0.1	0.5	0.1
2008	1.2	0.3	1	0.2	0.1	0.5	0.1
2009	1.1	0.3	0.8	0.3	0.1	0.4	0.1

*Light Extinction (B_{ext}) is the attenuation of light due to scattering and absorption as it passes through a medium.

Sulfate and POM are the main contributors on best visibility days. Best visibility days occur when levels of organic carbon are the lowest (Figure 3-12 and Table 3 12). Historic and projected deciview for the best 20% of days is shown in Figure 3 13.

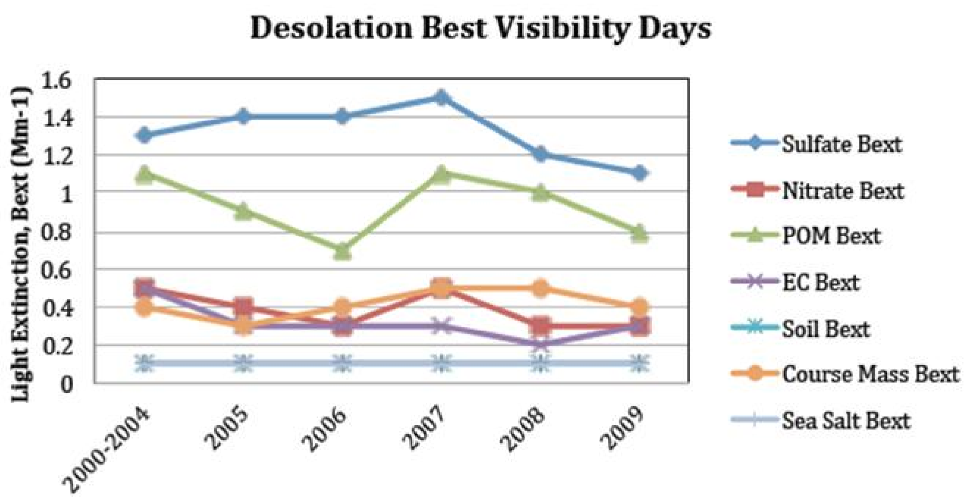


Figure 3 12. Light extinction from each pollutant on best visibility days at BLIS1

Both natural and man-made sources contribute to the calculated deciview levels made by haze pollutants at BLIS1. Some haze species arise from sources that are within the control of the State of California and neighboring states. Others arise from natural, uncontrollable situations such as wildfires, sea salt, or dust storms in natural areas. Finally, other uncontrollable, man-made sources are those industrial pollutants and other manmade (anthropogenic) emissions transported from outside the United States. The largest contributor to primary organic carbon at the BLIS1 monitor is from fire sources.

Figure 3 12 shows the existing 5 years (2000-2004) average deciview value (i.e., existing value calculated from IMPROVE monitoring data and the CA state calculated natural visibility values that need to be achieved by the year 2064 for best and worst days. These attainment values are described in the state prepared visibility SIP approved by the EPA in April 2011.

Table 3 13. Best and worst deciviews for the glide path

Year	Best	Worst
2000-2004	2.5	12.6
2064	0.4	6.1

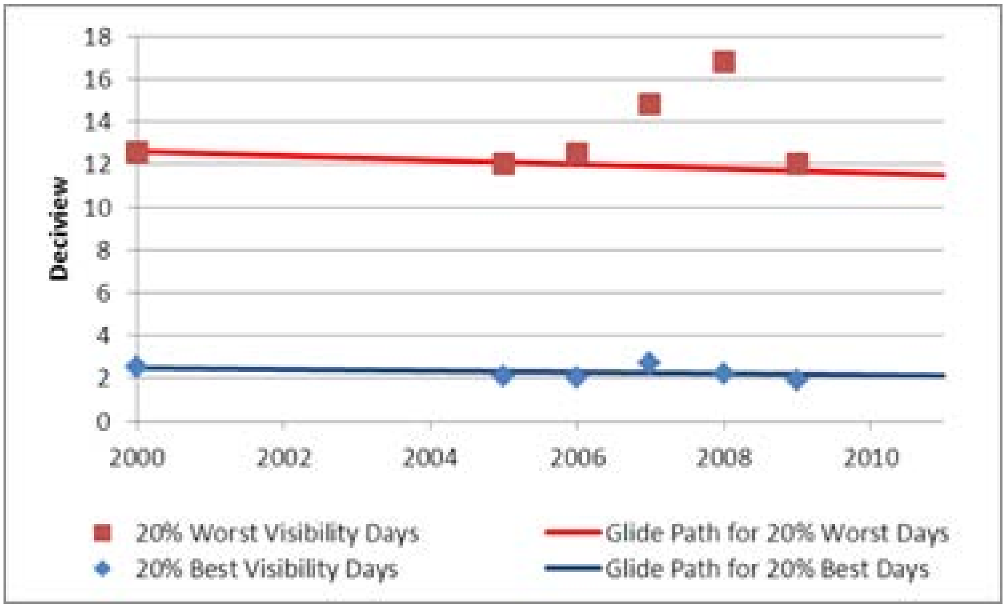


Figure 3 13. Worst and best 20% visibility days

By looking at the worst visibility graph (Figure 3-13) it is clear that organic carbon from wildfires play the major role in causing the decline in worst visibility at the BLIS1 site.

3.4.2.3. Environmental Consequences

Impacts to Air Quality

This section analyzes potential air quality impacts under the proposed alternatives on human health and forest health, resiliency, and sustainability. In addition, impacts of the alternatives on visibility and climate change (as indicated by greenhouse gas and black carbon emissions as well as carbon sequestration) are discussed. Because the proposed management strategies under each alternative can have short and long-term adverse or beneficial impacts to air quality locally, regionally, and globally, analysis of environmental consequences to air quality necessarily must attempt to balance short-term adverse impacts and long-term beneficial impacts. Emissions and deposition from implementation of the activities projected under the alternatives are often orders of magnitude less than those generated from sources outside the scope of this plan.

Outcomes are determined as beneficial or adverse. Beneficial outcomes reduce emissions or provide benefits to human health; forest health, resiliency, and sustainability; visibility; and climate change, while adverse increases emissions or have adverse impacts.

Air quality assessment of alternatives considers the environmental consequences of alternatives over time. Impacts that occur during an event are considered short-term impacts while long-term impacts consider future emission changes from management practices. Potential short-term adverse impacts may occur while generating long-term beneficial impacts. Short-term impacts include emissions and impacts associated with events, such as increased pollutant concentration during a fire, while long-term impacts consider future impacts to emissions, such as increased potential to mitigate future fire emissions through beneficial changes to forest health, resiliency, and sustainability (i.e., carbon sequestration stabilization) and visibility. Change in the natural ecological role of smoke in Sierra Nevada forest health, resiliency, and sustainability is considered.

Present and future gaseous pollutants and airborne particulate matter would continue to be present and dependent on life span (e.g., CO_2 has a life span of 200+ years while CH_4, O_3 and black carbon have short life spans and their control can result in CO_2 reduction in the short term). Primary emissions sources include wood burning stoves, motor vehicle exhaust, emissions from recreational campfires, emissions associated with development of private lands, prescribed fire, fugitive dust, and wildfires. Burning associated with foreseeable actions, as well as burns occurring outside of the managed area can impact air quality and have short-term effects.

While fire suppression can provide short-term beneficial impacts to local air quality and public health, this short-term benefit is balanced with the inherent lack of sustainability and the likelihood of adverse long-term impacts from larger, more intense wildfires on air quality, public health, and climate change. Fire suppression and the subsequent fuel accumulation generate a potential for negative long-term adverse impacts to air quality in the LTBMU. Controlled release of the backlog of emissions from fuel accumulation from fire suppression on the LTBMU has the greatest potential to alleviate long-term adverse impacts from fuel accumulation and provide long-term benefits to air quality that comes from a sustainable forest ecosystem. This method can be complemented with use of excess biomass for bioenergy (which generates much less pollutants than wood burning) and biochar (which conserves the carbon in a relatively stable state).

The concept of carbon carrying capacity, the amount of carbon that can be stored in a system by watershed condition units (HUC6) as a function of prevailing climatic conditions and natural disturbance regimes, has been proposed as a potential foundation for carbon management plans. Managing within the carbon carrying capacity for forests requires incorporating an understanding of fire and stand dynamics. Altering forest structure by thinning smaller trees and then carrying out prescribed burning aggregates

carbon into fewer larger trees and reduces the potential for uncharacteristic high severity fire. These actions may reduce the amount of standing carbon in trees, but they will improve the stability of these carbon stocks over time. Management objectives in this context focus on achieving a balance between carbon stock size and carbon stabilization that falls within the carbon carrying capacity of the forest.

Forests provide a suite of ecosystem services, including carbon sequestration for mitigating human-caused climate change. However, even if forest-based carbon sequestration were maximized to achieve the 1 giga-ton of carbon per year required to mitigate one-seventh of the global emissions projected by Pacala and Socolow (2004), reduced fossil-fuel consumption would still be required to lower atmospheric carbon dioxide concentration. Thus, forests offer a bridging strategy and are only part of the climate change mitigation portfolio (McCarl and Sands 2007). Although forest carbon sequestration does carry a risk of reversal, even impermanent carbon offsets generated by increasing above ground forest carbon stocks can serve to reduce compliance costs in a cap-and-trade system, and in the case of fire, this risk can be reduced (Hurteau et al. 2009, Mignone et al. 2009). However, mitigating fire risk and maintaining forest health and ecological function in a fire adapted ecosystem requires periodic carbon emissions from prescribed and natural ignition fires. Therefore this is insignificant on a global scale.

Biomass removal and timber harvest can reduce forest fuel loading from non-resilient and ecologically non-functional forest landscapes and can lead to resiliency and sustainability. Prescribed fire is an “anthropogenic” source, except where it is utilized to maintain an ecosystem that is currently in an ecologically functional and fire resilient condition, in which case it is classified as a “natural” source (WRAP 2007). This can also result in less intense wildfires and reduce organic matter carbon (OMC) contribution to worst visibility days. Biochar can reduce runoff and increase sub-surface water retention to help fulfill ecological restoration goals aimed at restoring degraded forest meadows to improve their habitat, function, and ability to hold water longer into the summer, and deliver clean water when most needed.

Pollutant Emissions from Fire

Emissions are projected through 5 periods with each period consisting of 10 years.

Because of the difficulty in projecting both acres and emissions from wildfire, particularly over a 50 year period, the analysis focuses on emissions from Period 1 (the first 10 years) under each alternative.

Pollutant emissions for prescribed fire are the lowest for Alternative B and E, increasing under Alternative A followed by Alternatives D and C (Table 3-14. and Figure 3-14).

Table 3 14. Pollutant emissions from prescribed fire for Period 1 (tons)

Alternative	PM_{10}	$PM_{2.5}$	CO	NMHC	NOx
A	3,562	3,188	31,671	2,551	1,028
B	2,802	2,542	26,312	1,643	816
C	4,464	3,996	39,695	3,197	1,289
D	3,822	3,477	36,307	2,130	1,114
E	2,802	2,542	26,312	1,643	816

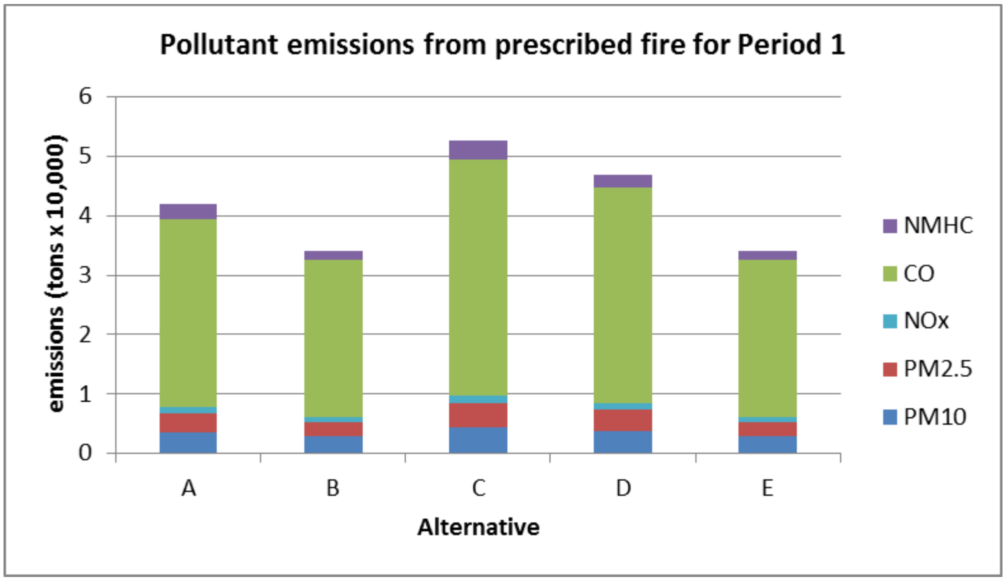


Figure 3 14. Pollutant emissions from prescribed fire for Period 1 (tons)

Pollutant emissions from wildfire are similar for all alternatives, with Alternative A showing the lowest emissions levels and Alternative C highest (Table 3-15 and Figure 3-15).

Table 3 15. Pollutant emissions from wildfire for Period 1 (tons)

Pollutant / Alternative	PM_{10}	$PM_{2.5}$	CO	NMHC	NOx
A	1,275	1,169	12,502	609	373
B	1,418	1,300	13,909	678	415
C	1,528	1,401	14,984	730	447
D	1,466	1,345	14,381	701	429
E	1,418	1,300	13,909	678	415

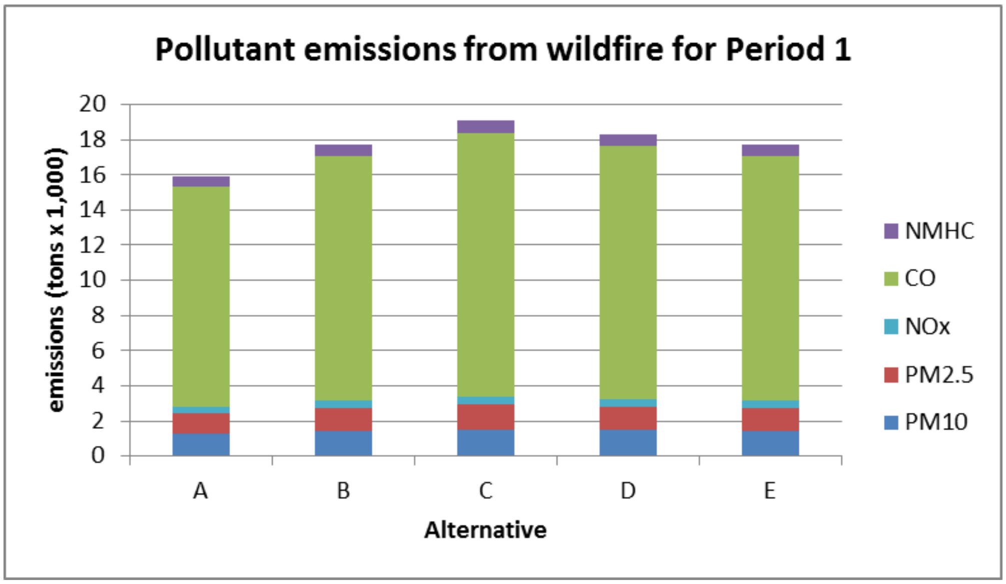


Figure 3 15. Pollutant emissions from wildfire for Period 1 (tons)

Total pollutant emissions from prescribed and wildland fire for Period 1 are lowest under Alternatives B and E. Emissions increase from Alternatives B and E to A to D to C, being highest under Alternative C. Table 3-16 and Figure 3-16 display the risk of public exposure to pollutant emissions from burning and wildland fire would be least under Alternative B and E and highest under Alternative C.

Table 3 16. Total pollutant emissions (prescribed and wildfire) for Period 1 (tons) by alternative

Pollutant / Alternative	PM_{10}	$PM_{2.5}$	CO	NMHC	NOx
A	4,837	4,357	44,173	3,160	1,401
B	4,220	3,842	40,221	2,321	1,231
C	5,992	5,397	54,679	3,927	1,736
D	5,288	4,822	50,688	2,831	1,543
E	4,220	3,842	40,221	2,321	1,231

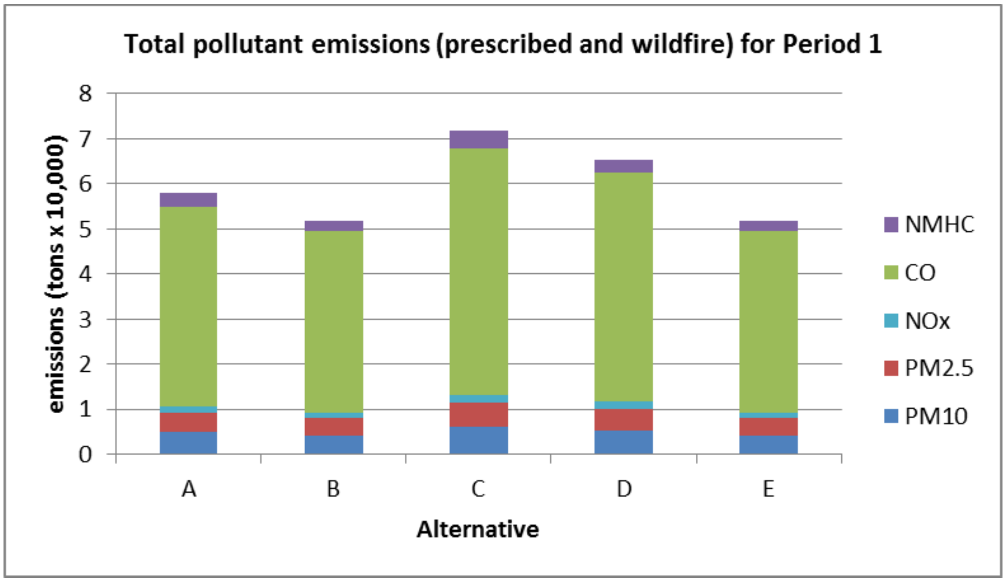


Figure 3 16. Total pollutant emissions (prescribed and wildland) for Period 1 (tons)

Alternatives B and E have the lowest emissions of air toxics (Figure 3-17). The highest toxics would occur under Alternative C. Public exposure to air toxics from prescribed and wildland fire combined would be least under Alternatives B and E and highest under Alternative C. Impacts from air toxic exposure are most applicable to those closest to the source of emissions, which are typically firefighters. Wildfire emissions typically occur during one or two events, where nearly all emissions are released in a short time period (typically less than two weeks) with little or no control over the timing of these emissions. Prescribed fires (planned ignitions) occur on declared burn-day designations under favorable environmental conditions, including good dispersal and defined parameters such as size, fuel moisture, temperature, etc. to control emission amounts and timing. Planned ignitions allow for flexibility in the timing of the emissions allowing avoidance of high use times, thereby minimizing exposure to air toxics. Emission rates and timing need to be considered when determining impacts from management actions. Maximum impact to public health occurs under wildfire.

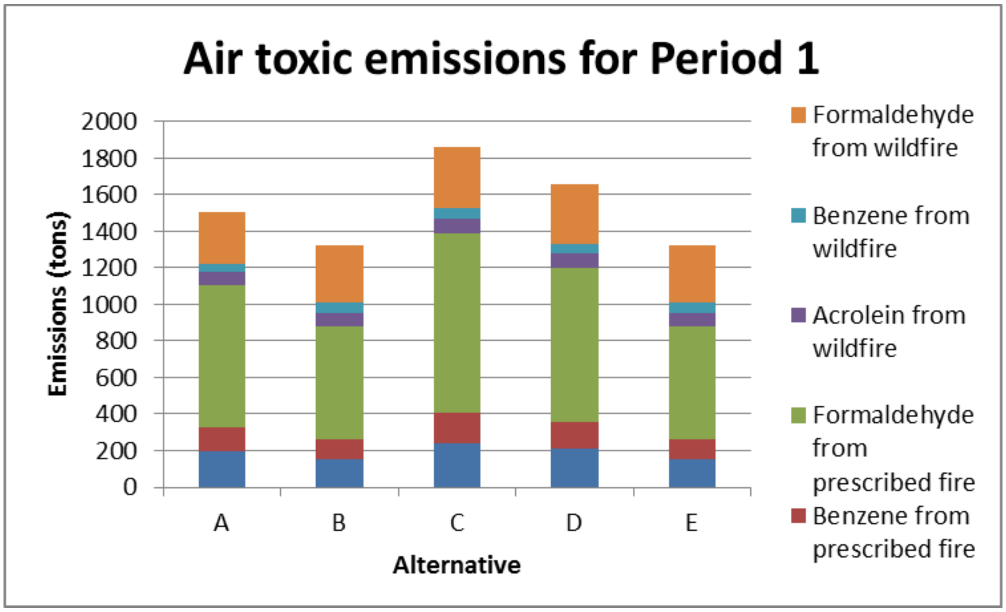


Figure 3 17. Air toxic emissions for Period 1 (tons)

Black Carbon Emissions from Fire

Figure 3-18 shows total black carbon emissions for prescribed fire and wildfire for each alternative for Period 1.

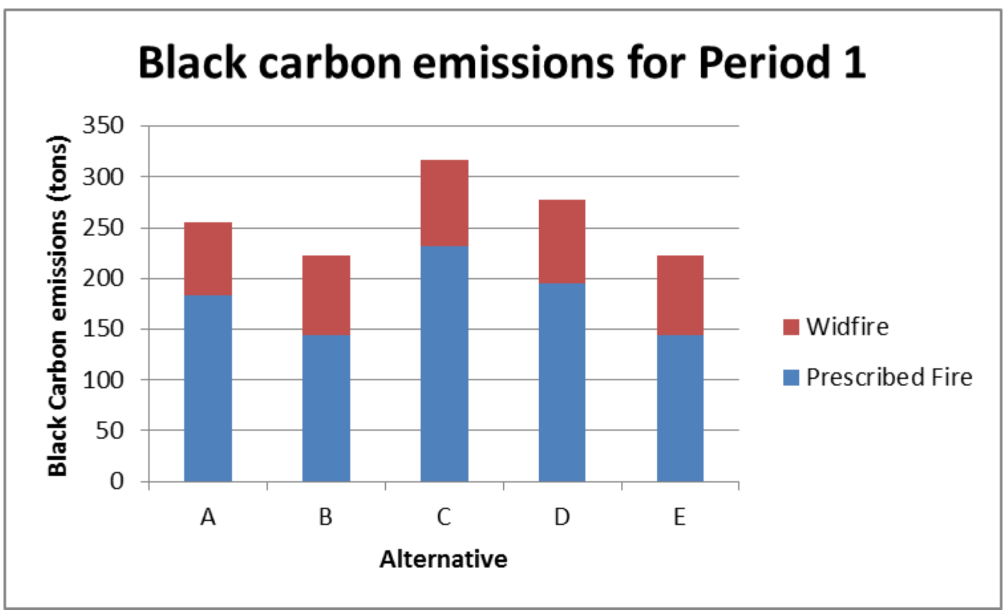


Figure 3 18. Period 1 black carbon emissions (tons)

During Period 1, the maximum black carbon is released under Alternative C followed by Alternative D, A, B and E. Total black carbon emissions are lowest under Alternative B and E. Black carbon, when deposited on snow covered areas especially in the spring, can be a major contributor to increased melting, particularly in the Arctic, thereby contributing to climate change. Because the lifetime of black carbon is approximately one to four weeks in the atmosphere, climate effects from black carbon are typically localized. Historic emissions from wildland fire limit the distance of transport of black carbon; however,

increased fire size and intensity or timing of emissions can increase the effects of black carbon on climate change. Total black carbon emissions are lowest under Alternative B and E and highest in Alternative C. However, the differences in black carbon emissions between alternatives are very small and expected to have little impact on snow melt.

Greenhouse Gas Emissions

CO_2, CH_4, and N_20 are the primary greenhouse gases (GHGs) emitted from land management actions. Total GHG emissions are calculated as CO_2 equivalents. Alternative B has the lowest GHG emissions for prescribed fire and wildfire. Total projected GHG emissions are highest under Alternative C. Alternative B and E have the lowest total projected GHG emissions in Period 1 (Figure 3-19). The GHG emissions from snowmobiles activities are very low in comparison to prescribed fires and wildfire and do not vary among alternatives.

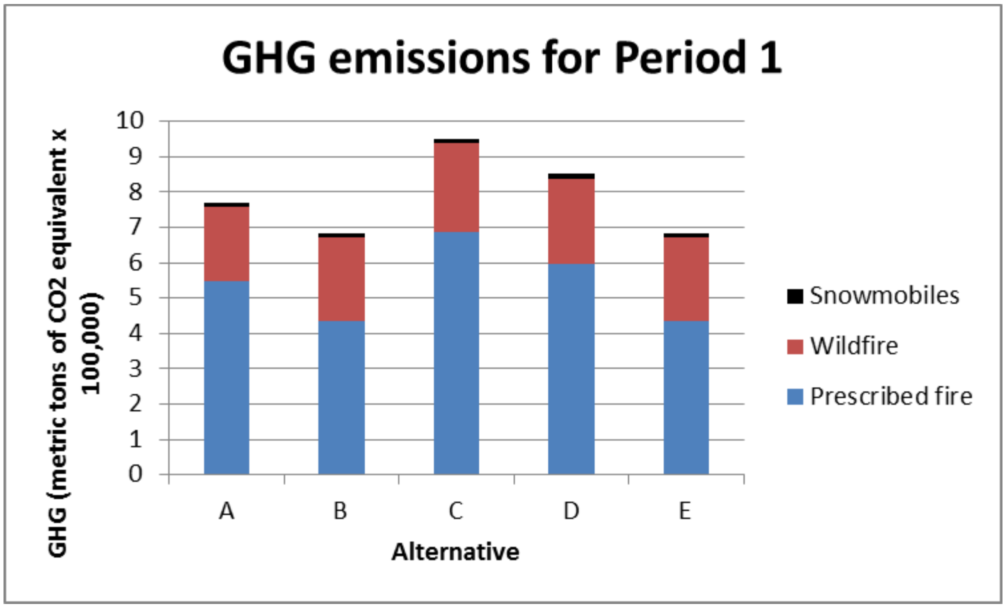


Figure 3 19. GHG emissions for Period 1 (metric tons of CO_2 equivalents)

Promoting forest health helps to limit GHG emissions, supporting a resilient ecological system that mitigates natural release of GHGs. For Period 1, the highest CO_2 emissions to the atmosphere are projected under Alternative C, followed in decreasing order by Alternative D, A, and then B and E.

Broadly speaking, there are two approaches for carbon sequestration in dry temperate forests: carbon maximization and carbon stabilization. Carbon maximization can be achieved by increasing the carbon density, on a relative scale, per unit of land area. However, the carbon maximization approach neglects the influence of changing climatic conditions and stand density on fire weather, fire behavior, fire severity, and tree mortality, and ultimately the potential for a very slow forest recovery or vegetation-type conversion (Hurteau 2011).

Trees sequester carbon; therefore, well-managed forests can act as a sink for carbon rather than an emission source. According to Mittal (2009), not all carbon is converted to CO_2 during wildland fires: black carbon and charcoal are also released and then deposited onto the soil. This material can remain in the soil a long time as additional sequestered carbon. The detailed research is lacking; however, according to the author, this material can account for up to 30% of the CO_2 released in a wildland fire.

Fire suppression policies, dating back over a hundred years, have altered the forests of the LTBMU. Climate change projection trends show that the region will become more water stressed due to the effects of higher temperatures on evaporation rates (Seager et al. 2007). Fuels have accumulated as the interval between fires has increased beyond the intervals associated with an active fire regime. This combination of warmer temperatures and accumulated fuels has the potential to reduce carbon stocks and net ecosystem productivity if the successional pathway of forested ecosystems is continually altered by stand-replacing fires. Such forest ecosystems more frequently transition into drought-tolerant grassland and shrub vegetation types.

Maintaining healthy, resilient forest ecosystems is a key to off-setting CO_2 emissions. Prescribed fire is a key tool in restoring and maintaining the health and resiliency of forest ecosystems.

Because smaller fuels typically drive wildland fire behavior, the level of biomass removed under each alternative provides another indication of the potential for GHG emissions. The emissions under wildfires are generally very high and will vary depending upon the extent and intensity of wildfires. The release of GHGs to the atmosphere for a given wildfire year can be greater than the carbon sequestration for that area. Figure 3-20 shows the biomass removed under each alternative. Forest thinning and follow-up fuels treatments that reduce the accumulation of forest fuels lead to smaller and lower intensity wildfires. This can result in reduced emissions of GHGs. Greater amounts of biomass removal are projected under Alternatives B, E and C as compared to Alternative A (no action).

Pollutant Emissions from Snowmobiles

Among the non-road recreational vehicles snowmobiles (OSVs) are very popular as winter activity. The forest has issued use permits for two sites to Zephyr Cove OSV tours and Lake Tahoe Snowmobile Tours. The recreationists also use other open areas of the forest that are not run by permittee. The data used to calculate emissions for permitted sites is for the 2010-11 winter, which was an above average snow year (Table 3-17). Permitted use data may overlap with the NVUM data i.e., a person who reported OSV use on the NVUM survey may have rented an OSV from one of the permittees. For the NVUM data, Table 3-16 shows emissions for estimated average use (in hours) with a range of values ±26.3 percent. NVUM methodology and analysis is explained in detail in the research paper entitled: Forest Service National Visitor Use Monitoring Process: Research Method Documentation; English, Kocis, Zarnoch, and Arnold; Southern Research Station; May 2002 (http://www.fs.fed.us/recreation/programs/nvum).

All the snowmobiles run by the Lake Tahoe Snowmobile Tour site have 4 stroke engines while the vehicles by Zephyr and at other forest sites have a mixture of 2 and 4 stroke engines. A 4 stroke emits less HC, CO and PMs but higher NOx emissions than a 2 stroke engine. Even though high NOx (a precursor of ozone) are emitted by 4 stroke engines, ozone concentrations are not expected to be higher because of low temperatures during the use period (Science Advisory Team 2011). The emissions from snowmobiles will not differ a great deal between alternatives. There is a possibility that emissions would be low under Alternative D. Wilderness designation in Alternative D would remove a large area currently open to OSVs. This might decrease use or it could simply displace users. Otherwise, areas open to OSV use do not vary by alternative and thus emissions from OSV use will not differ among alternatives. The table shows release of 13,458 tons of CO2 from snowmobiles that will add 12,207 metric equivalent tons to the atmosphere. The amounts are insignificant when compared to the release from prescribed and wildland fires.

Table 3 17. Emissions from Snowmobiles (tons/yr)

Site	hp	OSV use (hrs)	stroke	HC	CO	NOx (tons/yr)	PM	CO2	GHGs metric tons CO2 eq
Zephyr Cove OSV tours	80	6,000	2	29.6	108.5	0.3	0.8	325.4	295.1
Lake Tahoe Snowmobile Tours	120	18,654	4	11.5	195.1	21.6	0.7	2,023.4	1,835.2
NVUM estimate	80 & 120	146,320	2&4	198.5	1,447.2	103.1	7.1	11,109.7	10,076.5
Total from All Lake Tahoe Basin Areas		170,974		239.5	1,750.8	125.0	8.6	13,458.4	12,206.8

Emissions Averted

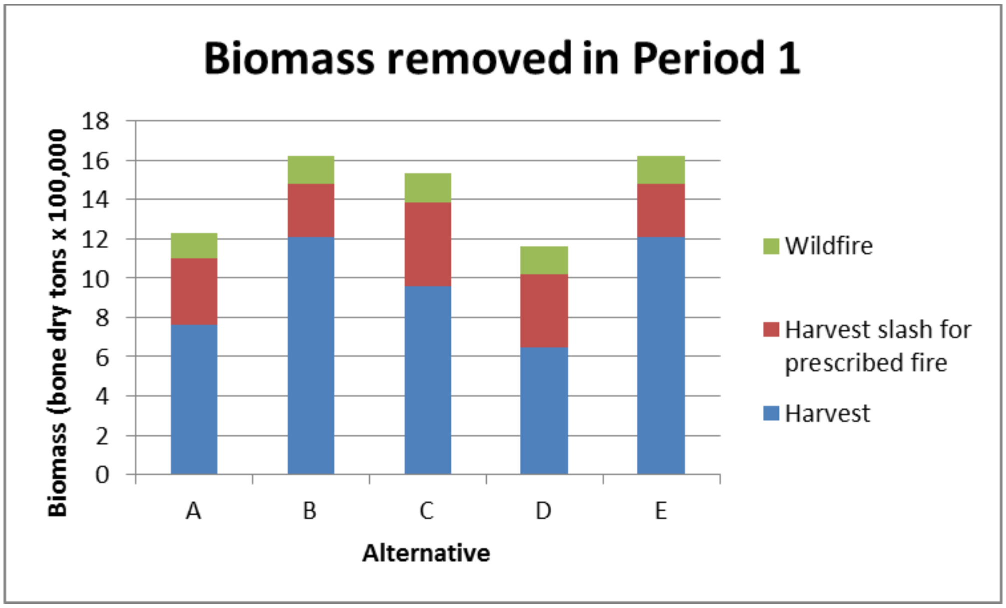


Figure 3 20. Biomass removed in Period 1 (bone dry tons)

During the first period, the maximum biomass is removed under Alternative B and E, followed by Alternatives C, A, and D.

Timber and biomass removal through mechanical or hand treatments and use of the harvested material for wood products, and, in the case of biomass, bio-energy and potentially biochar averts emissions from burning and wildland fires. The emissions averted can vary depending on how biomass is utilized. The removal of biomass through harvest or other means reduces the amount of emissions that would have been generated during wildfire or prescribed fire (Table 3-18 and Figure 3-21). Mill waste from harvested material is generally greater than 40% but the emissions table is based on total biomass transported to the mill. Therefore, emissions averted may be less than shown unless waste is used for bioenergy or biochar.

Table 3 18. Pollutant emissions averted by harvest for Period 1 (tons)

Alternative	PM_{10}	$PM_{2.5}$	CO	NMHC	NOx
A	7,795	7,148	76,425	3,726	2,281
B	12,390	11,363	121,485	5,923	3,626
C	9,801	8,988	96,097	4,685	2,869
D	6,615	6,067	64,864	3,163	1,936
E	12,390	11,363	121,485	5,923	3,626

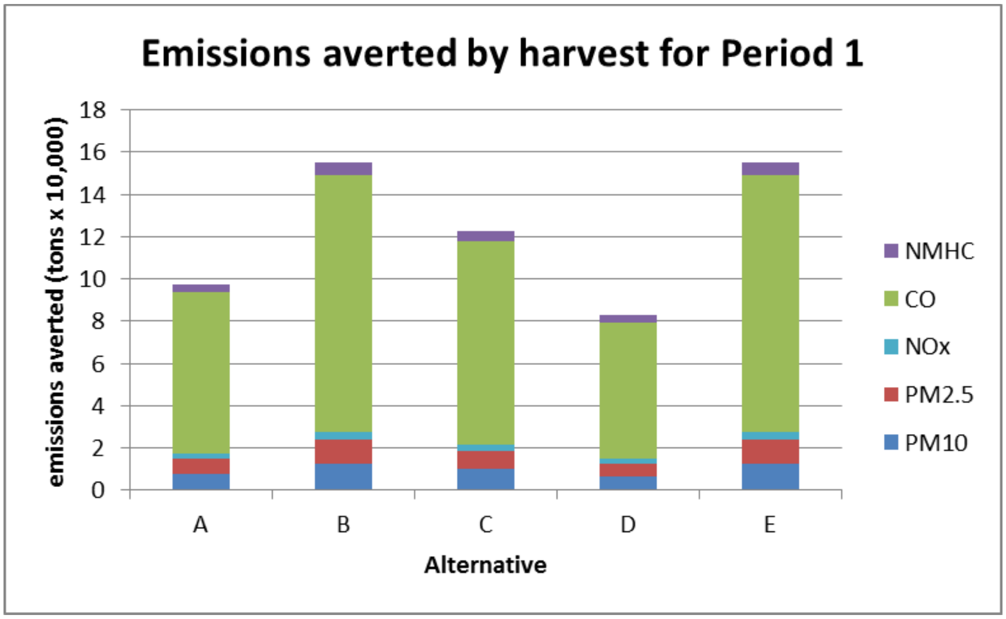


Figure 3 21. Pollutant emissions averted by harvest for Period 1 (tons)

For Period 1, Alternatives B and E have the greatest amount of emissions averted for pollutants and air toxics, with Alternative D having the least (Table 3-19 and Figure 3-22).

Table 3 19. Air toxic emissions averted by harvest for Period 1 (tons of CO_2 equivalent)

Alternative	Acrolein	Benzene	Formaldehyde	GHG	Black Carbon
A	426	297	1,726	1,218,403	395
B	677	471	2,744	1,936,765	629
C	535	373	2,171	1,532,019	497
D	361	252	1,465	1,034,091	336
E	677	471	2,744	1,936,765	629

Total GHG emissions averted are greatest under Alternatives B and E with Alternative D having the least. Period 1 black carbon and GHG emissions averted are greatest for Alternatives B and E and least for Alternative D. For Period 1, Alternative B and E have the largest emissions averted while Alternative D has the least. The calculated emissions averted account for removal of carbon through timber and biomass harvest. In the event of a change to more extreme fire behavior, these emissions averted estimates will lose relevancy.

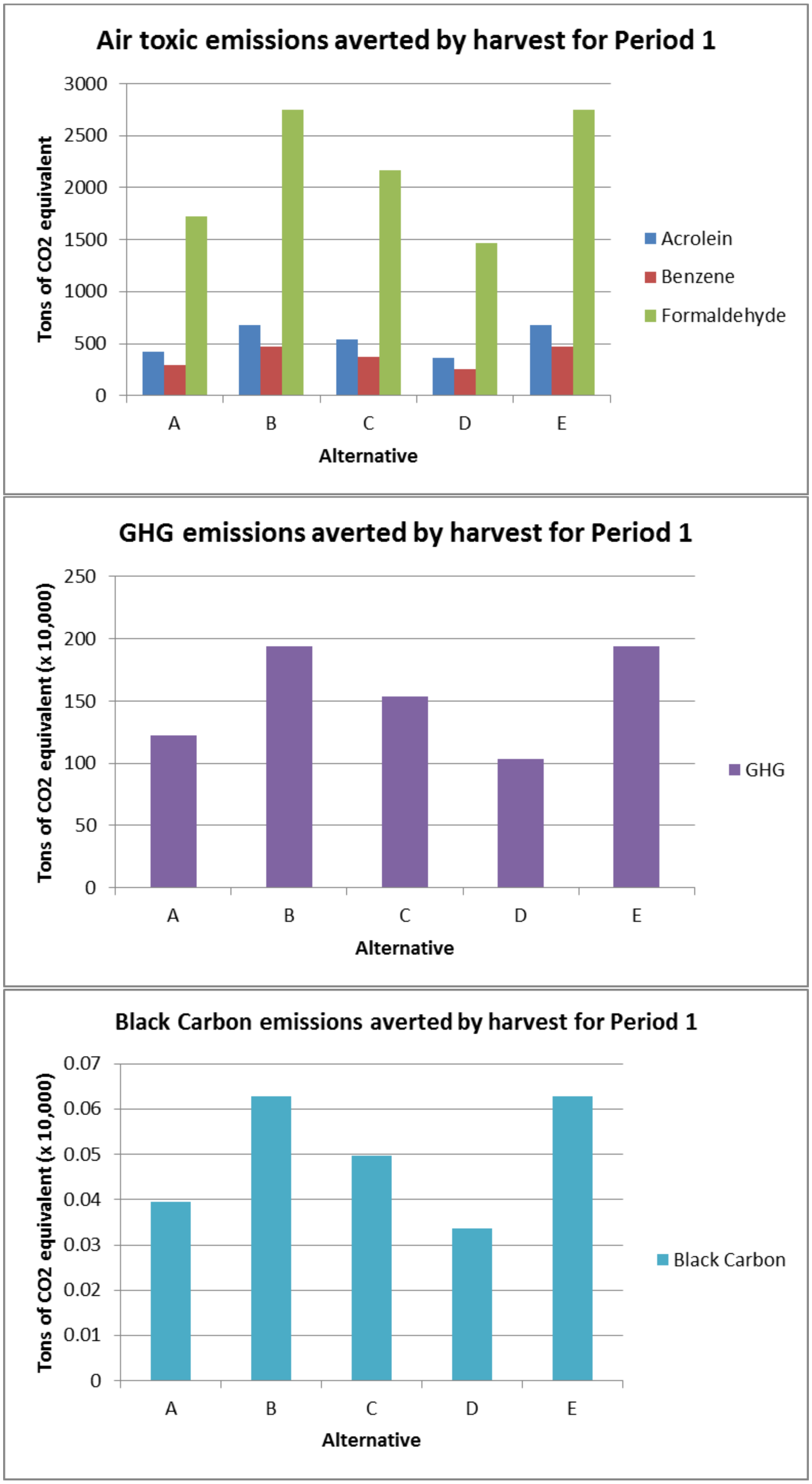


Figure 3 22. Air toxic emissions averted by harvest for Period 1 (tons of CO_2 equivalents)

Carbon Sequestered

Above ground biomass is expected to be similar for all alternatives in Period 1, with Alternatives C and B and E having the lowest over the five periods (Figure 3-23). There is a less than a 1% difference between alternatives in above ground biomass for Period 1.

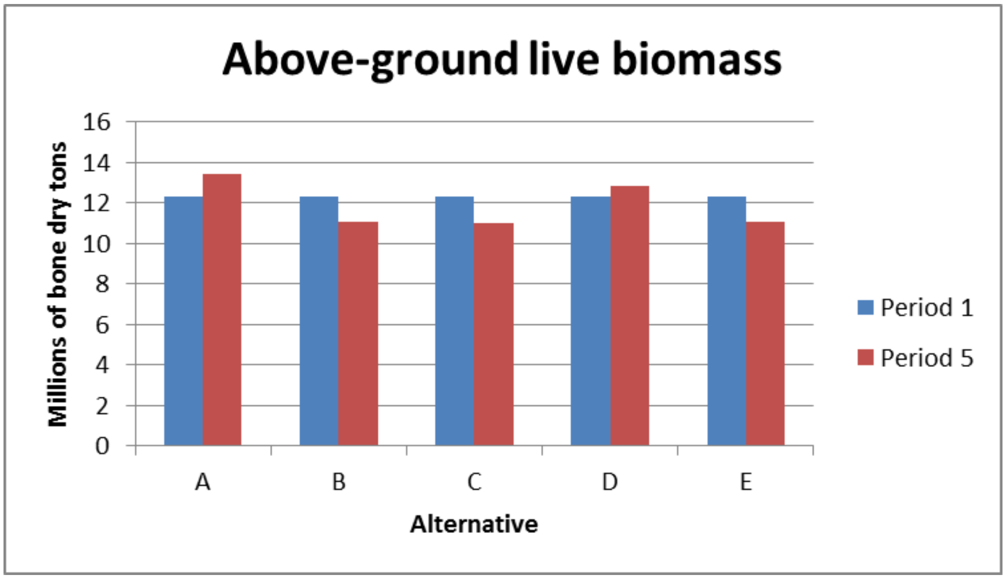


Figure 3 23. Above-ground live biomass (bone dry tons)

To estimate carbon sequestration under each alternative, only above ground biomass is considered (Figure 3-24).

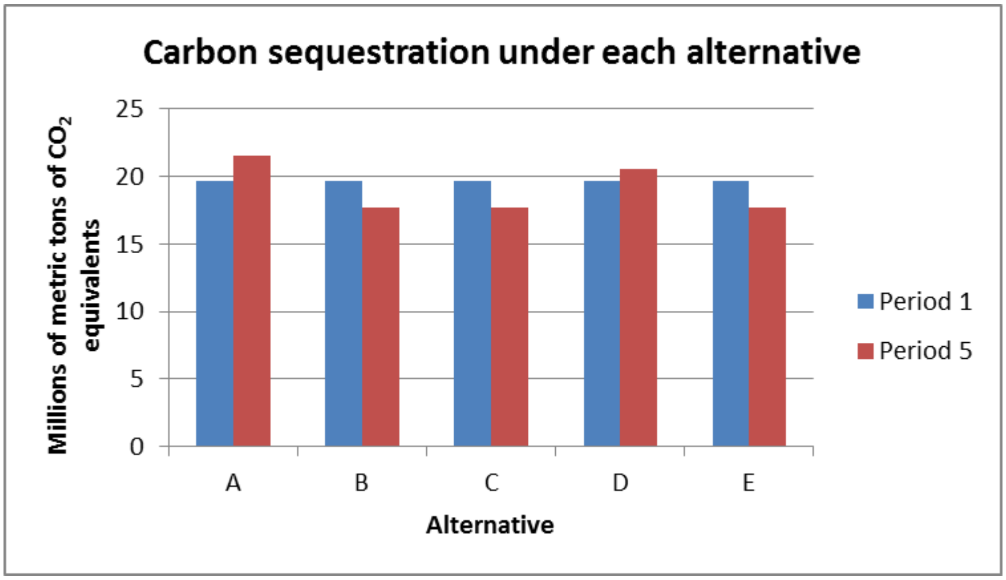


Figure 3 24. Carbon sequestration under each alternative (equivalents of CO_2 in metric tons)

The maximum amount of projected carbon sequestration occurs under Alternative A, followed by Alternatives D, B, E and C. Sequestration of carbon under this estimation is based solely on forest growth projections and assumes that stand replacing fire does not occur. Large, uncharacteristically severe

wildland fire would significantly alter the capacity and amount of carbon sequestration on the LTBMU. Alternatives B, E and C have lower total carbon sequestration through the five periods, with a relatively small difference in the first and second periods. Ensuring forest health and resiliency are key to stabilizing carbon sequestration in forest ecosystems. Carbon sequestration would be more stable under Alternatives B, C and E.

The fate of harvested tree carbon can be central to the carbon balance. For example, using thinned trees from forests for firewood and accounting for the reduction in fossil fuel used for home heating can result in a net carbon loss of 3.11 mega grams (Mg, equal to 1,000 kilograms or 1 metric ton) carbon per hectare (ha), whereas using the thinned material for longer-lived wood products results in a net gain of 3.35 Mg carbon per ha (Finkral and Evans 2008). In Sierra Nevada mixed-conifer forests, understory tree removal can yield a substantial number of trees that are appropriate for dimensional lumber production, with lumber being equivalent to 6.4% to 8.9% of the total post treatment carbon pool (North et al. 2009). North and colleagues (2009) reported that the waste associated with milling inefficiency is second only to prescribed fire emissions in understory thinning. If the milling waste is used as biofuel to generate electricity, the carbon contained in this material can be used to offset fossil fuel-based energy. Assuming some percentage of the waste can be converted to biochar, the carbon converted can remain in that form for thousands of years, and can also increase soil productivity.

Hansen et al. (2008) showed that improved forestry practices offer a more natural way to draw down CO_2. Deforestation contributed a net CO_2 emission of 60 ±30 ppm over the past few hundred years, of which ~20 ppm CO_2 remains in the air today. Reforestation could absorb a substantial fraction of the 60 ±30 ppm net deforestation emission. Forest wildfires and prescribed fires generate GHGs that can be recouped through plant sequestration partially or completely through management strategies.

Comparison of Consequences by Alternative

Effects Common to All Alternatives

Future wildfire frequency is expected to continue as described in the Fire and Fuels Section 3.4.11. Future large wildfires could have negative cumulative effects on air quality, depending upon the size and intensity of the fire. Visibility impairment and hazardous health impacts, due to sudden and dramatic releases of emissions, are likely with a large, high intensity wildland fire event. Such events may temporarily reduce visibility and air quality. In addition, they release high amounts of GHGs and reduce carbon sequestration from impacted areas for several years following fires. The cumulative effects are unknown, because the intensity and size of a wildfire is unknown. Research has indicated that wildfires can produce nearly twice the amount of smoke as prescribed fire (General Technical Report PNW-GTR-355). Prescribed burning activities would comply with California’s Smoke Management Plan to mitigate potential impacts from smoke.

In the event that population, energy consumption patterns, and vehicle travel remain at present levels or continue to increase, both short and long-term adverse impacts would continue from anthropogenic emissions prevalent in the region and would continue to dominate adverse impacts to air resources on the Lake Tahoe Management Basin Unit. The visitation is more tied to population growth in adjacent areas (Sacramento, Reno) and in California as a whole.

Alternative A

Alternative A would continue prescribed burning at current levels. It would allow management of wildfires to meet resource objectives only in the Desolation Wilderness, leading to increased accumulations of surface fuels in the other areas of the LTBMU with an associated increased potential for high intensity wildfires in the future and higher potential for air quality degradation. Currently, 91% of the Basin is in FRI condition class II or III and only 9% is in condition class I. Pollutants, black carbon,

and GHG emissions from fire are primarily from prescribed fire. Fuel loads can be expected to increase similar to historic levels of increase with fire suppression policies.

Under Alternative A (the no action alternative), short-term adverse impacts to human health would be negligible assuming fire activity and smoke generation is similar to those experienced in recent years. Short-term changes to NAAQS standard violations would be negligible because prescribed burns adhere to smoke management programs established by California's Air Pollution Control Districts (APCDs) and the Nevada Division of Environmental Protection (NDEP). Under the no action alternative, GHG emissions would remain largely unchanged from the recent past. Large wildfires are known to result in high levels of emissions, reduced visibility, and associated NAAQS violations. The potential for an unplanned ignition leading to uncharacteristically large and intense wildland fire events would continue to increase, as it has throughout the Sierra Nevada, leading to increased emissions; therefore long-term adverse impacts to human health are moderate under Alternative A.

Alternative A would have negligible short and long-term adverse impacts with pollutant emissions similar to recent years. Impacts to forest health from anthropogenic emission sources of air pollutants would continue to be the primary air pollutant stressor to forest health. Alternative A would have negligible short-term adverse impacts on air quality Moderate long-term adverse impacts are expected primarily caused by decreased control of emissions during wildfire events driven by excessive fuel accumulations and the lack of management strategies for adapting to a changing climate, reducing GHGs, and enhancing carbon sequestration.

Alternative B

Alternative B includes management strategies to adapt to climate change and preserves, perpetuates, and promotes old growth forests to reduce wildfire emissions. Wildland fire management for resource objectives is allowed in all Fire Management Units except WUI Defense Zones. Alternative B promotes forest resiliency to fire, changing climate through more stable environments for carbon sequestration, disease, and insects. Black carbon emissions under Alternative B for Period 1 are 52% from prescribed fire, 35% from wildfire, and 12% from brush. Period 1 pollutants, air toxics, and GHG emissions from fire are primarily from prescribed fire (55%). Biomass is primarily removed through harvest during Period 1 (75% of the total biomass removed). Alternative B reduces the potential for large, high intensity wildland fire by managing forest health for a changing climate and fire resistance.

Comparison of Alternative B to Alternative A shows more total acres treated for all periods. Wildland fire acreage projections are 17% more under Alternative B compared to Alternative A because wildland fire management for resource objectives is allowed in all Fire Management Units except WUI Defense Zones. In Period 1, pollutant emissions are 9 to 27% less under Alternative B compared to Alternative A, air toxic emissions are 64% less, GHG emissions for Period 1 are 12% less. Black carbon emissions are 13% below Alternative A. Biomass removal is 32% more in Period 1 under Alternative B compared to Alternative A and 32% more in total for all periods. Emissions reduced through harvest in Period 1 are 59% more than Alternative A.

Under Alternative B, short-term beneficial impacts to human health would be negligible based on the decreased acres burned, assuming fire activity and smoke generation is similar to levels experienced in recent years. Short-term changes to NAAQS violations would be negligible as a result of protocols implemented through the APCD and NDEP. Anthropogenic emissions would continue to dominate pollutant violation levels. Large wildfires are known to result in high levels of emissions with associated NAAQS violations and degraded visibility. The potential for an unplanned ignition leading to a large, uncharacteristically severe wildland fire event would be limited by management actions leading to decreased GHGs, pollutants, air toxics, and black carbon emissions. Long-term beneficial impacts to human health are moderate under Alternative B but slightly better than Alternative A.

Alternative B would have minor short-term adverse impacts, with smoke emissions below that of Alternative A and below historic emissions. Impacts to forest health from anthropogenic emission sources of air pollutants would continue to be the primary air pollutant stressor to forest health. Biomass removal would increase both in Period 1 and for all periods. Total carbon sequestration is 9% less under Alternative B compared to Alternative A, although the level of carbon sequestration is the same for both alternatives in Period 1.

LTMBU actions in Alternative B would have negligible short-term beneficial impacts to air quality with increased ability to control fire emission timing and quantity to mitigate human health impacts. Moderate long-term beneficial impacts are expected primarily through increased biomass removal and reduction of GHG emissions and increased fire resiliency enabling a higher probability of maintaining carbon in the forest biomass. Long-term beneficial effects would also be realized through Alternative B's utilization of management strategies that adapt to changing climate. Alternative B would have minor short-term adverse impacts as overall emissions from this alternative are below the historic normal. Emissions from this alternative are minor in comparison to anthropogenic emission stressors. Negligible long-term beneficial impacts on forest health, resiliency, and sustainability are expected from the higher probability of carbon remaining sequestered by promoting forest resiliency to fire.

Alternative C

Alternative C includes management strategies to adapt to climate change and preserves, perpetuates, and promotes old growth forest resiliency to reduce wildfire emissions. Wildland fire management for resource objectives is allowed in all Fire Management Units except WUI Defense Zone. Alternative C promotes forest resiliency to fire, changing climate, disease, and insects. Vegetation treatments are designed to reduce the number of entries needed to meet desired conditions by thinning to the lower range of desired tree stocking levels, reducing stand densities more than in Alternatives A and B. Black carbon emissions for Period 1 are 43% for prescribed fire, 30% for pile burning, and 27% for wildfire, with approximately the same total amount of black carbon emissions for all periods. Period 1 pollutant, air toxics, and GHG emissions from fire are primarily from prescribed fire (45%). Biomass is primarily removed through harvest during Period 1.

Alternative C reduces the potential for large, high intensity wildland fire by managing forest health for a changing climate and fire resistance and reducing stand densities to a greater extent than Alternatives A and B.

Wildland fire acreage projections are 29% more under Alternative C compared to Alternative A. In Period 1, pollutant emissions are 24% more, air toxic emissions are 23% more, and GHG emissions are 24% more under Alternative C compared to Alternative A because wildland fire management for resource objectives is allowed in all Fire Management Units except WUI Defense and Threat Zones. Black carbon emissions are 24% more under Alternative C than Alternative A. Biomass removal under Alternative C is 25% more in Period 1 and 32% more in total for all periods compared to Alternative A. Emissions reduced through harvest in Period 1 are 26% more under Alternative C than Alternative A. Sequestration of carbon under Alternative C is equivalent to Alternative A in Period 1 and 9% less in total for all periods.

Under Alternative C, short-term adverse impacts to human health would be negligible, assuming fire activity and smoke generation is similar to levels experienced in recent years. Large wildfires are known to result in high levels of emissions with associated NAAQS violations and degraded visibility. The potential for an unplanned ignition leading to a large, uncharacteristically severe wildland fire event would be decreased through Alternative C's management strategies, including those aimed at reducing stand density. Increased biomass removal would lead to greater forest stand resiliency to fire with

increased carbon sequestration over all periods and reduced emissions; however, long-term beneficial impacts to human health are minor under Alternative C.

Alternative C would have minor short-term impacts with smoke emissions projected to be lower compared to those of recent years. Impacts to forest health from anthropogenic emission sources of air pollutants would continue to be the primary air pollutant stressor to forest health. Biomass removal would increase under Alternative C both in Period 1 and for all periods compared to Alternative A. Total carbon sequestration under Alternative C is less than Alternative A, although the alternatives have similar levels of carbon sequestration in Period 1.

Alternative C would have negligible short-term adverse impacts to human health with increased ability to control fire emission timing and quantity to mitigate human health impacts. Increased fire resiliency enabling a higher probability of maintaining carbon in the forest biomass is a beneficial aspect of Alternative C with minor long-term beneficial impacts expected to human health. Forest health, resiliency, and sustainability under Alternative C would have minor short-term beneficial impacts as Period 1 emissions under this alternative are closer to the historic range. Emissions from this alternative are minor in comparison to anthropogenic emission stressors. Smoke emissions from wildfires would be reduced as a result of the higher probability of carbon remaining sequestered through Alternative C's emphasis on promoting forest resiliency to fire.

Alternative D

Alternative D largely allows natural systems to adapt to climate change at their own pace. Natural processes are the preferred means to recovery and restoration of disturbed areas. Vegetation treatments are focused in WUI areas. Management of natural ignitions and prescribed burning are the preferred tools. Wildland fire is recognized as an essential ecosystem process in need of restoration, and this alternative utilizes planned and unplanned ignitions to meet the need. Wildland fire management for resource objectives is allowed in all Fire Management Units except WUI Defense Zone. Black carbon emissions under Alternative D for Period 1 are 60% for prescribed fire, 10% for brush, and 30% for wild fire, and prescribed fire has the largest (53%) of the total black carbon emissions for all periods. Period 1 pollutants, air toxics, and GHG emissions from fire are primarily from prescribed fire (63%). Biomass is primarily removed through harvest during Period 1 (56% of the total biomass removed). Over all five periods, the biomass removal is nearly equal among wildfire 20%, prescribed fire 19%, harvest 19%, and pile burning 16%. CO_2 equivalents removed by harvest are primarily accomplished (75%) in Period 1.

Restoration of fire as an essential ecological process and increased use of natural ignitions is expected to increase the frequency and duration of smoke emissions while fuel accumulated through historic fire suppression is consumed. Smoke emissions typical of pre-suppression are expected. Alternative D reduces the potential for large, uncharacteristically severe wildfire with the emphasis on utilizing fire as a management tool.

Wildfire acreage projections are 29% more under Alternative D compared to Alternative A because wildland fire management for resource objectives is allowed in all Fire Management Units except WUI Defense Zones. In Period 1, pollutant emissions under Alternative D are from 10% less (NMHC) to 15% more (CO) than Alternative A, air toxic emissions are 10% more, and GHG emissions for Period 1 are 10% more. Black carbon emissions under Alternative D are 9% more than Alternative A. Biomass removal under Alternative D is 6% less in Period 1 than Alternative A and 1% more in total for all periods. Emissions reduced through harvest under Alternative D in Period 1 are 15% less than Alternative A. Sequestration of carbon under Alternative D is equivalent to Alternative A in Period 1 and 2% less in total for all periods.

Under Alternative D, short-term adverse impacts to human health would be minor from increased use of fire as a natural process to remove biomass, assuming fire activity is similar to levels experienced in

recent years. Short-term changes to NAAQS violations would be negligible because anthropogenic emissions would continue to dominate pollutant violation levels on the LTBMU. Large wildfires are known to result in high levels of emissions with associated NAAQS violations and degraded visibility. The potential for an unplanned ignition leading to a large, uncharacteristically severe wildland fire event would be limited by management actions, particularly re-introduction of fire as a natural process into the ecosystem. Increased biomass removal in Period 1 would lead to greater resiliency to fire with similar carbon sequestration over all periods and decreased emissions; therefore, long-term adverse impacts to human health are minor under Alternative C.

Alternative D would have moderate short-term beneficial impacts with re-introduction of smoke levels typical in this ecosystem that benefit smoke tolerant biota (Keeley et al. 2005). There are smoke adapted species such as Chia that germinate with smoke. Certain insects including Ovipositors are drawn by smoke to lay their eggs in snags caused by the fire. Certain species such as mistletoe and fungus, although part of the Sierra Nevada, are culled to natural population levels from episodic smoke events (Parmeter.1975, and Zimmerman. 1987). Smoke cues many plant species in Ponderosa Pine forest (Abella.2009). Additionally, Keeley (2005) shows increased seed germination and production and cuing for germination in California chaparral of the Sierra Nevada. It is a safe assumption that these are not limited to only the lower elevations.

Impacts to forest health from anthropogenic emission sources of air pollutants would continue to be the primary air pollutant stressor to forest health. Biomass removal would decrease slightly in Period 1 and remain at approximately the same for all periods. Total carbon sequestration is approximately the same across all periods. Long-term beneficial impacts to forest health, resiliency, and sustainability are moderate under Alternative D from the re-introduction fire and associated smoke emissions.

Alternative D would have minor short-term adverse impacts on human health with increased use of fire. However, careful management of fire would enhance the ability to control fire emission timing and quantity to mitigate human health impacts. Increased fire resiliency enabling a higher probability of maintaining carbon in the forest biomass is a beneficial aspect of Alternative D, but minor long-term adverse impacts are expected to human health through increased emissions. Forest health, resiliency, and sustainability under Alternative D would have moderate short-term beneficial impacts as overall emissions from this alternative increase from Alternative A and are nearer the historic range. Emissions from this alternative are minor in comparison to anthropogenic emission stressors. Moderate long-term beneficial impacts to forest health, resiliency, and sustainability are expected due to the higher probability of carbon remaining sequestered through Alternative D’s emphasis on promoting forest resiliency to fire.

Alternative E

Alternative E includes management strategies to adapt to climate change and preserves, perpetuates, and promotes old growth forests to reduce wildfire emissions. Wildland fire management for resource objectives is allowed on all NFS lands except the WUI Defense Zone. Alternative E promotes forest resiliency to fire, disease, insects and changing climate. Black carbon emissions under Alternative E for Period 1 are 52% from prescribed fire, 35% from wildfire, and 12% from brush. Period 1 pollutants, air toxics, and GHG emissions from fire are primarily from prescribed fire (55%). Biomass is primarily removed through harvest during Period 1 (75% of the total biomass removed). Alternative E reduces the potential for large, high intensity wildland fire by managing forest health for a changing climate and fire resistance.

Alternative E resembles Alternative B in terms of air quality impacts and effects. The only difference is that Alternative E adds 5000 acres to back country recreation. There is also 5% increase in recreational activities. This can lead to minor increase in emissions from these activities. The increase in emissions is insignificant as compared to emissions from forest fires. In addition the state is proposing new standards

for recreational vehicles which will lead to significant decline in future emissions as compared to existing emissions.

LTMBU actions in Alternative E would have negligible short-term beneficial impacts to air quality with increased ability to control fire emission timing and quantity to mitigate human health impacts. Moderate long-term beneficial impacts are expected primarily through increased biomass removal and reduction of GHG emissions and increased fire resiliency enabling a higher probability of maintaining carbon in the forest biomass. Long-term beneficial effects would also be realized through Alternative E's utilization of management strategies that adapt to changing climate. Alternative E would have minor short-term adverse impacts as overall emissions from this alternative are below the historic normal. Emissions from this alternative are minor in comparison to anthropogenic emission stressors. Negligible long-term beneficial impacts on forest health, resiliency, and sustainability are expected from the higher probability of carbon remaining sequestered by promoting forest resiliency to fire.

3.4.2.3. Analytical Conclusions

All of the alternatives are aimed at reducing the potential for large uncontrolled wildfires that typically occur under non-resilient forests. Wildfires present a risk to the public and result in damage to both the environment (e.g., increased erosion, air quality degradation) and property. Wildfires are known to result in high levels of emissions and associated air quality problems. Vegetation management treatments provide the opportunity on a long-term basis to reduce the magnitude of wildfire air quality problems.

Comparisons of each alternative to the No Action Alternative are summarized in Table 3-20.

Table 3 20. Air Quality Impact summary

Alternative	Issue	Short-term	Long-term
B	Human Health	Negligible beneficial	Moderate beneficial
	Forest Health	Minor adverse	Negligible beneficial
	Visibility	Minor Beneficial	Minor Beneficial
	Climate Change	Minor Beneficial	Minor Beneficial
C	Human Health	Negligible adverse	Minor beneficial
	Forest Health	Minor beneficial	Minor adverse
	Visibility	Minor Beneficial	Minor Beneficial
	Climate Change	Minor Beneficial	Minor Beneficial
D	Human Health	Minor adverse	Minor adverse
	Forest Health	Moderate beneficial	Moderate beneficial
	Visibility	Minor Beneficial	Minor Beneficial
	Climate Change	Minor Beneficial	Minor Beneficial
E	Human Health	Negligible beneficial	Moderate beneficial
	Forest Health	Minor adverse	Negligible beneficial
	Visibility	Minor Beneficial	Minor Beneficial
	Climate Change	Minor Beneficial	Minor Beneficial

3.4.3. Aquatic Wildlife Habitat and Species

3.4.3.1. Introduction

The alternatives (A, B, C, D, and E) under consideration are described in Chapter 2. This analysis evaluates the potential direct and indirect effects of the management activities proposed under the five alternatives on aquatic habitat as well as federally listed aquatic species under the Endangered Species Act of 1973 (as amended) and Region 5 Forest Service Sensitive species. Federally listed and sensitive species have been addressed in detail in the Biological Assessment (BA) and Biological Evaluation (BE), respectively. Management Indicator Species (MIS) and Tahoe Regional Planning Agency (TRPA) special interest species are addressed in separate documents. A summary of listed species and a comparison of the effects of the five alternatives on them are presented in this section. MIS are addressed separately in this chapter, in Section 3.4.14. Cumulative effects are described in Section 3.5 of this FEIS.

Methodology

The purpose of this section is to evaluate effects on aquatic resources from Alternatives A, B, C and D, and E. The Forest Plan includes unit-wide land management direction for the following program and sub-program areas, which could affect aquatic resources:

- Watershed and Aquatic Habitat Restoration
- Biological Resources
  - General/Native Species Conservation
  - Critical Aquatic Refuges (CARs)/Special Status Species Habitat Areas
  - Protected Activity Centers (PACs) and Home Range Core Areas (HRCAs)
  - Aquatic and Terrestrial Invasive Species
- Forest Vegetation
  - Wildland Urban Interface (WUI)
  - General Forest (Non-WUI)
  - Managed Wildfire
- Recreation
  - Developed
  - Dispersed
  - Wilderness
  - Backcountry
- Access to NFS Roads and Trails
- Permitted Land Uses

The scope of analysis for aquatic resources covers fish, amphibians and invertebrates, and their associated habitats including streams, lakes, wetlands and meadows. The aquatic resources analysis is driven by both Forest Service and other federal policies, which include various goals to conserve and/or protect species and habitat. The spatial extent of the analysis includes aquatic resources across the entire LTBMU. The following aquatic species and their federal and state listing status specifically addressed in this analysis are:

- **Lahontan Cutthroat Trout** (*Oncorhynchus clarkia henshawi*)
  Endangered Species Act (ESA) Listing Status: Threatened
  California State Listing Status: None
  Nevada State Listing Status: Vulnerable to Decline Due to Rarity or Restricted Range
  US Forest Service, Region 5 Status: None

- **Sierra Nevada Yellow-legged Frog** (*Rana sierrae*)
  ESA Listing Status: Proposed Endangered with Critical Habitat
  California State Listing Status: State Candidate Endangered or Threatened
  Nevada State Listing Status: None
  US Forest Service, Region 5 Status: Regional Forester's Sensitive Species

- **Yosemite Toad** (*Bufo canorus*)
  ESA Listing Status: Proposed Threatened
  California State Listing Status: Species of Special Concern
  Nevada State Listing Status: None
  US Forest Service, Region 5 Status: None

- **Northern Leopard Frog** (*Rana pipiens*)
  ESA Listing Status: None
  California State Listing Status: None
  Nevada State Listing Status: None
  US Forest Service, Region 5 Status: Regional Forester's Sensitive Species

- **Lahontan Lake Tui Chub** (*Gila bicolor pectinifer*)
  ESA Listing Status: None
  California State Listing Status: None
  Nevada State Listing Status: None
  US Forest Service, Region 5 Status: Regional Forester's Sensitive Species

- **Great Basin Great Basin rams-horn** (*Helisoma newberryi)*
  ESA Listing Status: None
  California State Listing Status: None
  Nevada State Listing Status: None
  US Forest Service, Region 5 Status: Regional Forester's Sensitive Species

Of the aquatic species listed above, Lahontan cutthroat trout, Sierra Nevada yellow-legged frog, and Yosemite toad require consultation with U.S. Fish and Wildlife Service (FWS). Sierra Nevada yellow-legged frog and Yosemite toad, as Proposed Endangered and Threatened, respectively, will require conference, while Lahontan cutthroat trout, as a threatened species, will require formal consultation.

On June 16, 2010 coordination began between the LTBMU and the U.S. Fish and Wildlife Service (USFWS), Reno, Nevada and Sacramento, California field offices for species protected under the ESA (threatened, endangered, and candidate species) on the revision of the Forest Plan. Discussions on the process for formal consultation, including requesting technical assistance for candidate species and incorporation of migratory bird act considerations were determined as well as the method of interaction and how information exchange would be completed during the revision process. With the changes in Forest Planning rules in late 2010, the consultation process with USFWS was placed on hold until the new Draft EIS and Revised Draft Forest Plan was released in the spring of 2012. On May 3, 2012 a formal request for consultation, technical assistance, and comments was sent to the USFWS (both Reno and Sacramento field offices) for the revised Draft EIS and Draft Forest Plan. On April 25, 2013, the USFWS published two proposals to list Sierra Nevada yellow-legged frog as Endangered with proposed

Critical Habitat and Yosemite Toad as Threatened with proposed critical habitat (no critical habitat was proposed on the LTBMU) and opened a 60 day public comment period that ended on June 24, 2013. During and after the initial comment period, the USFWS received significant interest in extending the comment period. On July 18, 2013, the USFWS reopened the comment period for an additional 120 days. Additional information regarding the status of the proposed species and critical habitat listing can be found at http://www.fws.gov/sacramento.

The aquatic resource analysis is composed of 2 parts, which include habitat and species. Potential direct and indirect effects on aquatic special-status species and associated habitat were measured by: 1) Status and Trend in Aquatic Habitat and 2) Status and Trend in Species Distribution. The analysis identifies: (1) the management activities (stressors) associated with each alternative, (2) the proposed magnitude of change in these activities by alternative, and (3) potential direct and indirect effects from these management activities. Stressors are produced as part of implementing programs and sub-programs, which vary by alternative and factor into the effects on aquatic resources. Each stressor has an estimated duration (time in which habitat or species is exposed to them) and identifies factors causing the stress.

The analysis area for potential effects is defined as all NFS lands within the LTBMU administrative boundary. All measures of effects are evaluated at a basin-wide scale and based on the assumption that the future revised LTBMU Forest Plan will be programmatic in nature and not area-specific and/or project-specific. All effects are evaluated on a 15-year basis for the anticipated life of the Plan; short term effects would be addressed in project-specific NEPA analysis as projects under the revised Forest Plan are initiated.

Assumptions

In addition to universal assumptions (see Section 3.3), the following aquatic resource specific assumptions have been made:

- Increased recreation capacity would cause or result in increased use
- Increased access to NFS lands would result in increased access and increased dispersed recreation activities.
- Creation of new developed recreation sites (e.g., facilities, campgrounds) would be compatible with natural resource objectives.
- Expansion of ski resort operational boundaries under Alternatives A, B, C, and E means additional ski runs, facilities, lifts and all other infrastructure and activity that occurs in current operational boundaries could occur in the newly expanded boundary area.
- Aquatic Organism Passage (AOP) would continue to be an emphasis of small scale aquatic restoration projects
- Actions comprising each program and sub-program area would be consistent with pertinent aquatic resource federal and state law and current and proposed revised Forest Plan standards and guidelines.
- Current and future actions for threatened, endangered (T&E) and candidate species restoration and recovery would be consistent with the Lahontan cutthroat trout recovery plan and Sierra Nevada yellow-legged frog management strategy, when finalized.

3.4.3.2. Overview of the Affected Environment

Lake Tahoe has a relatively small watershed (800 square kilometers, including the lake) for the size of the lake surface (500 square kilometers). The basin's land area is approximately 205,000 acres, including federal, state, tribal and local government and privately owned lands. The federal ownership is approximately 75 percent of the land area in the basin. Between 1870 and 1900, the forests of the basin were heavily logged for use in mine shafts at the Comstock Silver Lode in Virginia City, Nevada. Forest stands have largely been left alone to regenerate during the last 100 years, while wildland fires have been aggressively suppressed (USDA 2000). This has led to basin forests that are overcrowded with fuels and fairly uniform in age. Urbanization of the basin has eliminated 75 percent of its marshes, 50 percent of its meadows and 35 percent of its stream zone habitats (USDA, 2000).

Lake Tahoe was created in the late Tertiary Age when a lava flow blocked the glacially formed basin at its north-west extent, allowing it to fill with water (USDA 2000). The Upper Truckee River, Trout Creek, Blackwood Creek, Ward Creek and Taylor Creek provide the primary water sources to Lake Tahoe. Lake Tahoe has a mean depth of 313 meters (1,027 feet) and a maximum depth of 501 meters (1,645 feet). Much of the beauty of the Lake comes from its extraordinary transparency and related deep blue color. Secchi disks were visible at depths of over 40 meters (131 feet) in the 1960's, and the Lake historically transmitted enough light to support beds of mosses and other plants at depths of up to122 meters (400 feet) (USDA 2000). In a study released by the UC Davis Tahoe Environmental Research Center and the Tahoe Regional Planning Agency, scientist's report that water clarity dropped to 19.6 meters (64.4 feet) in 2010, the lowest clarity level ever recorded at Lake Tahoe since 1959, when nutrient loading studies were initiated (USDA 2000). Factors likely contributing to these declines include climate change and algae growth promoted by increased sediments and nutrients.

Efforts to protect Lake Tahoe since the 1960's have been pioneering examples of watershed planning and nonpoint source control, but much work remains to be done. Lake Tahoe is a designated "Outstanding National Resource Water" under federal anti-degradation regulations and is one of only two lakes with such a designation in California. The Lake Tahoe basin receives over 20 million visitor days per year, about five times the visitation to Yosemite National Park (USDA 2004). Five million of these visitor days are directly related to outdoor recreation (USDA 2004). The Lake Tahoe basin is recognized as a national priority because of its high resource value and its sensitivity to water quality impacts; however, increased development and watershed disturbance in the Basin continue to impact the Lake and its tributaries in spite of a comprehensive point and nonpoint source control program.

Aquatic Habitat

Physical Habitat Characteristics

The Lake Tahoe basin has 11 HUC 6 (Hydrologic Unit Code 6) watersheds encompassing 63 perennial streams and approximately 400 miles of stream (USGS 1994), of which three-quarters are within the LTBMU. The watersheds vary in elevation (1,900 to 3,320m (6,225 to 10,900ft)), size (1195 to 14585 hectares (2,953 to 36,040 acres)), geology (granitic or volcanic), and level of disturbance. The largest watershed is the Upper Truckee River which contains 14,585 hectares (36,040 acres), which serves as the main inlet for Lake Tahoe as well as the major source of sediment followed by Blackwood and Ward, respectively (USDA 2000).

Watersheds and associated perennial streams vary in topography and precipitation based on orientation (TRPA and USDA 1971). Streams on the west side of the basin are steep and receive an average annual precipitation of 180 to 200 cm (71 to 79 inches) on average. In contrast, streams on the east side of the basin are less steep and typically get approximately 90 to 100 cm (30 to 39 inches) of precipitation on average. Both the north and south side streams and watersheds are intermediate in terms of steepness and precipitation in comparison; however, streams on the south side are the most gradual in slope because the

rim of the basin is farther from the lake. Because of this characteristic, streams on the south side of the basin are large with a high diversity in channel morphology specifically towards the mouths of the channel.

Between 1993 and 2004 the LTBMU conducted watershed improvement needs (WIN) inventories throughout the Lake Tahoe basin. During these inventories all, trails and stream channels were visited to identify areas of accelerated erosion, and opportunities for restoration (See Section 3.4.26 – Watersheds for more information). Additionally, all streams in the Basin were classified using the Rosgen Channel Typing protocol (Rosgen 2006).as well as fish habitat typing. This information was used to identify stream reaches exhibiting unstable geomorphic channel characteristics and poor aquatic habitat quality.

There are approximately 325 permanent lakes ranging in size from 0.012 to 49,776 hectares (0.03 to 123,000 acres). Of those 325 lakes, 273 or 84percent are located on NFS lands. More than half of the lakes (186) on NFS lands are less than 1 acre in size. Within the Lake Tahoe basin boundary, there are approximately126, 655 acres of lakes. Of these acres, 122,786 are Lake Tahoe while 2,400 are within the LTBMU jurisdiction with the remaining 1,470 acres in other ownership.

Management of Lake Tahoe falls under the jurisdiction of the States (both California and Nevada); however, restoring and protecting Lake Tahoe, including associated aquatic habitats and species, is a shared responsibility.

Historic Land Uses and Impacts to Habitats

Regardless of orientation or jurisdiction, aquatic ecosystems in the LTBMU have been influenced by major historic land uses and practices such as Comstock era logging (1860-1920), cattle and sheep grazing (1850's-1950's), rapid human development (1960-1980), and fire suppression throughout the basin (1911-present).

Fine sediment (<20 microns) transport to Lake Tahoe, and its effect on Lake Clarity is a primary water quality concern in the Lake Tahoe basin. Nutrient inputs (nitrogen and phosphorus) are also a concern, particularly as it affects near shore clarity (See Section 3.4.24 – Water Quality for more information). Invasive species in the forms of both aquatic plants and mollusks have also been recently identified as a major contributor to adverse impacts on near shore clarity. Because of the multi- jurisdictional status of Lake, conservation, enhancement and restoration efforts are often multi-agency endeavors.

During the Comstock Era, many land use practices contributed to the degradation of water quality in both lakes and streams and to the creation of unnatural bodies of water by damming and diversions. At least two-thirds of the basin's forests were clear-cut. Clear-cutting and uncontrolled grazing probably caused the discharge of heavy loads of sediment into regional water bodies (Elliott-Fisk et al. 1997; Heyvaert 1998). In addition, Strong (1984) noted that it was common to dump sawmill waste, such as sawdust, directly into streams and Lake Tahoe. Heyvaert (1998) estimated that sediment deposition rates into Lake Tahoe increased between seven- and 12-fold during this era compared to pre-European deposition rates. Streams and lakes throughout the basin, such as Marlette and Spooner lakes, were dammed and diverted to maintain a supply of water to logging flumes (Strong 1984; Landauer 1995). This practice created artificial water bodies and changed water levels in existing water bodies such that lowland vegetation and riparian communities were presumably converted to aquatic systems. Some historians speculate that the diversion of streams and the deposition of large quantities of sediment and silt in streams and lakes were partially responsible for the decline of native LCT (Gerstung 1988; Elliott-Fisk et al. 1997).

Wetlands and meadows experienced heavy grazing pressure during the late 1800's through 1900's, which likely negatively affected stream environment zones as well as lakeshore habitat. Grazing continues to be an authorized use on the LTBMU; however, all grazing allotments are currently in vacant status. Since the mid-1900s, approximately 75 percent of marshes and 50 percent of meadows have been degraded, and

around 25 percent of the basin's marshlands were developed between 1969 and 1979 (Elliott-Fisk et al. 1997). Development includes conversion from wetlands and meadows to housing developments, parking lots, and marinas, for example.

In the 1870s, the first dam on Lake Tahoe was built at the Truckee River outlet, and its use was debated by local residents (Landauer 1995). The dam raised the lake's water level by 2m (6 feet) (Elliott-Fisk et al. 1997). Raised lake levels have altered the dynamics of marshes surrounding the lake. Loss of these once dynamic systems has altered habitats for native species as well as systems that acted as sediment and nutrient sinks, thus protecting the clarity of Lake Tahoe.

Current Land Uses and Habitat Impacts

With urbanization came facilities and amenities that encouraged the growth of tourism. The LTBMU is recognized as one of the nation's most popular recreation areas and receives approximately 4.6 million visitors per year. The high concentration of recreation activities and type of recreation activities (i.e., motorized, non-motorized, developed, dispersed) affect the condition of the aquatic habitat and influence abundance, distribution, and community structure of native species. The LTBMU manages campgrounds, resorts and lodges, day use sites, recreation residences, and ski areas, and also provides special use permits for management of developed recreation facilities, outfitter and guide activities and organized events. Recreation activities occur throughout the Basin but many highly concentrated activities occur along the lake shore where there tend to also be a variety of sensitive habitat types (e.g., meadows, marshes, etc.) and species. This is particularly true of the south shore, an area that has particularly high recreation use and also a high concentration of sensitive wildlife species and habitats.

Aquatic Invasive Species

Of increasing concern is the spread of aquatic invasive plant, animals and disease pathogens throughout Lake Tahoe and its associated water bodies. These species are known to have significant impacts to economic, social and ecologic functions (USACE, 2009). Aquatic invasive species (AIS) may be transported from infested lakes and rivers via a variety of pathways, for example, recreational watercraft, fishing gear, waders, construction machinery, and rafts. These invasive species include: zebra and quagga mussels (*Dreissena polymorpha* and *D. rostriformis bugensis*, respectively), Eurasian watermilfoil (*Myriophyllum spicatum)* and curlyleaf pondweed (*Potamogeton crispus)*, and Asian clams (*Corbicula fluminea*).

Despite public awareness campaigns and regulations prohibiting their introduction, both plant and animal invaders have been found on boats traveling to or preparing to launch in Lake Tahoe and other waterbodies in the basin. The Lake Tahoe basin is not only threatened by new AIS from other waterbodies, but also the expansion of existing populations within Lake Tahoe that expand the threat of further spread with in the Basin to nearby waterbodies. As examples, Eurasian watermilfoil has been spreading from the south to the western shores of Lake Tahoe over the last 15-20 years, and curlyleaf pondweed has begun to expand dramatically at the south end of the Lake over the last three years. Additionally, beds of Asian clams have been established in Lake Tahoe and are degrading water quality and aquatic habitat (USACE, 2009).

Populations of warm water fishes such as largemouth bass (*Micropterus salmoides*) and bluegill (*Lepomis macrochirus)* are expanding in the mouths of various tributaries and lagoons, specifically in marinas, which provide optimal habitat for these invasive species (Kamerath et al. 2008). Moreover, global climate change has resulted in warmer water temperatures, likely facilitating the establishment of non-native plants in the nearshore environment and providing increased spawning areas for warm water fishes that compete with desirable species.

In recent years, warm-water fishes, e.g., bluegill and largemouth bass, occur at 58% of the 16 locations monitored in Lake Tahoe. Their establishment in the south (e.g., Tahoe Keys) has led to the continued decline of native fishes since 1999; when non-natives are present, often no native fish are caught during the surveys (Kamerath et al. 2008).

An Establishment Likelihood Model was developed by University of Reno (UNR) for largemouth bass based on limnological and satellite data. Temperatures observed in this study revealed the entire near shore is thermally suitable for warm water fish spawning, and that future establishment is currently limited by the distribution of aquatic plants (Chandra, 2013).

A Bioenergetics Model was also developed by UNR to determine the potential impact of largemouth bass on native fishes. After numerous simulations the model indicates these predators could eliminate 100% of fish biomass at 37- 80% of sites examined. Fortunately the movement and establishment of warm water fishes is still in its early stages and fish exhibit generally slower growth rates, allowing for the potential control of these populations (Chandra, 2013). A control project is currently being implemented in the Tahoe Keys by CDFW; although funding is becoming limited making future treatment uncertain.

Aquatic ecosystems within the LTBMU provide critical habitats for fishes, amphibians, benthic invertebrates and lake plankton. Aquatic ecosystems not only include streams and lakes, but also a complex network of wetlands and meadows that provide hydrated conditions in the form of springs, seeps, swamps/marshes and lagoons AIS threaten the diversity or abundance of native species and the ecological stability of infested waters USACE 2009). Given AIS are commonly spread by activities such as boating, fishing, hatchery releases, and aquarium dumping, an area such as Lake Tahoe, with the large amount of visitor use, is highly susceptible to invasion.

Restoration Efforts

Concern for the basin's water quality and aquatic habitat has steadily increased since the 1960s, as research continues to reveal the impacts of urban pollution, particularly sewage and runoff, on the basin's watersheds and on Lake Tahoe itself (Goldman et al. 1986). Most sources of pollution have long-lasting effects. For example in the 1970s, Heavenly Creek still carried 60 times the nutrient load of Ward Creek five years after sewage effluent was released around Heavenly Creek (Strong 1984). To address these problems, the Tahoe Regional Planning Agency (TRPA) announced a set of environmental threshold carrying capacities in 1982 that were designed to control nutrient loading and other damage to Lake Tahoe's natural resources (TRPA 1982).

Since the adoption of the 1988 Forest Plan and the creation of the Environmental Improvement Program (EIP) in 1997, functional characteristics of aquatic habitats have improved as a result of stream and wetland restoration efforts, reduced grazing pressure and/or installation of water quality upgrades at road/trail and recreation facilities. Based on benthic macroinvertebrate results from 2011, the overall quality of most streams is good to excellent with nearly 70 % are in reference condition (i.e., undegraded and therefore in compliance with the Clean Water Act). Restoration efforts to restore physical and biological processes, such as efforts at Blackwood Creek, Trout Creek, and Cold Creek, all of which were Environmental Improvement Projects (EIP), not only improved geomorphic processes but are also improved habitat for native species. Since the creation of the EIP, over 3,000 acres of sensitive land have been acquired, 800 acres of wetlands have been restored, 30 miles of state highways have improved stormwater runoff, 60 miles of dirt roads have been re-vegetated or removed

Aquatic Organism Passage

Aquatic Organism Passage (AOP) was assessed in 2010 and 2011. In the summer of 2010 the LTMBU evaluated 112 road/stream crossings. Of these, 61 had full assessments completed and 51 were partial assessments due to factors such as no flow, no structure, the crossing was a bridge, or the crossing was on

a decommissioned road. Approximately 82% (50 of 61) of the full assessment on all road crossings do not meet the criteria for fish passage (RED), and are barriers for at least one life stage of salmonid or sculpin. Only 11% of the fully assessed crossings met the passage criteria (GREEN) to fish for both juvenile and adult salmonid life stages. The remaining 7% of fully assessed crossings were undetermined (GREY) for salmonid or sculpin and are candidates for further evaluation. In the summer of 2011, the LTMBU evaluated 204 road-stream crossings. Of these, 117 had full assessments completed and 87 were partial assessments. Approximately 82% (96 out of 117) of the full assessments on all road-stream crossings in the 2011 survey did not meet the criteria for fish passage (red), and were barriers for at least one life stage of salmonid or sculpin. Only 8% (9 out of 117) of the fully assessed crossings met the passage criteria (green) for both juvenile and adult salmonid life stages. The remaining 10% of fully assessed crossings were indeterminate (gray) for either salmonid or sculpin and are candidates for further evaluation.

Climate Change

Changes in temperature, precipitation, and fire behavior have been occurring in the Lake Tahoe basin and throughout the Sierra Nevada due to fire suppression and a changing climate and are likely influencing aquatic habitat. Mean annual temperature has risen by about 17 degrees Centigrade (two degrees Fahrenheit) and precipitation has increased by 7 inches over the past 98 years; however, there is large interannual variability (FEIS Appendix D, Safford 2010). Overall there appears to be a strong upward trend in air and lake temperature, rainfall intensity, a shift from snow to rain, earlier seasonal snowmelt events, and increased inter-annual variability in the Lake Tahoe basin (Coats 2010). Stewart et al. (2005) showed that the onset of spring thaw in most major streams in the central Sierra Nevada occurred 5-30 days earlier in 2002 than in 1948, and peak streamflow (measured as the center of mass annual flow) occurred 5-15 days earlier. The Sierra Nevada has experienced an increased frequency of fires since the 1980’s (Westerling et al. 2006) and an increase in the mean and maximum fire size, total burned area, and fire severity between the early 1980’s and 2007 (Miller et al. 2009); increases are attributed to the interaction between climate change and increasing forest fuels.

Changing climate conditions are likely influencing amphibian and fish populations in the Lake Tahoe Basin but our understanding of the effects are not well understood and predictions are limited due to the complexity of biological and physical interactions. Temperature, water quality, food availability, flow regime, and biotic interactions are all critical factors for aquatic species distributions (Wegner et al. 2011). Changes in aquatic habitats will parallel trends in climate changes, streams and lakes will become warmer, flow will be more variable, there will be an increase in extreme events such as flooding, droughts (Rieman and Isaak 2010). Changes in sediment input and recruitment of large woody debris will likely occur due to altered forest and riparian communities and increased fire (Rieman and Isaak 2010, Miller et al. 2007).

Individual species will respond differently to changing climate, which may change community composition and lead to the formation of novel communities. Sensitivity to changes in temperature and flow regime varies by species. Trout and salmon require cold water to survive and the warming of the atmosphere will increase water temperatures, making certain sections of streams and rivers uninhabitable for trout and salmon as water temperatures increase. Most climate change models predict water temperature increases of approximately 5.4° F by the year 2050. Fish that are already stressed by poor water quality, degraded habitat, and non-native species will have a harder time as these natural disturbances increase and cause additional strain on them (Haak 2010). Additionally, trout are coldwater species that are sensitive to high water flow after spawning (Wenger et al. 2011).

Amphibians are more threatened than either birds or mammals due to a combination impacts including: non-native fish introduction (Knapp 1996, Knapp et al. 2000a), disease (Daszak et al. 2003), habitat loss (Davidson et al. 2002) ultraviolet (UV) radiation (Blaustein et al. 1988, Blaustein et al. 2003), climate

change (Davidson et al. 2002, Stuart et al. 2004) and pesticide use (Davidson et al. 2002, Boone and Bridges 2003).

In order to survive, species have two options, migrate to appropriate conditions or adapt to new environmental conditions (Hawkins et al. 2008). Species will only be able to migrate if habitat exists and barriers to dispersal and migration do not (Rieman and Isaak 2010).

In addition to the physical habitat qualities, habitat needs to be suitable biologically. It cannot be degraded by competition with or predation by non-native species or disease. Climate may play an indirect role in facilitating disease. Chytridiomycosis (Chytrid fungus) is a fungal disease that infects amphibians and has been causing mortality and population declines worldwide (Berger et al. 1999, Daszak et al. 1999, Fellers et al. 2001, Bradley et al. 2002, bell et al. 2004). Fungal habitat is normally influenced by temperature and water availability (Bosch et al. 2007). Bosch et al. (2007) identified a positive correlation between climate change and chytridiomycosis.

Aquatic Species

Fish

A basin-wide inventory of native non-game fishes was initiated in 2007 to gain an understanding of the current distribution, relative abundance of species and relative composition of native fish species verses non-native within tributaries. The monitoring efforts were intended to determine and inform land managers of the baseline conditions of fisheries and provide information for future watershed and ecosystem level management decisions. To date 26 streams within the Lake Tahoe basin have been surveyed. Data from these monitoring activities revealed that native non-game fishes have been eliminated or drastically reduced in tributaries where wide spread introduction of non-native salmonids have occurred. Of the 26 streams surveyed since 2007, 15 have been dominated by non-native trout. Non-native trout have occupied nearly every habitat in all tributaries surveyed throughout the fish assessment and account for approximately 61% of fish surveyed since 2007. Paiute sculpin, speckled dace, and Lahontan redside shiner make up 38% of all fish surveyed, while the other native species and warm-water invasives including bluegill, brown bullhead, and goldfish make up the remaining 1% (USFS 2011). Surveys determined when native non-game species were detected, it was typically in the lower third of streams (USFS 2010).

Species such as mountain whitefish, Tahoe sucker, Lahontan redside shiner and Paiute sculpin historically dominated Lake Tahoe's species assemblage, along with Lahontan cutthroat trout. Other studies found similar distributions and determined that of the eight native species historically found in the Tahoe Basin, Lahontan cutthroat trout and Lahontan lake tui chub are vulnerable and mountain whitefish is near threatened (Moyle et al. 2011, Moyel et a. 1995, Moyel et a. 1989). Native fish species have also been further depressed by the illegal introductions of invasive warm-water fishes. In 2011, California Department of Fish and Game initiated manual removal efforts of invasive warm-water fishes in the Tahoe Keys and will continue such management in 2012.

Amphibians and Reptiles

Similar monitoring efforts occurred in lentic habitats to determine the status and trends of amphibian and reptile populations from 2002 through 2004 (Manley et al. 2005). Results were consistent with other research that describes this habitat and associated species particularly vulnerable to degradation because of sensitive physical, biological, and chemical balanced required to sustain the biological integrity. Specifically, amphibians and non-native fish interactions have proven detrimental to native amphibian population throughout the Sierra Nevada's, including Lake Tahoe (Knapp 1996, Knapp et al. 2000a).

Results from the basin-wide monitoring effort determined that of the four native amphibians and three native garter snakes species, with the exception of Pacific treefrog, all had low occupancy, and that long-toed salamander, western toad, and Sierra Nevada-yellow legged frog were vulnerable of extinction (Manley et al. 2005). Of the 72 lakes and 16 wet meadows (88 sample units) that were sampled, Pacific tree frogs were present in 43 of the sample units while the remaining native species occurred in only one to eight of the 88 sample units.

It is evident from these survey results that native amphibians in the Lake Tahoe basin are at risk of population declines and potential extinction. The number of sites occupied by the American bullfrog, an aquatic invasive species that predates on native species and a vector of infectious disease (*Batrachochytrium dendrobatidis*) has been detected at the majority of low elevation lentic habitats (Manley et al. 2005) and has the potential to spread with rising water temperatures predicted through climate change. Bullfrogs are considered are known to prey on any species smaller than themselves, including other bullfrogs. Eradication of bullfrogs would be required in any native species recovery effort.

Lahontan Cutthroat Trout (Oncorhynchus clarkia henshawi)

Lahontan cutthroat trout (LCT) was listed as an endangered_species in 1970 (Federal Register_Vol. 35, p.13520). In 1975, under the Endangered Species Act of 1973 as amended (ESA), LCT was reclassified as threatened to facilitate management and to allow for regulated angling (Federal Register Vol. 40, p.29864). In 1995, the U.S. Fish and Wildlife Service (USFWS) released its recovery plan for LCT, encompassing six river basins within LCT historic range, including the Truckee River basin. Endangered Species Act Specific recovery targets related to down listing (i.e., number of self-sustainable sub-populations) have yet to be determined for the basin.

The 2009 LCT 5-year status review recommended the following range-wide actions including: revise the 1995 recovery plan, develop state and tribal hatchery management plans, improve utility of monitoring/accomplishment databases and develop regulations to help conserve LCT. Discussion between both state and federal agencies regarding the revision to the 1995 recovery plan has occurred, but revision has not been formally initiated.

Historically, LCT occurred throughout the Truckee River drainage from lakes and streams within the Lake Tahoe basin downstream to Pyramid Lake, which has no outlet (Gerstung, 1988). The LCT in Pyramid Lake and Lake Tahoe were known regionally as a valuable food source consumed by the Pyramid Lake Paiute Tribe, the Washoe Tribe, early explorers and by commercial fishermen (Fowler and Bath 1981). By 1938 LCT had been extirpated from the Tahoe Basin. Historically, LCT utilized both lake and stream habitat. Like other native fish species, they preferred cold water habitat but could utilize a wide variety of habitats as long as oxygen levels were high and cover and food were plentiful. Stream dwelling LCT feed on drift, typically a combination of terrestrial and aquatic insects. In lake habitat, small LCT fed on zooplankton or insects, while larger LCT fed on other fish species, historically Lake Tahoe tui chub (Moyle, 2002)

LCT were introduced to the headwaters of the Upper Truckee River in Meiss Meadows in the late 1980’s and early 1990’s through a cooperative effort between the CDFW, USFS and FWS. The Meiss Meadow population is one of the only high-elevation meadow populations of LCT in the Sierra Nevada Mountain Range and also functions as a source population for LCT in the lower river. This is the only self-sustaining population in the Lake Tahoe basin. Expansion efforts were initiated to increase the range of this population in 2009 and will continue through 2015. Additional recovery actions for LCT are ongoing in Fallen Leaf Lake and Glen Alpine Creek. Future recovery activities could also over the next 10 years in Lake Tahoe, and Third, Blackwood, Meeks, and Taylor creeks.

Sierra Nevada Yellow-legged Frog (Rana sierrae)

Sierra Nevada (mountain) yellow-legged frog (SNYLF) is a Proposed Endangered Species under the Endangered Species Act (ESA) and a Region 5 Forest Service Sensitive Species (USDA Forest Service 1998). On April 25, 2013, the US Fish and Wildlife Service (FWS) published a proposal in the Federal Register (Federal Register Vol.78, No. 80) proposing listing SNYLF as endangered and designating critical habitat. The criterion for the proposed listing is based on the danger of extinction throughout the species entire range and on the immediacy, severity, and scope of the threats to its continued existence. These threats include habitat degradation and fragmentation, predation and disease, climate change, inadequate regulatory protections, and the interaction of these various stressors impacting small remnant populations. There has been a rangewide reduction in abundance and geographic extent of surviving populations of frogs following decades of fish stocking, habitat fragmentation, and most recently a disease epidemic. Surviving populations are smaller and more isolated, and recruitment in disease-infested populations is much reduced relative to historic norms. This combination of population stressors makes persistence of the species precarious throughout the currently occupied range in the Sierra Nevada.

It is recognized that restoration and recovery efforts are needed to restore the species habitat and prevent its range-wide extinction. To date, range-wide conservation activities (including the development of a conservation strategy) for SNYLF have been accomplished in a multi-agency format involving the FWS, National Park Service (NPS), US Forest Service (USFS), CDFW and academic institutions such as the University of California, Berkeley and Sierra Nevada Aquatic Research Laboratory.

SNYLF occupied the majority of lake, pond, marsh, and stream habitats within its historic range, and may have been the most abundant vertebrate in these montane ecosystems (Grinnell and Storer 1924). Because of their abundance, SNYLF played important roles in structuring aquatic ecosystems, nutrient cycling and food web dynamics (Finlay and Vredenburg 2007). Non-native trout, however, that have been introduced to over 90% of the historic SNYLF habitat have drastically altered these ecosystems (Knapp et al. 2008, Epanchin et al. 2010). The introduction of fishes into naturally fishless mountain lakes often results in the extirpation of large-bodied zooplankton species (Knapp et al. 2008). In another study comparing 24 fishless and stocked lakes, lakes with fish had 98% fewer mayflies than did fishless lakes (Epanchin et al. 2010). The presence and abundance of mayflies is an indicator of the health of a waterbody and an important found source for aquatic species. The decline of the SNYLF is being driven primarily by the introduction of non-native fish and the emerging infectious disease, *Batrachochytrium dendrobatidis* (sometimes referred to as *Bd* or chytrid fungus) (Knapp et al. 2003, Vredenburg 2004, Knapp et al. 2007, Vredenburg et al. 2010).

Within the historical range of SNYLF, most aquatic habitats were naturally fishless due to the presence of natural barriers that prevented the upstream movement of fish from occupied downstream habitats. Starting in the mid-1800s, several species of trout were widely introduced into fishless lakes and streams throughout the Tahoe Basin. Predation by trout on all SNYLF life stages resulted in marked declines of SNYLF across their range (Knapp and Matthews 2000, Vredenburg et al. 2005). These declines caused by introduced trout are now being partially reversed via removal of trout populations from some sites by the NPS, CDFW, and USFS Knapp et al. 2007).

Bd is a skin disease linked to population declines and extinctions of over 200 amphibian species, including SNYLF (Longcore et al., 1999; Skerratt et al., 2007). Since its description in 1999, a considerable amount of research on the pathogen's life history, physiology, population genetics, its responses to host immunity and how it causes death has occurred (Morehouse et al., 2003; Piotrowski et al., 2004; Berger et al., 2005; Rollins-Smith and Conlon, 2005; Morgan et al., 2007; Woodhams et al., 2007a, b, 2008). However, much less is known about how to control or manage the disease in nature. There have been recent developments in research using Janthinobacterium lividum (J. lividum), a skin microbe naturally found on amphibians. Studies have determined that skin microbes, like J. lividum, can

enhance the disease resistance and thus reduce the impacts of the disease (Harris et al. 2009). Although additional research on the relationship of amphibians' skin microbes and Bd is needed, these new breakthroughs are promising. Research is currently underway in Desolation Wilderness that will test a treatment method using skin microbes.

SNYLF has been nearly extirpated from the Lake Tahoe basin. A small remnant population was discovered in Hell Hole Meadow, located in the headwaters of Trout Creek in the 1990's. Monitoring in the last decade has shown that the Hell Hole population is all but extirpated presumably due to prevalence of *Bd* and other factors. In an effort to avoid extirpation from the LTBMU, a recovery effort was initiated in 2008 to restore historic habitat in Desolation Wilderness. Seven lakes were identified in close proximity to source populations on the Eldorado National Forest. A sub-adult was detected in close proximity to a newly restored lake in 2011. Implementation activities were completed in 2007 and included manual removal of non-native trout, with plans to initiate SNYLF re-introduction efforts in these seven lakes.

Yosemite Toad (Bufo canorus)

The Yosemite Toad is currently a Proposed Threatened species for listing under the Endangered Species Act (ESA) of 1973, as amended. On April 25, 2013, the US Fish and Wildlife Service (FWS) published a proposal in the Federal Register (Federal Register Vol.78, No. 80) proposing listing Yosemite toad as Threatened and designating critical habitat. Yosemite Toad is also listed by the State of California as a Species of Special Concern. To date, range-wide conservation activities (including the development of a conservation strategy) for BUCA have been accomplished in a multi-agency format involving the FWS, National Park Service (NPS), US Forest Service (USFS), CDFW and academic institutions such as the University of California, Berkeley and Sierra Nevada Aquatic Research Laboratory.

Yosemite toads are endemic to the Sierra Nevada Mountains or Province from Ebetts Pass, Alpine County to the Spanish Springs Mountain area, Fresno County (Karlstrom, 1973; Stebbins 1966) at elevations ranging from 1950 to 3444 m (6398 to 11299 ft). Jennings and Hayes (1994a) estimate that populations have disappeared from 50 percent of historical habitat. Of historical sites, declines have been concentrated in lower elevation locations with greater persistence in higher elevation locations (Davidson et al. 2002). Their current range borders the boundary of the Tahoe Basin but, to date, no detections have been recorded. However, habitat for the species, which includes high elevation, open, montane meadows with permanent water sources, does occur throughout the basin. Given projected climate changes impacts, species such as Yosemite Toad, could expand their current range in response to changing habitat conditions.

Northern Leopard Frog (Rana pipiens)

The northern leopard frog is a Region 5 Forest Service Sensitive Species (USDA Forest Service 1998). Historically this species occurred from Newfoundland and southern Quebec to West Virginia and west across the Canadian and northern and central portions of the United States including Oregon, Washington, and Northern California (Stebbins 1985). Reports of extirpation and range contraction are common in the western United States, where the species has disappeared from 95 percent of its historic range in California (Jennings 1995). Northern leopard frogs may be absent where large populations of American bullfrog (*Rana catesbeiana)* occur (Hammerson, 1982b; Jenning and Hayes, 1994b), as is the case in many lower elevation (lake level) habitats in the Tahoe basin. According to Jennings and Hayes (1994b), northern leopard frogs were introduced to the Lake Tahoe basin. Although preferred habitat exists within the Lake Tahoe basin, including streams, wetlands, or ponds as well as upland areas for foraging, to date, there have been no detections of this species.

Lahontan Lake Tui Chub (Gila bicolor pectinifer)

Lahontan Lake tui chub is a Region 5 Forest Service Sensitive Species (USDA Forest Service 1998). They occur in open water habitats, such as lakes, lagoons or river mouths and feed primarily on zooplankton. Tui chub populations have presumably declined as a result of introductions of non-native species, specifically kokanee salmon (*Oncorhychus nerka*) and opossum shrimp (*Mysis relicta*), which, through predation and competition, have significantly reduced native zooplankton (Moyle, 2002). Compounding these impacts are the illegal introductions of invasive warm-water fishes, specifically largemouth bass but potentially blue gill, crappie and brown bullhead catfish, which prey on juvenile chubs at their inshore rearing habitats (Kamerath et al. 2008).

Great Basin Great Basin rams-horn (Helisoma newberryi)

Great Basin Great Basin rams-horn is a Region 5 Forest Service Sensitive Species (USDA Forest Service 1998). This aquatic pulmonate snail has haemoglobin in its blood and a secondary gill or pseudobranch, allowing it to occupy poorly oxygenated, but cold waters such as cold spring upwellings. It can be almost invisible to the casual observer even when abundant because it may burrow into muddy substrates. This species may be found in larger lakes and slow rivers, including larger spring sources and spring-fed creeks (Taylor 1981). In Eagle Lake, Lassen County, *H. newberryi* commonly occurs on top of sandy substrates at depths greater than 3 meters (10 ft) (Brim Box et al. 2005). Historically the species occurred in Lake Tahoe and the slow flowing outflow into the Lower Truckee River. The population status of Great Basin rams-horn is currently unknown and there are currently no known occupied sites on the Lake Tahoe basin. However, habitat does exist indicating that if populations were detected through survey efforts they would be vulnerable to bed altering activities including, but not limited, to marina dredging and pier replacement.

3.4.3.3. Environmental Consequences

This section will provide a brief discussion of Alternatives A, B, C, D, and E by various program areas and the direct and indirect effects on aquatic resources. A summary of the effects by alternative is displayed in Table 3-21.

Watershed and Aquatic Habitat Restoration

Alternative A

Alternative A is the No-Action alternative and continues current management as described in the 1988 Forest Plan as amended.

Watershed and aquatic habitat restoration under this alternative continues to protect and conserve aquatic habitat. Alternative A would continue to emphasize the need and importance of healthy watersheds, stable stream channels, and the critical role of Stream Environmental Zones (SEZs) for their contribution to local water quality and lake clarity goals. This alternative would continue to recognize that activities adjacent to SEZs have the potential to deliver sediment to stream channels. Restoration of streams and related watershed processes is primarily linked to decreasing or eliminating sediment sources (stream banks, roads, and other infrastructure) and other non-point pollution sources with improving aquatic habitat conditions as secondary goals. Existing management direction under Alternative A gives the highest priority, if a conflict in management would occur, to ‘the protection of water quality and the enhancement of the clarity of water in Lake Tahoe.”

Management would continue to utilize the 2004 Sierra Nevada Forest Plan Amendment (SNFPA), Riparian Conservation Areas (RCAs) and Critical Aquatic Refuges (CARs) associated goals, objectives, and Standards and Guidelines in those defined areas, providing opportunities to incorporate protection measures for aquatic species (i.e., mitigation measures, design features,) to minimize risks and impacts to aquatic species and their associated habitat.

Stressors to aquatic habitat and species caused through implementation of watershed and aquatic habitat restoration are typically short-term and mitigated by installation of BMP’s, which are standards designed to mitigate and alleviate impacts from stressors. Stressors can include temporary road construction and decommissioning, use of heavy equipment, water drafting, stream dewatering, and new channel construction. These stressors that are actions associated with restoration activities are consistent through all alternatives.

Status and Trend in Aquatic Habitat (Streams, Wetlands, Meadows and Springs)

Aquatic habitat will continue to improve as restoration efforts restore and enhance physical processes of degraded stream channels by constructing new stream channel, reconnecting floodplain connectivity, planting riparian vegetation, and creating habitat conditions needed by native aquatic species. Results depicting the benefits to streams and meadows from restoration activities are seen at Cookhouse Meadow (USDA, 2009), where a new channel was constructed in 2005 and 2006. Post restoration, the channel morphology has changed, overbank flows have been reestablished, and groundwater levels have increased dramatically. Channel survey measurements (cross sections and longitudinal profiles) as well as visual observations indicate that the channel is maintaining both horizontal and vertical stability, and is maintaining the desired channel stability and habitat characteristics of a “C” Rosgen stream channel type. Prior to restoration out of bank flows had not occurred in this meadow for approximately 30 years. During the three spring snowmelt seasons that have passed since completion of the restoration work, a relatively small amount of over bank flooding occurred for 6 days in 2008, and a larger amount of over bank flooding (approximately 50% of the meadow) occurred during a 21 day period following rain on snow events in May of 2009. Based on groundwater data collected throughout the meadow, the increased

wetted area with available water for plants during the late summer is estimated to have increased 10% in 2007 and 60% in 2008. These efforts will reduce sediment and nutrients generated from eroding stream beds and banks, increase stream shade and riparian vegetation, and enhance critical habitat components, such as large wood and pool riffle structure, where new stream channel is created.

The construction of temporary roads needed for some implementation activities will degrade conditions by potentially increasing sediment, but these degradations should be short-term. Standards and Guidelines and project-specific resource protection measures will reduce or eliminate impacts to aquatic habitat.

Status and Trend in Aquatic Habitat (Lakes)

Lake habitat will stay in current conditions or improve where sediment load reductions occur as a result of restoration activities, resulting in improved lake clarity. Stream restoration efforts that restore the connection of the stream to its floodplain contribute in the reduction of sediments and nutrients entering lakes, including Lake Tahoe. If, however, climate change impacts exceed what active management can affect, lake habitat quality could decrease as clarity decreases with an increase in phytoplankton.

Status and Trend in Species Distribution (LCT, SNYLF, and Yosemite toad)

Where watershed and aquatic restoration efforts include the reclamation or restoration of LCT or SNYLF habitat, species distribution should stay in baseline conditions or increase. An outstanding goal of stream restoration is to improve habitat conditions. However, food resource availability (e.g., Ensign et al. 1990), climate (e.g., Clarkson and Wilson 1995), competition (e.g., Budy et al. 2007, Knapp and Mathews 2000, Knapp et al. 2007), and habitat (e.g., Bozek and Rahel 1991, Knapp et al. 2003,) are just a few examples of the factors limiting the distribution and abundance of salmonids and amphibians. In many cases it is a combination of these factors that determine the quality of a habitat. Therefore, the impact of habitat improvement depends on the extent to which habitat, rather than other biological factors such as the presence non-native or invasive species, was the limiting factor before restoration efforts are initiated (Bond and Lake 2003; Lepori et al. 2005). If biological factors are limiting the distribution of LCT or SNYLF, non-native species eradication will be needed in addition to physical habitat restoration to increase the distribution of LCT and SNYLF.

By restoring aquatic habitat components for various lifestages of each species, range expansion is possible, thus providing opportunities for an increase in distribution. The term habitat includes many variables, such as temperature, water velocity, cover (e.g., deep pools, undercut banks, boulders, overhanging vegetation), substrate, and depth. The relative importance of these different variables often changes over the life history of both LCT and SNYLF. For example, spawning activity for LCT is strongly correlated with depth, water velocity, and substrate size (Thurow and King 1994; Magee et al. 1996; Knapp and Preisler 1999), while rearing habitat is more strongly correlated with cover (Quiñones and Mulligan 2005; House 1996). Similarly, habitat for SNYLF varies based on lifestage. Although both are aquatic dependent, adults do utilize exposed boulders and logs for basking while tadpoles require in-lake habitat for cover as well as basking. Populations of LCT and SNYLF (and Yosemite toad, if detected) as a whole can suffer if the habitat requirements for all life stages are not met (White and Rahel 2008). The abiotic factors limiting populations can potentially be determined by identifying the habitat requirements of individuals of different life stages (Rosenfeld 2003). However, in most cases, even if the abiotic factors are restored, if biotic factors, such as the influence [or presence] of non-native species, are not also addressed, an increase in population distribution will be limited.

Status and Trend in Species Distribution (Tui chub, Great Basin rams-horn, and Northern leopard frog)

Species distribution will increase where aquatic habitat restoration overlaps with biological restoration (i.e., warm-water fish and Eurasian water milfoil removal) and emphasizes or focuses on tui chub habitat

needs. Great Basin Great Basin rams-horn distribution will continue to stay in baseline conditions by maintaining and protecting the integrity of springs, spring-influenced and near-shore habitats, and riparian zones.

Alternatives B, C, and E

The emphasis of these alternatives is to protect, conserve and restore aquatic habitat. Although Alternative A provides management direction to protect and conserve, it does not provide clear direction on restoration, unlike Alternative B, C and E. These alternatives would continue to implement restoration necessary to restore watershed and aquatic habitat conditions. Similar to Alternative A, the primary focal areas over the next 5 years would continue to be those projects that decrease sedimentation from actively eroding features (i.e., stream bed and banks) and have measured contributions toward the Lake Tahoe TDML. Results of current restoration efforts and benefits to aquatic habitat are described above in Alternative A (USDA, 2009).

In addition the current watershed restoration efforts, Alternatives B, C and E provides additional direction that would also focus restoration activities on achieving aquatic organism passage at road crossings, enhancing aquatic habitat structural components/function of streams, lakes and wetlands, and reclaiming meadow boundaries/ecological processes by removing conifers and reintroducing fire. By improving both water quality through reducing sedimentation while restoring other stream characteristics needed for life history requirements for aquatic species, such as rearing, spawning, and migration, Alternatives B, C, and E would improve habitat. Additionally, Forest Plan direction would move from a broad approach (tied to Riparian Conservation Objectives [RCOs] in the SNFPA Aquatic Management Strategy (AMS) to a more basin-specific strategy that addresses key aspects of watershed and aquatic habitat restoration (i.e., implementing natural channel design approaches). In Alternatives B, C, and E the importance of lake clarity and meeting the Lake Tahoe TMDL is equal to habitat restoration.

Status and Trend in Aquatic Habitat (Streams, Wetlands, Meadows and Springs)

Aquatic habitat will continue to improve as restoration efforts restore and enhance physical processes to reduce sediment and nutrients generated from eroding stream beds and banks, increase stream shade and riparian vegetation, and enhance habitat components, such as large wood and pool/riffle structure. Sensitive aquatic habitat that has been degraded due to developed recreation will be restored or enhanced. In most cases these types of habitats occur along the shoreline of Lake Tahoe. Any restoration or enhancement effort that improves habitat components along the junction of streams and Lake Tahoe will increase required habitat for native species that utilize the mouths of streams, lagoons, or lake shore wetlands. Basin-wide fish assessments (USFS 2011) have determined that the majority of native fish species are found in the lower third of watersheds.

Status and Trend in Aquatic Habitat (Lakes)

Lake habitat will stay in current conditions or improve where sediment load reductions occur resulting in improved lake clarity. Stream restoration efforts that restore the connection of the stream to its floodplain contribute in the reduction of sediments and nutrients entering lakes, including Lake Tahoe by encouraging riparian vegetation to stabilize soils, protect stream banks from erosion, and intercept nutrients that might otherwise enter the lake. If, however, climate change impacts exceed what active management can affect, lake habitat quality could decrease as clarity decreases with an increase in phytoplankton. Because higher air temperatures can promote an increase in the surface water temperature in lakes, changes in climate can affect the physical and chemical processes in a body of water and its watershed and, as a result, influence the primary production of waterbodies (Izmest'eva 2009).

Status and Trend in Species Distribution (LCT, SNYLF, and Yosemite toad)

Where watershed and aquatic restoration efforts include the reclamation or restoration of LCT or SNYLF habitat, species distribution will increase because of increased recovery efforts including both physical and biological habitat restoration. By restoring aquatic habitat components for various lifestages of each species, range expansion is possible thus providing opportunities for an increase in distribution. As state above, a goal of stream restoration is to improve habitat conditions. However, food resource availability (e.g., Ensign et al. 1990), climate (e.g., Clarkson and Wilson 1995), competition (e.g., Budy et al. 2007, Knapp and Mathews 2000, Knapp et al. 2007), and habitat (e.g., Bozek and Rahel 1991, Knapp et al. 2003,) are just a few examples of the factors limiting the distribution and abundance of salmonids and amphibians. In many cases it is a combination of these factors that determine the quality of a habitat. Therefore, the impact of habitat improvement depends on the extent to which habitat, rather than other biological factors such as the presence non-native or invasive species, was the limiting factor before restoration efforts are initiated (Bond and Lake 2003; Lepori et al. 2005). If biological factors are limiting the distribution of LCT or SNYLF, non-native species eradication will be needed in addition to physical habitat restoration.

Alternative B, C, and E provide specific Standards and Guidelines to direct future management of habitat restoration to support all life stages of native assemblages by provided connectivity, appropriate conditions for reproduction and rearing habitat. Additionally, Alternative B, C, and E provide strategies for continued coordination and partnerships to meet the recovery needs of the species. By providing management direction that supports and encourages habitat restoration, rather than merely protection and mitigation, distribution should increase in Alternative B, C, and E.

Status and Trend in Species Distribution (Tui chub, Great Basin rams-horn, and Northern leopard frog)

The status and trend of tui chub, and Northern leopard frog (if detected) will increase where aquatic habitat restoration overlaps with biological restoration (i.e., warm-water fish and Eurasian water milfoil removal) and targets specific habitat needs. Restoration activities that improve stream habitat including but not limited to water quality conditions (e.g., reduction of sediment, reduction in nutrients), restore biological characteristics (e.g., trout abundance), and/or improve stream characteristics (e.g., pool riffle ratios, stream complexity, LWD) will improve habitat for tui chub. Great Basin rams horn distribution will continue to stay in baseline condition by maintaining and protecting the integrity of springs, spring-influenced and near-shore habitats, and riparian zones. Restoration activities that restore sensitive near shore habitat that provide spawning and rearing habitat for Lake Tahoe tui chub and Great Basin rams horn will improve the distribution of these species by increasing optimal and, currently, limiting habitat.

Alternative D

Restoration projects that have measurable benefits for the Lake Tahoe TMDL, T&E species recovery and aquatic organism passage related to road upgrades would continue to be implemented. Beyond these activities, this alternative puts less emphasis on active management and restoration and, instead, allows natural processes and system adjustment to occur. This alternative directs land managers to remove potential stressors to a specific system and then allow natural processes, both positive and potentially negative to occur. For instance, in-stream headcuts would not actively be stabilized, thus allowing for natural channel adjustment processes to occur.

Status and Trend in Aquatic Habitat (Streams, Wetlands, Meadows and Springs)

The status and trend of aquatic habitat will continue to improve where planned projects are implemented. In these areas, restoration efforts will reduce sediment and nutrients generated from eroding stream bed and banks, increase stream shade and riparian vegetation, and enhance habitat components, such as large wood and pool/riffle structure, where new channels are designed and constructed. Other aquatic habitat

will remain in baseline conditions where currently stable OR degrade where features, such as headcuts, migrate upstream and result in channel incision. In these areas, efforts will be made to conserve and protect but no active restoration will occur, thus any improved habitat conditions would come through natural processes and time, most likely beyond the life of the Forest Plan.

Status and Trend in Aquatic Habitat (Lakes)

Lake habitat will generally stay in baseline conditions OR degrade where structural improvements, such as stream restoration to improve bank stability and reduce sediment and/or nutrient transport, are needed to restore or enhance habitat conditions. Although stressors will be removed to allow natural processes to restore habitat, this passive approach to restoration could lead to reduction in lake clarity and degradation of habitat as temperature or water chemistry exceed critical thresholds for native aquatic species.

Status and Trend in Species Distribution (LCT, SNYLF, and Yosemite toad)

Where watershed and aquatic restoration efforts include the reclamation or restoration of LCT or SNYLF habitat, species distribution will increase. By restoring aquatic habitat components for various lifestages of each species, range expansion is possible thus providing opportunities for an increase in distribution. Because management for TE, candidate and proposed species has the intention of assisting in the recovery and subsequent delisting or downlisting of listed species, the passive management approach in Alternative D will not negatively impact LCT, SNYLF, or Yosemite toad directly, as Recovery Plans are put in place if a species is listed on the Endangered Species Act. However, other native species could decline due to lack of active management while non-desirable non-native and invasive species could increase due to lack of active management (eradicate). This would indirectly impact the distribution of LCT, SNYLF, and Yosemite toad, if detected.

Status and Trend in Species Distribution (Tui chub, Great Basin rams-horn, and Northern leopard frog)

Species distribution will increase where currently planned aquatic habitat restoration overlaps with biological restoration (i.e., warm-water fish and Eurasian water milfoil removal) and targets tui chub habitat needs. Beyond these planned restoration activities, tui chub distribution will remain in baseline conditions or decline where aquatic habitat is impacted by, for example, urbanization, climate change, or expansion of invasive species. Where these habitat impacts cannot be off-set by restoration, biological and physical habitat quality (water quality) will decline as will species distribution. Great Basin rams-horn distribution will continue to stay in baseline conditions by maintaining and protecting the integrity of springs, spring-influenced and near-shore habitats, and riparian zones.

Restoration activities that improve stream habitat including but not limited to water quality conditions (e.g., reduction of sediment, reduction in nutrients), restore biological characteristics (e.g., trout), and/or improve stream characteristics (e.g., pool riffle ratios, stream complexity, LWD) will improve habitat for tui chub.

Biological Resources

Alternative A

Under Alternative A, the no-action alternative, the 2004 SNFPA Aquatic Management Strategy (AMS) would continue to be implemented. The current CAR boundaries and associated Standards and Guidelines would be maintained. The AMS Standards and Guidelines address aquatic habitat in general context, focused on protection and mitigation, and more related to achieving water quality goals by preventing stream degradation. Special status species (LCT, SNYLF, and Yosemite toad are addressed in the AMS Standards and Guidelines only in the context of grazing management (stream bank disturbance) and pesticide application (i.e., herbicides).While the 2004 SNFPA did include goals and strategies for a wide

variety of aquatic ecosystem features as well as Riparian Conservation Objectives (RCOs) and designation of Critical Aquatic Refuges (CARs), this direction was for protection and mitigation of species and habitat aimed to reduce the impacts of other activities. The ability to initiate and participate in proactive approaches for threatened, endangered, and candidate species recovery and management is more tied to FSM 2670 policy, which provides direction for the recovery and delisting of federally listed species and habitat. Because the SNFPA AMS was intended to provide management direction for all National Forests in the Sierra Nevada, it does not include specific protection or mitigation measures to address native non-special status species, such as Lake Tahoe's native non-game fishes. In addition, the SNFPA and 1988 Plan do not address aquatic invasive species management, as the impact of these species was not prevalent during the development of the SNFPA.

Status and Trend in Aquatic Habitat (Streams, Lakes, Wetlands, Meadows, and Springs)

Aquatic habitat will generally stay in baseline conditions, with potential to improve where physical and chemical habitat elements are restored or enhanced to meet threatened, endangered or candidate species life history needs. Current efforts to restore habitat through the removal of nonnative species in selected streams and lakes, as well as, stream restoration efforts that incorporate aquatic habitat components required by various life stages of native species will continue to improve status and trend of aquatic habitat. Restoration efforts that restore and enhance physical processes of degraded stream channels by constructing new stream channel, reconnecting floodplain connectivity, planting riparian vegetation will improve habitat conditions needed by native aquatic species. These efforts will reduce sediment and nutrients generated from eroding stream beds and banks, increase stream shade and riparian vegetation, and enhance critical habitat components, such as large wood and pool riffle structure, where new stream channel is created. Removal of non-native or invasive species improves habitat by reducing threats of predation, competition for food resources as well as spawning and rearing habitat thus improving growth, survivorship and overall distribution.

Status and Trend in Species Distribution (LCT, SNYLF, and Yosemite toad)

LCT distribution will continue to increase in Upper Truckee River, through continuation of habitat expansion efforts down the watershed by manually removing non-native species. Increases in LCT distribution within other basin watersheds may be limited due to conflicts with management area direction or lack of consensus with the multiple agencies that make up the Recovery Implementation Team. SNYLF distribution will increases in Desolation Wilderness in response to fish removal efforts from selected lakes (Knapp et al. 2007). There is a high potential for the SNYLF population in Hell Hole to go extinct due to the presence of *Bd* and other factors. Due to management area direction specifically as it relates to recreational fishing, the presence of non-native fish, and current or proposed California Department of Fish and Wildlife (CDFW) stocking allotment, SNYLF distribution may be limited in other basin watersheds. If Yosemite toads were detected within the life of the Forest Plan, protection and conservation measures would be taken.

Status and Trend in Species Distribution (Tui chub, Great Basin rams-horn, and Northern leopard frog)

Tui chub distribution may increase or decrease depending on where warm water fish are targeted for removal. Restoration activities that improve stream habitat including but not limited to water quality conditions (e.g., reduction of sediment, reduction in nutrients), restore biological characteristics (e.g., trout), and/or improve stream characteristics (e.g., pool riffle ratios, stream complexity, LWD) will improve habitat for tui chub. Great Basin rams horn distribution will continue to stay in baseline conditions by maintaining and protecting the integrity of springs, spring-influenced and near-shore habitats, and riparian zones. If Northern leopard frogs were detected within the Lake Tahoe basin within the life of the plan, protection and conservation measure would be implemented. Distribution would expand wherever competing or picivorous, warm water fish removal efforts were successful.

Alternatives B, C, and E

Alternatives B, C, and E put forth a revised set of desired conditions, objectives, and Standards and Guidelines that are based on current biological resource needs and anticipated future needs. Alternative E, in response to comments, added additional management direction to further clarify and add management direction to ensure the both the conservation and enhancement of habitat for aquatic species.

This set of protection measures shifts from the current species-specific emphasis approach towards a more holistic habitat-based approach that focuses on habitat elements, function, connectivity, climate change, and community-level needs. To shift to this holistic approach, habitat and species management direction was categorized into four biological resource groups that are interrelated. These groups include: 1) General Conservation, (2) Special Status Species Habitat Areas, (3) Protected Activity Center (PAC)/ Home Range Core Area (HRCA) (discussed in the Terrestrial Wildlife Report), and (4) Invasive Species (Table 3-21).

Table 3 21. Biological Resource Groups and Emphasis

Group	Aquatic Resource Type	Management Function as Related to Desired Conditions
General Species Conservation	Native Species (including Region 5 sensitive, TRPA, and species of local concerns) and Habitat Lahontan tui chub, Tahoe sucker, Lahontan Redside, Paiute sculpin, speckled dace, mountain whitefish, western toad, long-toed salamander, Great Basin Great Basin rams-horns, and western pearlshell mussel (*Margaritifera falcata*).	Sets a framework for aquatic habitat management by linking physical conditions/processes to life history needs and concepts necessary to achieve species diversity. Recognizes the unique assemblages of endemic aquatic species and allows for partnership collaboration to conserve species and enhance habitat.
Special Status Species Habitat Areas	LCT and SNYLF (and others per potential future listing actions)	Sets desired trajectories for T&E and candidate species recovery.
Invasive Species	Aquatic Invasive Species: Mollusks – Quagga/zebra mussels, New Zealand mudsnail, Asian clam Plants – Eurasian water milfoil, curly leaf pondweed Fishes – Largemouth bass, bluegill, crappie, brown bullhead catfish, goldfish Amphibians – bull frogs Disease/pathogens – Chytrid fungus (Bd), whirling disease	Sets a framework for AIS management (prevention, control, eradication and interagency collaboration) to guard against wide spread ecological, social and economic impacts.

These groups have been ordered in an “umbrella” organization where the General Species Conservation provides overarching, broad direction for the entire LTBMU while the other three groups, also applicable throughout the entire LTBMU, provide more specific direction for certain species and current or potential habitat.

The General Conservation incorporates management direction for all habitat and associated special status species within the LTBMU. It provides general direction in the form of desired conditions, objectives, S&G, and strategies that will guide future decision makers on habitat protection, enhancement, and/or restoration measures needed to maintain and improve the status and habitat of special status species (including Threatened, Endangered, Candidate, Proposed, and R5 Sensitive Species).

The Special Status Species Habitat Area provides more specific direction for Threatened, Endangered, Candidate, or Proposed species listed under the Endangered Species Act. Unlike the General Conservation Area, the Special Status Species Habitat Area provides decision makers with detailed guidance to aid in the recovery of these species protected under ESA while still providing the flexibility for species that could be listed in the future.

Similar to the Special Status Species Habitat Area, the Invasive Species groups provide more detailed direction for species and habitat. Direction within the Invasive Species Group provides direction for prevention, control, and eradication of invasive species that currently degrade terrestrial or aquatic habitat, as well as species that are considered potential threats for future invasion. This direction was not provided in Alternative A and is limited in Alternative D due to passive management approach.

Status and Trend in Aquatic Habitat (Streams, Lakes, Wetlands and Meadows)

Aquatic habitat will improve where physical and biological habitat elements are restored or enhanced to meet native species life history needs. Where management emphasizes or focuses on the removal of Eurasian milfoil, curly leaf pondweed (i.e., decrease non-native habitat structural components that invasive warm water fish utilize), prevention of non-native mussel introductions, and control or eradication of warm water fish, available habitat will increase for native species. Where restoration activities restore connectivity, aquatic habitat in streams will improve. Alternative B, C, and E recognize the need for both aquatic passages to fulfill various natural history requirements as well as the possible impacts climate change could have on aquatic systems. These alternatives provide direction for insure the connectivity, both spatial and temporal, of aquatic habitats to allow for the unobstructed movement of native species to support migration, reproduction, and dispersal needs.

Current efforts to restore T&E habitat through the removal of nonnative species in selected streams and lakes, as well as, stream restoration efforts that enhance aquatic habitat components required by various life stages of native species, such as large woody debris structures, increased riparian vegetation, and pool riffle ratios that mimic historic conditions (if new stream channel is constructed), will continue to improve status and trend of aquatic habitat.

Status and Trend in Species Distribution (LCT, SNYLF, and Yosemite toad)

Overall LCT distribution increases as recovery targets resident fluvial and lacustrine life histories in multiple watersheds throughout the Lake Tahoe basin. Additionally, LCT distribution would increase in areas where warm-water fish removal occurs and where restoration efforts continue to remove nonnative salmonids that out-compete LCT.

Regardless of additional management direction to aid in the recovery of SNYLF, there is a high potential for the population in Hell Hole to go extinct due to with presence of disease (*Bd*) and other factors. However, current recovery efforts in Desolation Wilderness will increase the distribution within the wilderness, although translocation techniques will most likely be required. Translocation efforts could be utilized to further increase the distribution of this species into other historic location throughout the basin as future recovery strategies are identified. Research initiated in 2012 will provide additional tools to aid in the recovery and expansion of SNYLF.

If Yosemite toads were detected within the LTBMU, conservation, enhancement, and restoration measures would be implemented to insure actions were consistent with recovery strategies. These actions would insure that species distribution would be maintained or improved.

Status and Trend in Species Distribution (Tui chub, Great Basin rams-horn, and Northern leopard frog)

As the emphasis on near shore habitat management and restoration increases such as the control and removal of warm water fish and aquatic invasive weeds, as well as, the restoration of geomorphic conditions and barrier beach formation that support marsh and lagoon habitat, native tui chub distribution will increase.

Efforts that restore slow moving water such as lakeshore lagoons, wetlands, and barrier beaches, which are rare and important habitats, and occur where fluvial systems interface with Lake Tahoe will maintain or increase Great Basin rams-horn as well as tui chub distribution. Additionally, efforts to control and remove Eurasian water milfoil and curly leaf pond weed will maintain or increase the distribution by improving water chemistry conditions and removing optimal habitat for warm water invasive fish.

If Northern leopard frogs were detected within the Lake Tahoe basin within the life of the plan, protection and conservation measure would be implemented. Distribution would increase where warm water fish removal efforts were targeted.

Alternative D

This alternative implements a more passive approach to management of native and aquatic invasive species. Recovery programs for T&E and candidate species would continue to occur in order to meet ESA and FSM 2670 policies. Only prevention and control for high priority species (e.g., quagga/zebra mussels, New Zealand mudsnail, Eurasian milfoil and curlyleaf pond weed) are implemented. Otherwise, current invasive species populations will be allowed to persist, compete with native aquatic ecosystems and/or succumb to environmental and anthropogenic factors. Desired Conditions and Standards and Guidelines in Alternative D are the same as Alternative B and C; however, objectives that recommend active restoration beyond those projects that are already planned, would not occur in Alternative D.

Status and Trend in Aquatic Habitat (Streams, Lakes, Wetlands and Meadows)

Aquatic habitat will generally stay in baseline conditions, with potential to improve where physical/chemical habitat elements are restored during restoration efforts that are already planned. Aquatic habitat that is degraded or lacking components needed for life history requirements of native species will be managed passively. Known stressors, which are contributing to limited functionality, will be removed and the system will be allowed to recover through time. Aquatic habitat status and trend could decline through the life of the plan as there is a potential for a reduction in water quality/chemistry, lack of flood plain connectivity and associated stream shade, increased w/d ratios, increase of warm water fish and other medium to low priority AIS species, such as bullfrogs. Improvements, beyond just removing known long term stressors, to physical, chemical, or biological habitat elements would only be employed in cases that are needed to restore TE, candidate, or proposed species life history traits.

Status and Trend in Species Distribution (LCT, SNYLF, and Yosemite toad)

Overall LCT distribution increases as recovery actions target resident fluvial and lacustrine life histories in multiple watersheds throughout the Lake Tahoe basin. Because Alternative D utilizes the passive management approach, eradication and control measures for some AIS would not occur and instead natural selection processes would be allowed to determine species composition. This would indirectly impact the distribution of LCT, SNYLF, and Yosemite toad (if detected), as most AIS reduce both the abundance and distribution of native species that provide food sources and reduce the quality of habitat by altering water quality (i.e., temperature, dissolved oxygen, pH).

There is a potential for SNYLF distribution to increase in other basin watersheds as future recovery strategies are identified and coordination with partner agencies continues. However, SNYLF distribution may decrease due to lack of targeted bull frog population reduction if such species expands to higher elevation habitats (factor being climate change). If Yosemite toads were detected within the LTBMU, conservation measures would be implemented to insure actions were consistent with recovery strategies.

Status and Trend in Species Distribution (Tui chub, Great Basin rams-horn, and Northern leopard frog)

Tui chub distribution may decline where invasive warm water fishes are not treated on NFS lands. Where active restoration is unacceptable, nearshore habitat may decline, thus further reducing the habitat and distribution of tui chub.

Great Basin Great Basin rams-horn distribution will be maintained at current levels through the protection of spring habitat, spring-influenced and near-shore habitats, and riparian zones. Distribution in slow

moving water habitat could decline when active restoration is needed yet unacceptable and leads to increased sediment or reduction in water quality and chemistry required for species survival.

If Northern leopard frogs are detected, conservation measures would be incorporated to maintain distribution. Where warm water fish interact with population, distribution may decrease.

Forest Vegetation

Forest vegetation management practices occur within various stream environment zones (SEZs) where management is usually adjusted to prevent long-term erosional processes, measurable decreases in stream shade and undesired adjustments to channel form and function.

In all alternatives there are risks of adverse resource effects associated with wildfire, which could result in degradation of overall aquatic habitat and watershed condition. Because of the extreme unpredictability of either wildfire occurrence or level of effects, it is not useful to speculate regarding the level of effects on resources attributes that could occur under the various alternatives as a result of wildfire. However it can be assumed that there is a heightened level of risk of adverse effects on resources, associated with the elevated level of risk of catastrophic wildfire that would lead to the loss of vegetation, increased stream temperatures, and increased erosion that would contribute to decreases in water quality.

Treatment types and vegetation prescriptions vary between the alternatives and each pose some level of short term risk of soil erosion and subsequent impacts to aquatic habitat. These risks will be managed by a variety of established best management practices (BMPs), project-specific resource protection measures, and the standards and guidelines presented in the Draft Forest Plan.

Stressors to aquatic habitat and species in the course of conducting forest vegetation management include temporary road construction, permanent road construction, road decommissioning, mechanical equipment use, landings, piles, use of foam, and water drafting. Beyond the potential impacts of permanent roads, the environment consequences for aquatic resources would be short-term and mitigated by BMPs or project level design features.

Alternative A

Status and Trend in Aquatic Habitat (Streams, Wetlands, and Meadows)

Stream habitat will generally stay in baseline condition. Habitat will improve where forest vegetation treatments improve the structure of riparian vegetation structure in SEZ's thus floodplain processes that trap sediments and nutrients and provide stream shade and bank stability. The construction of temporary and permanent roads needed due to lack of road access in WUI and general forest could degrade conditions by potentially increasing sediment, at least short-term, because roads can create linear conduits for concentrating flows and eroded sediments. Additionally, temporary roads could increase the establishment of invasive species and create, potentially short term, passage issues for aquatic species. However implementation of BMPs and standards and guidelines would adequately manage this risk.

Depending on wildfire behavior (severity) there are potential effects on riparian vegetation and sediment, habitat structure (i.e., large wood recruitment) and base flows. Baseflows could increase as riparian and adjacent upland vegetation decrease. Alterations in baseflows could affect spawning and rearing habitat of aquatic species.

Wetland habitat will stay in baseline conditions or decline with more potential to change site hydrologic characteristics as road construction could affect the quantity and/or timing of ground water delivery. Depending on wildfire behavior (severity) there are potential effects on riparian vegetation and sediment storage, habitat structure (i.e., large wood recruitment) and possibly ground water availability. If riparian

and herbaceous vegetation decreases due to severe fire intensity, wetland functions, such as sediment storage, will decrease leading to decrease in water quality.

Similar effects could be seen in meadow habitat from road construction. However, meadow habitat will improve where removal of encroaching conifers is included in forest health treatments. Where forest vegetation treatments overlap with SEZ habitat and remove upland species from within and along meadow edges, habitat for riparian dependent species will improve. These efforts will increase meadow size, and improve vegetative composition and/or site hydrologic characteristics.

Status and Trend in Aquatic Habitat (Lakes)

Lake structure, depth, and clarity generally stay in baseline conditions as any potential excess sediment reaching lake habitat from forest management activities is not expected to be measurable. Wildfire would increase the potential for short-term impacts to water quality due to ash and fine sediment deposition with increasing benthic/plankton production resulting from input of nutrients.

Status and Trend in Species Distribution (LCT, SNYLF, and Yosemite toad)

Forest vegetation treatment under Alternative A will not change the distribution of LCT, SNYLF, or Yosemite toad. Recovery efforts will continue as directed by Recovery Plans and Recovery Strategies. Forest activities will not delay future LCT or SNYLF increase in distribution resulting from restoration/recovery actions. There is potential for short-term impacts to LCT sub-populations from increased sediment or escaped fire followed by recovery due to stocking and/or natural recruitment from connected occupied drainages. Where fire moves into occupied SNYLF or Yosemite toad habitat, there is potential for short-term local extirpation where high - moderate burn severities occur.

Status and Trend in Species Distribution (Tui chub, Great Basin rams-horn, and Northern leopard frog)

No change in the distribution of tui chub or Great Basin rams-horn are expected due to forest vegetation treatments under Alternative A. Rather, the status and trend of these species is dependent on effectiveness of future AIS and aquatic habitat management. There could be short-term impacts from temporary roads that contribute sediment to stream channels; however, BMPs would be in place to mitigate the effects. Vegetation treatments that improve meadow habitat will improve the distribution of Northern leopard frog, if they are detected.

Alternatives B, C, and E

In Alternatives B, C, and E trees greater than 30 inches in diameter could be removed under certain limited circumstances. While canopy closure limits would only be retained for PACs and HRCAs, emphasis would be placed on maintaining and improving late seral habitats. Openings up to 10 acres can be created under these alternatives. However, cutting large trees or thinning to lower densities would be implemented where the objective is to enhance the promotion of mid seral, longevity of late seral stands, or the resiliency of any stand. There is allowance for the creation of openings within the mid seral stage of up to 10 acres in size to establish early seral habitat. Therefore, vegetation treatments under Alternatives B, C, and E could remove the largest diameter trees under limited circumstances and open up the canopy beyond 40% and 50% closure, respectively. Alternative C differs from Alternative B and E in that a greater number of treatment acres would be implemented annually and more acres would be treated using mechanized equipment if possible. All other factors are the same.

Status and Trend in Aquatic Habitat (Streams, Wetlands, and Meadows)

Similar to Alternative A, stream habitat will generally stay in baseline condition in Alternative B,C, and E. Habitat will improve where forest vegetation treatments improve the structure of riparian vegetation

structure in SEZ's thus floodplain processes that trap sediments and nutrients and provide stream shade and bank stability. Although these alternatives could remove large diameter trees and open canopy beyond 40% and 50%, standards are in place to protect both streambanks and water temperature. Additionally, removal of larger trees within meadows or meadow edges that are seed sources for conifer encroachment would benefit meadow restoration efforts.

Because Alternative C proposed the treatment of more acres as well as more mechanical treatment (Table 2.1: Forest Vegetation Management section), more temporary and permanent roads will be needed. These could degrade conditions by potentially increasing sediment, at least short-term, because roads can create linear conduits for concentrating flows and eroded sediments. Additionally, temporary roads could increase the establishment of invasive species and create, potentially short term, passage issues for aquatic species. However implementation of BMPs, project-specific resource protection measures, and standards and guidelines would adequately manage this risk.

Alternatives B, C, and E provide direction for reintroducing fire into meadows, specifically if encroaching conifers have been removed. Where forest vegetation treatments overlap with SEZ habitat and remove upland species from within and along meadow edges, habitat for riparian dependent species will improve. These efforts will increase meadow size, vegetative composition and/or site hydrologic characteristics. These actions would benefit aquatic habitat by restoring the vigor and diversity of riparian and herbaceous vegetation, improving water storage, and reducing the likelihood of catastrophic fire.

Status and Trend in Aquatic Habitat (Lakes)

Same as Alternative A except Alternative C, which proposes slightly more acres to be treated and burned, could have greater risk of short-term impacts to water quality due to ash and fine sediment deposition with increasing benthic/plankton production resulting from input of nutrients.

Status and Trend in Species Distribution (LCT, SNYLF, and Yosemite toad)

The status and trend in species distribution of LCT, SNYLF, and Yosemite toad is the same Alternative A.

Status and Trend in Species Distribution (Tui chub, Great Basin rams-horn, and Northern leopard frog)

The status and trend in species distribution (Tui chub, Great Basin rams-horn, and Northern leopard frog) is the same as Alternative A.

Alternative D

Alternative D is similar to Alternative A, but is further limited in the size of trees that could be removed (dbh limit of 12 inches).

Alternative D focuses more heavily than the other alternatives on the use of fire in management of forest vegetation. This alternative would also emphasize hand thinning more than the other alternatives.

Status and Trend in Aquatic Habitat (Streams, Wetlands, and Meadows)

Stream, Wetland and Meadow habitat would stay in baseline condition or decline as limited Forest Vegetation projects would overlap with SEZs, thus conifer encroachment within these habitats could continue to degrade conditions as riparian and herbaceous vegetation is replaced by upland species. As forest health declines through lack of active management and increased beetle infestations, the likelihood of catastrophic fire increases. Depending on fire behavior (severity) there is potential for effects on riparian vegetation, erosion, and possibly base flows. Baseflows are expected to increase as riparian and

adjacent upland vegetation decrease. Alterations in baseflows could affect spawning and rearing habitat of aquatic species.

Because of the 12 in. diameter limit set in Alternative D, most areas will be treated using hand removal methods, which require either the creation of burn piles or underburns with the material lop and scattered through the unit. This could result in temporary impacts to riparian habitats, and delay vegetation rejuvenation after burns due to soil damage.

Status and Trend in Aquatic Habitat (Lakes)

Alternative D has the greatest potential to cause excess sediment transport to lake habitat due to the increase likelihood of unplanned, catastrophic fire. Additionally, water quality could further decline as the potential for ash and fine sediment deposition increases in Alternative D leading to increases in benthic/plankton production resulting from input of nutrients.

Status and Trend in Species Distribution (LCT, SNYLF, and Yosemite toad)

Forest vegetation treatment will not affect the distribution of LCT, SNYLF, or Yosemite toad. Recovery efforts will continue as directed by Recovery Plans and Recovery Strategies. However, as the risk of catastrophic fire increases risk of sedimentation into streams and lakes, increased benthic and plankton production could occur in Alternative D, and LCT, SNYLF, and Yosemite toad distribution could decline as habitat is degraded or lost. Where fire moves into occupied LCT, SNYLF or Yosemite toad habitat, there is potential for short-term local extirpation where high - moderate burn severities occur.

Status and Trend in Species Distribution (Tui chub, Great Basin rams-horn, and Northern leopard frog)

As the risk of catastrophic fire, increased sediment loads into streams and lakes, increase benthic and plankton production could occur in Alternative D, indirectly Lake Tahoe tui chub, Great Basin rams-horn, and Northern leopard frog distribution could decline as habitat is degraded or lost. Where fire moves into occupied habitat, there is potential for short-term local extirpation where high - moderate burn severities occur.

Recreation

Managed and unmanaged recreation has varying degrees of impacts on aquatic resources, especially where activities occur in or near Stream Environment Zones (SEZs). Facilities, including parking lots, marinas, roads, and trails, pending the use, location, and site specific characteristics can impede the hydrologic characteristics of these sites, alter the vegetative composition and reduce the quality of habitat for native species. Typically the areas that provide recreational opportunities overlap with some of the most sensitive and rare habitat found in the Lake Tahoe basin, which includes lake shore wetlands, lagoons, meadows, barrier beaches, and stream mouths. Alternatives A, B, C, and E allow for some varying degree of expansion.

Under all alternatives snowmobile use will continue to be allowed in all areas that are not designated as closed in the OSV use maps. Some concerns exist regarding this activity and potential impacts on water quality, indirectly impacting aquatic habitat. There are two potential concerns related to this permitted use as it relates to hydrology, soils, and water quality. First is potential for ground disturbance, if sufficient snow cover is not maintained on travel routes leading to potential increase in erosion. This concern is addressed in Section 3.4.22 - Soils of this FEIS.

The second is the impacts of vehicle emissions on water quality, as exhaust emissions (VOCs and PAHs and nitrogen) are discharged and accumulate within the snowpack. There has been limited research conducted on water quality impacts from snowmobile emissions, primarily in Yellowstone and Grant

Teton National Park. The results of this research indicate that although these emissions have been documented in the snowpack, there has been no evidence of exceedance of water quality standards in adjacent water bodies, related to VOCs and PAHs and the VOC concentrations in the snowmelt runoff were well below levels that would adversely impact aquatic systems (Arnold 2006, Reah 2005, NPS 2011).

The incremental amount of OSV contributions to nitrogen loading is relatively small, but could be important if total loading is close to or exceeded a critical load of nitrogen (NPS, 2011). According to the Tahoe TMDL, the amount of total nitrogen loading in the Tahoe Basin (largely from out of basin atmospheric sources) is such that Lake Tahoe is considered to be largely phosphorus limited, in terms of effects on Lake clarity.

It is also important to note that existing research was conducted during a time when the majority of snow mobiles in use were utilizing 2-stroke engines, which produce much more of these pollutants, then 4-stroke engines that are becoming much more prevalent and are required to meet current EPA standards for emissions. Hydrocarbon and carbon monoxide emissions are reduced by 50% and 30% respectively when comparing average 2 stroke engines to current EPA snowmobile requirements (NPS 2011).

Based on an analysis of the existing research, we conclude that continued OSV use, as proposed under all the alternatives, will result in negligible impacts to water quality and aquatic habitat. However, additional monitoring is needed to determine the effects of this use on breeding success and overwintering survival of amphibian species, specifically Sierra Nevada yellow-legged frog and, if detected, Yosemite toad. Currently, research is lacking regarding the impacts of ground vibration during overwinter hybridization “torpor”. Research and monitoring is also lacking on the effects of breeding success and spring OSV use. Potential effects would not differ per alternative.

Alternative A

Alternative A allows for 10% expansion of developed recreation sites within the designated permit area and into the general forest. Alternative A also identifies a number of site-specific areas where recreation facilities could be expanded and new recreation facilities could be developed based on direction from the 1988 LTBMU Forest Plan (as amended). SNFPA provides general direction for avoiding adverse effects from ground disturbing activities, designing management to meeting habitat and species goals and implementing mitigations to prevent further declines of aquatic habitat conditions. For instance, a new Fallen Leaf Lake boat launch facility was identified as desirable for construction. If pursued, new facilities such as this pose high risk for both expansion of existing AIS and new introductions where developed recreation sites expand and provide direct/indirect access to waterbodies.

Status and Trend in Aquatic Habitat (Streams, Lakes, Wetlands, Meadows, and Springs)

Where campgrounds and parking areas are expanded adjacent to SEZs, local hydrologic processes/characteristics may change, thereby affecting water quality and aquatic habitat parameters. Standards and guidelines would require that project design incorporate measures to mitigate effects to SEZs. However, regardless of standards and guidelines or project level BMPs, expanded recreation development will cause increased impacts. Although the measures are implemented to protect sensitive areas during expansions, visitors often deviate from direction making it challenging to both increase use and protect habitat. Otherwise, where campgrounds and parking areas are expanded in dry upland areas, there would be no expected change in baseline conditions. The risk of decrease in stream, wetland and meadow condition where resort, ski area, new trail crossings, etc. expansion results in modification of hydrologic function would impact water quality parameters, affecting habitat quality and quantity. There is potential for aquatic habitat to improve (physical form and function) where facilities are moved out of SEZs.

Status and Trend in Species Distribution (LCT, SNYLF, and Yosemite toad)

LCT distribution will generally stay in baseline conditions as recreation site expansion should not preclude recovery actions; however expansion of recreation may result in an increase in human disturbance on the species, increase threat of illegal stocking of non-native fish, and increase threat of new AIS infestation.

LCT will continue to occupy habitat in the Upper Truckee River within the recommended Wild and Scenic River (WSR) segment that is self-sustaining and reproducing with elements of source sub-populations. Individual LCT will continue to migrate downstream to lower UTR segments that are outside of the WSR designation as expansion efforts continue.

Recreation activities may directly disturb SNYLF in all life stages, specifically tadpoles and juveniles that have the potential to be injured or killed by bikers, hikers, OHVs, and pack-stock animals. Recreational foot traffic in riparian areas tramples the vegetation, compacts the soils, and can physically damage the streambanks (Kondolf et al. 1996). Hiking, horse, bicycle, or off-highway motor vehicle trails compact soils within riparian habitat (Kondolf et al. 1996), and can cause increased erosion. However, studies have not been conducted to determine the extent to which recreational activities are directly contributing to the decline of the Sierra Nevada yellow-legged frog populations, and direct effects from recreation have not been implicated as a major cause of the decline of this species. Nevertheless, recreational activities are the fastest growing use of National Forests. As such, their impacts on Sierra Nevada yellow-legged frog are likely to continue and to increase (USDA 2001b). Currently, recreational activities are considered a threat of low significance to the species' habitat overall.

Stocking of high elevation lakes with non-native fish to support recreational fishing has had the greatest impact on this species, because all life stages are preyed upon by the fish (Bradford 1989, Feller and Drost 1993). Additionally, the recreational activity of anglers at high mountain lakes can be locally intense in the Sierra Nevada, with most regions reporting a level of use greater than the fragile lakeshore environments can withstand (Bahls 1992).

With the potential to increase recreation facilities by 10 percent, direct and indirect impacts could decrease the abundance and distribution of SNYLF. Emphasis on SNYLF recovery in the Desolation Wilderness will continue (per Wilderness Act and FS wilderness policy), but this species will continue to face extinction and local extirpation threats which include: *Bd* disease and human impacts on the quantity and quality of historic and current habitat. SNYLF will continue to be at risk of local extirpation in Hell Hole due to disease and other factors. Similar responses would apply to Yosemite toad distribution if the species was detected in the LTBMU.

Status and Trend in Species Distribution (Tui chub, Great basin rams-horn, and Northern leopard frog)

Tui chub and rams-horn distribution will generally stay in baseline conditions; however disturbance from recreation site expansion may result in a decrease of habitat quality by potentially increasing access to sensitive aquatic habitats. Site expansion and associated increased visitor use could also increase the threats of new AIS introduction through both motorized and non-motorized boat use. This would further reduce habitat and distribution of tui chub and potentially Great Basin rams-horn and Northern leopard frog (if detected).

Alternative B

Status and Trend in Aquatic Habitat (Streams, Lakes, Wetlands, Meadows)

Where campgrounds and parking areas are expanded adjacent to SEZs, local hydrologic processes will risk decline if soil compaction, vegetative compositions, and ground water characteristics decline and

affect water quality and aquatic habitat parameters. However, standards and guidelines would require that project design incorporate measures to mitigate effects to SEZs. These potential direct and indirect impacts would be less than Alternative A as the potential for expansion decreases 5 percent in this Alternative. However, regardless of standards and guidelines or project level BMPs, expanded recreation development will cause increased impacts. Although the measures are implemented to protect sensitive areas during expansions, visitors often deviate from direction making it challenging to both increase use and protect habitat. Where campgrounds and parking areas are expanded in drier site upland areas no change in baseline conditions is expected. The potential for a decrease in stream, wetland and meadow condition where resort, ski area and new trail crossing expansion results in modification of hydrologic function, water quality and habitat would be mitigated as required by the standards and guidelines. Alternative B allows for the relocation of developed recreational sites that are located in sensitive habitats. Where developed recreation facilities are modified or relocated in order to restore habitat parameters that resemble historic conditions, aquatic habitat will improve (physical form and function). Sensitive habitats such as SEZs, wetlands, and barrier beaches not only provide dynamic and rare habitat for aquatic species but also filter fine sediments and nutrients, thus protecting water quality parameters of both streams and lakes.

Status and Trend in Species Distribution (LCT , SNYLF, and Yosemite Toad)

The potential recreational impacts to LCT, SNYLF, and Yosemite Toad are the same as Alternative A.

Status and Trend in Species Distribution (Tui chub, Great basin rams-horn, and Northern leopard frog)

Tui chub, Great basin rams-horn, and Northern leopard frog (if detected) distribution will generally stay in baseline conditions or improve where habitat is restored. Where recreation site expansion overlaps with sensitive species or habitat, there may be a decrease of habitat quality as access to sensitive aquatic habitats increases.

Alternative C

Status and Trend in Aquatic Habitat (Streams, Lakes, Wetlands, Meadows)

As in Alternative A and B, where campgrounds and parking areas are adjacent to SEZs, local hydrologic processes/characteristics could change as potential soil compaction increases, infiltration decreases, vegetation diversity decreases, and erosion increases, thereby affecting water quality and aquatic habitat parameters. However, standards and guidelines would require that project design incorporate measures to mitigate effects to SEZs. Alternative C allows for the greatest amount of expansion, therefore has the greatest potential impacts to the status and trend of aquatic habitat. Similar to Alternatives A and B, regardless of standards and guidelines or project level BMPs, expanded recreation development will cause increased impacts. Although the measures are implemented to protect sensitive areas during expansions, visitors often deviate from direction making it challenging to both increase use and protect habitat. These potential impacts would be the greatest in Alternative C.

Otherwise, where developed recreation is expanded in drier site upland areas, conditions will remain in baseline or decrease as visit use and associate impacts increase. There is a potential for decrease in stream, wetland and meadow condition where resort, ski area, new trail crossings, etc. expansion results in modification of hydrologic function. These impacts could impact to water quality parameters affecting habitat and/or direct modification of habitat. However, similar to Alternative B, Alternative C provides directions for the relocation, if deemed. There is potential for aquatic habitat to improve (physical form and function) where facilities are moved out of SEZ; however, as recreational sites increase by 15%, unforeseen human disturbance is expected to increase thus degrading habitat conditions.

Status and Trend in Species Distribution (LCT , SNYLF, and Yosemite Toad)

LCT and SNYLF distribution will generally stay in baseline conditions as recreation site expansion should not preclude recovery actions; however expansion may result in an increase in human disturbance on the species. Potential disturbance and habitat degradation is the greatest in Alternative C as the recreation footprint can increase by 15 percent.

Status and Trend in Species Distribution (Tui chub, Great basin rams-horn, and Northern leopard frog)

Tui chub and Great Basin rams-horn distribution will generally stay in baseline conditions, however disturbance from recreation site expansion may result in a decrease of habitat quality by potentially increasing access to sensitive aquatic habitats. Increased recreational facilities and associated use could increase fine sediment into streams and lakes and contribute to new infestations of AIS.

Alternative D

Status and Trend in Aquatic Habitat (Streams, Lakes, Wetlands, and Meadows)

Where campgrounds and parking areas or other developed recreation facilities are reduced by 15%, in SEZs, water quality and aquatic habitat parameters has the potential to improve in both form and function. Removal of developed sites in sensitive areas where streams intersect with Lake Tahoe will improve lake clarity and water chemistry. These areas, if restored, trap sediments and nutrients. These areas also offer access to Lake Tahoe. If this access is removed, unmanaged recreation could occur and have unanticipated negative impacts such as excess trash, waste and user created trails in these sensitive habitats. The impacts of unmanaged recreation use in highly desirable locations, which often overlap with highly sensitive habitat, could lead to more degradation of these areas than if some component of the developed site remained. Due to the large amount of use and the projection that the demand will continue to increase in the future, visitors will certainly create access to these areas.

Status and Trend in Species Distribution (LCT, SNYLF, and Yosemite toad)

LCT and SNYLF distribution will generally stay in baseline conditions as recreation site reduction shouldn't influence recovery actions; however this reduction may result in a decrease in human disturbance on the species. Reduction in recreation in sensitive habitats along the lakeshore of Lake Tahoe could increase the distribution of native non-game fish. By aiding in the recovery of the historic foodweb, distribution of LCT will be improved.

Status and Trend in Species Distribution (Tui chub, Great basin rams-horn, and Northern leopard frog)

Tui chub and Great Basin rams-horn distribution will increase as the removal of recreation sites may result in an improvement of habitat quality by decreasing human disturbance and access to sensitive aquatic habitats. Restoration that removes developed recreation from mouths of creeks will increase available habitat for both species. However, because this alternative proposes active management, the benefits of the reduction in developed recreation could be offset by the unintended consequences of this passive approach, such as, increase distribution of AIS and the impacts of unmanaged recreation (increase trash, waste, and user created trails).

Alternative E

Status and Trend in Aquatic Habitat (Streams, Lakes, Wetlands, Meadows)

As in Alternatives A, B, and C where campgrounds and parking areas are adjacent to SEZs, local hydrologic processes/characteristics could change as potential soil compaction increases, infiltration decreases, vegetation diversity decreases, and erosion increases, thereby affecting water quality and

aquatic habitat parameters. However, standards and guidelines would require that project design incorporate measures to mitigate effects to SEZs. Alternative E allows for a mix of expansion and reduction when compared to other alternatives. Similar to Alternative B, Alternative E allows for 5 percent expansion in both developed recreation sites and day use parking. Similar to Alternative A, both overnight accommodations and ski area footprints can expand up to 10 percent under Alternative E. Where developed recreation is expanded in drier site upland areas, conditions will remain in baseline or decrease as visitor use and associated impacts increase. Where overnight accommodations expand unforeseen human disturbance including but not limited to potential introductions or spread of invasive species, could increase thus degrading habitat conditions. There is a potential for decrease in stream, wetland and meadow condition where resort, ski area, new trail crossings, etc. expansion results in modification of hydrologic function. These impacts could impact water quality parameters, affecting habitat and/or directly modifying habitat.

However, similar the Alternative B and C, Alternative E provides directions for the relocation, if deemed appropriate, of developed sites to higher capability land. Therefore, there is potential for aquatic habitat to improve (physical form and function) where facilities are moved out of SEZ and habitat is restored. Additionally, standards and guidelines found in Alternative E would provide additional direction (beyond that found in Alternative B and C) for protection and enhancement of aquatic habitat and ensure any recreation expansion was compatible with natural resources.

Status and Trend in Species Distribution (LCT , SNYLF, and Yosemite Toad)

The potential recreational impacts to LCT, SNYLF, and Yosemite Toad are the same as Alternative A.

Status and Trend in Species Distribution (Tui chub, Great Basin rams-horn, and Northern leopard frog)

Tui chub, Great basin rams-horn, and Northern leopard frog (if detected) distribution will generally stay in baseline conditions, however disturbance from recreation site expansion may result in a decrease of habitat quality by potentially increasing access to sensitive aquatic habitats.

Access to NFS Roads and Trails

Alternative A, B, and E

Stream connectivity is a critical component of a healthy stream by allowing fish species to migrate to fulfill various life history needs (Fairfull and Witherridge 2003). The potential direct and indirect effects of impeding fish passage include interrupting spawning or season migrations, restricting access to preferred habitat and available food, reducing genetic flow between populations, increasing susceptibility to predation, and fragmenting previously continuous populations (NSW Department of Primary Industries 2006). Additionally the effects of roads on aquatic habitat can include increased fine sediment (Weaver and Fraley 1993, Young et al. 1991), changes in streamflow (Fairfull and Witheridge 2003), changes in water temperature by loss of shade cover, migration barriers, vectors for diseases, invasive fish introduction, channel reconfiguration and increased fishing pressure.

Status and Trend in Aquatic Habitat (Streams, Lakes, Wetlands, and Meadows)

Aquatic habitat would generally stay in baseline conditions or improve where roads and trails were restored or where BMPs were implemented to improve aquatic resource conditions.

Culverts can result in significant modification to channel bed form and flow conditions due to increased flow velocities, turbulence and reduced flow depth through the structure. Warren and Pardew (1998) observed that fish passage success at waterway crossings was inversely related to flow velocity, in addition to culvert structures exhibiting the highest velocities of crossing types assessed. High water

velocities and excessive headloss (otherwise known as the waterfall effect) are of particular importance to many native fish. Culverts can further restrict fish movement due to insufficient lighting within culvert, and from debris build-up at the opening, which physically blocks fish passage. Where AOP issues are addressed by replacing or re-engineering problem road crossings and enhancing form and function of the stream, habitat will increase in both quantity and quality. Hydrologic characteristics of stream channels will improve aquatic habitat by decreasing factors that contribute to erosion, contribute fine sediments and nutrients to aquatic habitat and reduce water quality.

By addressing the unauthorized trails either through adoption or decommissioning, condition of habitat in close proximity will most likely benefit by reducing potential sediment from unmanaged trails. There is a potential for an increase in stream, wetland and meadow condition where upgrades to the road or trail system results in modification of hydrologic function, impacts to water quality affecting habitat and/or direct modification of habitat (i.e., new trail crossings at streams). By decommissioning or adopting and installing appropriate BMP’s there would be an expected reduction in soil compaction, erosion, and loss of vegetative compositions that is seen on unmanaged trails.

Where off-road highway vehicles are permitted near aquatic habitat, conditions could deteriorate where soil compaction and erosion increase, reducing ground water characteristics, water quality, vegetative compositions and overall habitat quality. As riparian vegetation decreases, water quality often decreases, as this type of vegetation captures sediment and nutrients. Additionally, infiltration capacity of compacted soils is reduced increasing the likelihood of overland flow during high rain events. If riparian and herbaceous vegetation is lacking, there is a greater potential for sediments and nutrient to enter stream channels and other aquatic habitat.

Status and Trend in Species Distribution (LCT, SNYLF, and Yosemite toad)

Species distribution will generally stay in baseline conditions or continue to increase as road management shouldn't preclude recovery and restoration actions. Wherever connectivity is restored through the reengineering of problem stream crossings, increased distribution should occur. In some cases, however, these barriers could restrict non-desirable aquatic species from occupied habitat. Removal of barriers to organism passage may elevate the risk of spreading invasive species and depressing the abundance and distribution of these species. These situations would be addressed during project level analysis.

The potential increase in trails may increase human disturbance and increase potential for illegal fish introduction in LCT or SNYLF occupied habitat. New trails could also increase sediment loads, increased fishing pressure, or increased potential for disease (e.g., Bd) to spread in occupied or potential SNYLF habitat.

Status and Trend in Species Distribution (Tui chub, Great Basin rams-horn, and Northern leopard frog)

Distribution will generally stay in baseline conditions or increase where AOP increases habitat connectivity. If Northern leopard frogs were detected near existing OHV trails, distribution could decrease due to degraded habitat conditions and increased disturbance.

Alternative C

Status and Trend in Aquatic Habitat (Streams, Lakes, Wetlands, Meadows)

Aquatic habitat has the potential to decrease in amount and quality as miles of road open to passenger vehicles increases. Some part of these could be paved roads, which create impervious surfaces where surface runoff of substances such as motor oil, gasoline, heavy metals, as well as toxic substance used in de-icing programs can reach aquatic habitats (Noss 1995). However, an aggressive BMP retrofit program has disconnected most roads from stream channels. There will be similar aquatic habitat benefits as

stated in Alternative B when AOP issues are addressed and when unauthorized roads are decommissioned.

Status and Trend in Species Distribution (LCT, SNYLF, and Yosemite toad)

Distribution will generally stay in baseline conditions or continue to increase as road management shouldn't preclude recovery/restoration actions. The potential increase in trails and road miles open to passenger vehicles will increase human disturbance and increase potential for illegal fish introduction in LCT or SNYLF occupied habitat. New trails could also increase fishing pressure or potential for disease (e.g., Bd) to spread in occupied or potential SNYLF habitat. These impacts will be greater in Alternative C than other alternatives.

Status and Trend in Species Distribution (Tui chub, Great Basin rams-horn, and Northern leopard frog)

Species distribution will generally stay in baseline conditions or increase where AOP increases habitat connectivity. Disturbance from potential road and trail expansion may result in a decrease of habitat quality by potentially increasing access to sensitive aquatic habitats (more than Alternative A and B) where species occur. Increased sediment from increased road and trails could further reduce habitat and water quality, but would be prevented through measures required by the standards and guidelines.

Alternative D

Status and Trend in Aquatic Habitat (Streams, Lakes, Wetlands, Meadows)

Potential to decrease (same as or slightly less than Alternative C) due to an increase in total road mileage for high clearance vehicles and OHV. Where OHV use increases, there is a potential for accelerated habitat degradation. Because of their weight, off-road vehicles compress and compact soil, altering its ability to absorb and retain water and nutrients thus concentrating the surface flow of water and increasing erosion (Dregne 1983). OHV use is only allowed on designated routes and areas, and trail design and maintenance controls runoff, minimizing impacts.

Status and Trend in Species Distribution (LCT, SNYLF, and Yosemite)

Generally stay in baseline conditions or continue to increase as road management shouldn't preclude recovery/restoration actions. Potential increase in roads and trails may increase human disturbance and increase potential for illegal fish introduction in LCT/SNYLF occupied habitat (same as or slightly less than Alternative C).

Status and Trend in Species Distribution (Tui chub, Great Basin rams-horn, and Northern leopard)

The effects to species distribution would be slightly greater than other alternative because of the increase in high clearance vehicles and OHV use.

Permitted Land Uses

Alternatives A, B, C, D, and E

Status and Trend in Aquatic Habitat (Streams, Lakes, Wetlands, Meadows)

Aquatic habitat quality will generally stay in baseline conditions or decrease where activities impact SEZs. Level of impact to aquatic habitat is dependent on duration of activity and spatial extent which occurs. However, developed standards and guidelines should eliminate or minimize any direct or indirect effects to aquatic habitat.

Alternative A considers livestock grazing as a suitable use; however, it is given the lowest priority when conflicts arise. Highest priority is given to the protection of water quality and the enhancement of clarity in Lake Tahoe

Alternative B, C, D, and E also consider livestock grazing as a permitted use although site specific environmental analysis would be needed to determine the suitability of this activity any of the vacant grazing allotment on the LTBMU. Any authorized livestock grazing is, however, expected to have impacts to stream, wetland and meadow form and function within a designated allotment. Livestock grazing has been known to widen channels, reducing the amount of pool habitat and raising water temperatures thus reducing dissolved oxygen (Hubert et al. 1984, Stuber 1985). These alterations in channel form and function reduce spawning habitat for salmonids and other aquatic organisms. Sediments blanket spawning gravel, entombing or suffocating fish embryos and juveniles (Stevens et al. 1992).

Status and Trend in Species Distribution (LCT, SNYLF, and Yosemite toad)

Beyond livestock grazing, permitted land uses will generally have no direct or indirect effects on LCT, SNYLF or, if detected, Yosemite toad. Developed Standards and Guidelines should eliminate or reduce impacts to any TE, proposed or candidate species. However, as distribution increases through implementation of recovery efforts, there is potential for human interaction and disturbance on occupied sites to increase. This would lead to an increase potential for new AIS infestations, reduction in habitat quality (i.e., reduced stream shade or increased sediment on spawning gravels) and an increased probability of disease transmission, specifically *Bd*.

If livestock use were authorized, current distribution of LCT, SNYLF, and, if detected, Yosemite toad could decrease due to habitat degradation. Livestock grazing reduces herbaceous and riparian vegetation, causes soil compaction, and alters stream channels due to streambank trampling. Higher water temperatures from loss of shade, increased sedimentation and reduction in plant detritus and some benthic macroinvertebrates (Rinne 1988) are known impacts of livestock grazing and cause a loss in species that require clean, cold water habitats such as LCT, SNYLF, and Yosemite toad.

Status and Trend in Species Distribution (Tui chub, Great Basin rams-horn, and Northern leopard frog)

There is potential for decrease of habitat quality and distribution by potentially increasing access to sensitive aquatic habitats where species occur. If Northern leopard frog were detected, habitat and distribution could decrease if authorized grazing occurred near occupied habitat. Grazing can replace riparian species by upland species and invasive weeds (Kauffman et al, 1983a, Green and Kauffman 1995), reducing riparian habitat for species such as Northern leopard frog.

Climate Change

Reiman and Isaak (2010) provide management options to support adaptation of fish populations and stream communities in response to climate change. These include enhance resilience and resistance, prioritize, facilitate transition to new states, develop local information, and coordinate efforts. While all alternatives address some of these options, Alternative D does not enhance resilience and resistance, or facilitate transition to new states because this alternative focus on passive management. Alternatives B, C, and E specifically address removal of barriers for migration, and aquatic invasive species. Removal of barriers to organism passage will afford an opportunity for species to take advantage of the improved connectivity, allowing them to migrate and avoid localized detrimental conditions caused by climate change.

3.4.3.4. Analytical Conclusions

Management direction in Alternative B, C, and, to the greatest extent, E more clearly and contemporarily outlines restoration and enhancement of watershed and aquatic habitat specific to the Lake Tahoe basin. Lahontan cutthroat trout and Sierra Nevada yellow-legged frog are expected to increase in their localized range with implementation of area-specific recovery/restoration efforts. Impacts from the recreation, road and trail and permitted land use programs could potentially off-set achievement of desired conditions for aquatic habitat and species due to increased human disturbance in and around aquatic habitat. This potential situation is prevalent in all alternatives, but somewhat buffered in Alternatives B, C, D, and E where updated desired conditions, objectives and standard and guidelines provide project-level direction for protection, enhancement, and restoration for aquatic habitat and associated species.

Alternative E would offer the greatest benefits to aquatic habitat and species because the impacts from other resource areas are the same or less than other alternative but the benefits from AIS management are the greatest. Although some components of recreation (overnight accommodations and ski area) increase in Alternative E, compared to Alternative B, this alternative has additional Desired Conditions and Standards and Guidelines that provide direction for both conservation and enhancement of aquatic habitat. Although Alternative C shares the restoration benefits and AIS management (same as B but less than E), it is off-set by the increase in recreation, roads and trails. Furthermore, the prevalence of existing AIS populations and potential for new introductions becomes highest in Alternative D where passive management would make control and eradication more challenging as only the highest priority species would be targeted for control and/or removal.

How the Alternatives Maintain or Achieve the Desired Conditions

The restoration objectives and biological resource protection measures proposed under Alternatives B, C, and, to the greatest extent, E address contemporary desired conditions tied to species life history, habitat needs, and overall community-level management in the LTBMU. The biological resources protection measures provide clear and proactive management direction for special-status species protection and habitat restoration and enhancement as well as management standards for certain hot spot areas in the LTBMU. The desired conditions are based on Lake Tahoe and Sierra Nevada specific current state of knowledge from various watershed, ecological and species-centric assessments and research. The goal of the restoration program desired conditions is to refine management intent by defining proactive elements which sustain aquatic wildlife habitat and communities of special status species. In addition, approaches to achieve such watershed and aquatic restoration, and biological resource protection desired conditions (strategies, objectives and standards and guidelines) are scientifically credible and outcomes measurable. In contrast, desired conditions under the current direction (Alternative A) are founded in a more reactive management intent with goals of preventing aquatic habitat and species degradation from land management actions. Under Alternative A the opportunity to design site-specific land management projects to restore multiple ecosystem functions becomes more of a challenge. Alternative D includes the same desired conditions as Alternatives B, C, and E for biological resources protection and watershed and aquatic habitat condition but fails to follow the same restoration objectives to achieve these desired conditions. Therefore, Alternatives A and D may fall short of reaching desired conditions because of the lack of the proactive biological resource protection measures in Alternative A and lack of continued restoration under Alternative D. Additionally, due to the lack of active restoration, forest management, and AIS treatment, Alternative D could contribute to habitat degradation.

Overall, Alternatives A, B, C, and, to a greater extent, E include management options that would maintain and/or improve aquatic wildlife habitat and better enable the habitats to respond to changing climate conditions, thereby assisting species dependent on features of these habitats. Alternative D does not provide for these opportunities. Alternatives B, C, and E also provide for maintenance and improvement of movement corridors that would improve habitat connectivity and assist species as changing climate conditions may influence species ranges or habitat needs. The increase in recreation proposed in

Alternative, A, C, and, to a lesser extent, E, however, limit opportunities to meet the desired conditions for aquatic habitat and species by increasing the threat of AIS. These limitations, however, are offset in Alternative E due to additional desired conditions and management direction. Therefore, Alternative E provides the best balance in land use and management direction to attain aquatic desired conditions.

Comparison of Consequences by Alternative

Table 3 22. Comparison of Consequences by Alternative, Aquatic Wildlife

Aquatic Resource Type	Alternative A	Alternative B	Alternative C	Alternative D	Alternative E
Streams, Lakes, Wetlands and Meadows	Status and trend: a) improve as result of restoration and enhancement, b) stays at baseline in roadless and wilderness areas, or areas treated in forest vegetation actions, or c) decreases where impacted by land uses, especially where expansion of recreation increases potential for AIS transference.	Status and trend: a) improve as result of restoration and enhancement, b) stays at baseline in roadless and wilderness areas, or areas treated in forest vegetation actions, or c) decreases where impacted by land uses, especially recreation, roads and trails and permitted livestock grazing. Impacts on aquatic habitat are less than Alt. A.	Status and trend: a) improve as result of restoration and enhancement, b) stays at baseline in roadless and wilderness areas, or areas treated in forest vegetation actions, or c) decreases where impacted by land uses, especially recreation, roads and trails, construction of temporary roads (forest veg), permitted livestock grazing. Impacts on aquatic habitat are more than Alt. A and B.	Status and trend: a) improve as a result of currently planned restoration and enhancement b and c) decreases where restoration or enhancement (aquatic and terrestrial) is needed but not permitted, by land uses, especially recreation, roads and trails and permitted livestock grazing. Impacts on aquatic habitat more than A, B, and C (due to AIS threats and risks of catastrophic fire).	Status and trend: a) improve as result of restoration and enhancement, b) stays at baseline in roadless and wilderness areas, or areas treated in forest vegetation actions, or c) decreases where impacted by land uses, especially recreation, roads and trails and permitted livestock grazing. Impacts on aquatic habitat are less than Alt. A and similar to B.

Aquatic Resource Type	Alternative A	Alternative B	Alternative C	Alternative D	Alternative E
LCT	The species distribution is expected to increase as recovery/restoration strategies progress. LCT may face increased threats with expansion of recreation facilities, trails and subsequent human interaction on occupied habitat.	The species distribution is expected to increase as recovery strategies progress. LCT may face increased threats with expansion of recreation facilities, trails and subsequent human interaction on occupied habitat at levels less than Alt. A.	The species distribution is expected to increase as recovery strategies progress. LCT may face increased threats with expansion of recreation facilities, trails and subsequent human interaction on occupied habitat at levels greater than Alt. A and Alt. B.	The species distribution is expected to increase as recovery strategies progress. LCT may face greater threats than in Alts A, B and C due to increased AIS, increase risk of fire, increase impacts of unmanaged recreations, and lack of active restoration	The species distribution is expected to increase as recovery strategies progress. LCT may face increased threats with expansion of recreation facilities, trails and subsequent human interaction on occupied habitat at levels less than Alt. A and similar to B.
SNYLF	The species distribution is expected to increase as recovery/restoration strategies progress. SNYLF may face increased threats with expansion of recreation facilities, trails and human interaction and potential for an increase in AIS as human interaction in occupied habitat increases.	The species distribution is expected to increase as recovery strategies progress. SNYLF may face increased threats with expansion of recreation facilities, trails and subsequent human interaction and potential for an increase in AIS as human interaction in occupied habitat increases. This potential threat is less when compared to Alt. A.	The species distribution is expected to increase as recovery strategies progress. SNYLF may face increased threats with expansion of recreation facilities, trails and subsequent human interaction and potential for an increase in AIS as human interaction in occupied habitat increases at levels greater than Alt. A and B.	The species distribution is expected to increase as recovery strategies progress. SNYLF may face greater threats than in Alt.'s A, B and C due to increased AIS, increase risk of fire, increase impacts of unmanaged recreations, and lack of active restoration.	The species distribution is expected to increase as recovery strategies progress. SNYLF may face increased threats with expansion of recreation facilities, trails and subsequent human interaction and potential for an increase in AIS as human interaction in occupied habitat increases. This potential threat is less when compared to Alt. A and similar to B.

Aquatic Resource Type	Alternative A	Alternative B	Alternative C	Alternative D	Alternative E
Tui Chub, Great Basin rams-horn, and Northern leopard frog	The species distribution is expected to stay at baseline conditions or decrease with a potential increased distribution of existing and new AIS. Otherwise, the species will be susceptible to potential impacts on sensitive shore zone and lake-stream interface habitats.	The species distribution is expected to stay at baseline conditions or increase with continued emphasis on AIS prevention, control and eradication and restoration and enhancement efforts. Potential impacts to sensitive habitat are expected to be less than Alt. A.	The species distribution is expected to stay at baseline conditions or increase with continued emphasis on AIS prevention, control and eradication and restoration and enhancement efforts. Species distribution will decrease where land use, specifically recreation, roads/trails, temporary roads (forest management) increase. Potential impacts to sensitive habitat are expected to be more than Alt. A and B.	The species distribution is expected to stay at baseline conditions or increase with decreases in recreation. Species distribution expected to decrease due to increased threat of AIS, catastrophic fire, unmanaged recreation. Potential impacts to sensitive habitat comparable or greater than other alternatives.	The species distribution is expected to stay at baseline conditions or increase with continued emphasis on AIS prevention, control and eradication and restoration and enhancement efforts. Potential impacts to sensitive habitat are expected to be less than Alt. A and similar to B.

3.4.4. Botanical Resources

3.4.4.1. Introduction

The purpose of this analysis is to evaluate potential effects to botanical resources—plants, lichen, and fungi taxa as well as unique plant communities—across the five Forest Plan Revision alternatives. Descriptions of Alternatives A, B, C, D, and E are included in Chapter 2. The Biological Evaluation for Threatened, Endangered, Proposed, Candidate, and Sensitive (TEPCS) Plants Species provides a more complete discussion of the species analyzed and the potential effects, including a determination for each species and each alternative. There are no Threatened, Endangered, or Proposed plant species known to occur or have suitable habitat on LTBMU.

Methodology

Analysis Area & Duration of Effects

The analysis area for direct and indirect potential effects is defined as all NFS lands within the LTBMU administrative boundary because this is the area affected by the direction included in the revised Forest Plan. All indicators are evaluated at a basin-wide scale and based on the assumption that the revised Forest Plan will be programmatic in nature and not area-specific and/or project-specific. Effects of projects designed under the revised Forest Plan will be addressed in project-specific planning and environmental analysis. All effects are evaluated on a 15-year basis for the anticipated life of revised Forest Plan.

Species Considered

There are over 1000 species of plants, lichen, and fungi (referred to collectively as plants) known to occur on LTBMU—most of which are not considered in this analysis. For the vast majority of species, the general species and habitat guidance provided in the revised Forest Plan is considered sufficient to maintain variable populations and therefore maintain botanical diversity. These more common plant species are not at risk for a loss of viability due to a combination of their relative abundance and a relative low risk that management activities will significantly impact populations or suitable habitat; these species are not specifically addressed in the FEIS. Instead, the analysis focuses on species at risk of not maintaining viable populations. Appendix E details the management direction and process undertaken to evaluate species at risk as well as the list of species considered for inclusion in the revised Forest Plan and FEIS.

Species lists maintained by the US Fish and Wildlife Service under the Endangered Species Act—Threatened, Endangered, Proposed, and Candidate species—and the Forest Service's Pacific Southwest Region—Regional Forester's Sensitive Species List—were the primary sources for identifying species at risk (US Fish and Wildlife Service 2011b, USDA Forest Service 2013a).(US Fish and Wildlife Service 2011b, Tahoe Regional Planning Agency (TRPA) 2012, USDA Forest Service 2013a). These are referred to collectively as TEPCS plants or species. Because the listing process for both agencies includes an assessment of endangerment, these lists were preferred over other ranking systems that focus on species rarity, such as Nature Serve's global ranking or the California Rare Plant Rank. Rarity is an expression of the pattern of distribution and abundance of a species at a specified time; some plants naturally occur less frequently than others (Regan 2004). Whereas, endangerment refers to factors—generally human-related—that make a particular species more susceptible to decline or extinction. Species listed as Sensitive by the Tahoe Regional Planning Agency (TRPA) were also considered; all TRPA Sensitive species are included within the R5 Sensitive list (Tahoe Regional Planning Agency 2012). TEPCS species present or having suitable habitat on LTBMU are considered the most likely to be impacted by the proposed activities. Conversely, species outside the LTBMU were not considered to have a high likelihood of being impacted by the proposed project either directly, indirectly, or cumulatively.

Therefore, only those TEPCS species with known occurrences or with high potential for suitable habitat on LTBMU were analyzed.

Species Analyzed

Detailed descriptions of each species can be found in the Biological Evaluation for Threatened, Endangered, Proposed, Candidate, and Sensitive (TEPCS) Plants Species. Some species have more than one subspecies or variety—lower taxonomic levels—that are considered at risk (e.g., *Lewisia kelloggii*, *Draba asterophora*). To simplify terminology in this analysis, these lower taxa are referred to as species and included separately in counts of species diversity.

Table 3 23. Plant species analyzed in the revised Forest Plan FEIS

Scientific Names	Common Name	Legal Status	Suitable habitat characteristics
Boechera rigidissima var. demota	Galena Creek rock cress	R5S	Open, rocky areas along forest edges of conifer and/or aspen stands; usually found on north aspects; 7,500 ft. & above.
Boechera tiehmii	Tiehm's rock cress	R5S	Open rocky soils in the Mt. Rose Wilderness; 10,000 ft. & above.
Boechera tularensis	Tulare rockcress	R5S	Shaded, mostly east-facing subalpine rocky areas, including rocky slopes, rock-lined streams and seeps, rocky outcrops, saddles, and canyons; 6,000-11,000 ft.
Botrychium spp			Botrychium species are found in similar habitat; wet or moist soils such as marshes, meadows, and along the edges of lakes and streams; generally occur with mosses, sedges, rushes, and other riparian vegetation; 2,000-10,000 ft.
Botrychium ascendens	upswept moonwort	R5S	See Botrychium spp.
Botrychium crenulatum	scalloped moonwort	R5S	
Botrychium lineare	slender moonwort	R5S	
Botrychium lunaria	common moonwort	R5S	
Botrychium minganense	Mingan moonwort	R5S	
Botrychium montanum	western goblin	R5S	
Bruchia bolanderi	Bolander's candle moss	R5S	Mainly in montane meadows and stream banks, but also on bare, slightly eroding soil where competition is minimal.
Dendrocollybia racemosa[1,2]	branched collybia	R5S	On old decayed or blackened mushrooms or occasionally in coniferous duff, usually within old growth stands.
Draba asterophora var. asterophora	Tahoe draba	R5S; TRPA	Rock crevices and open granite talus slopes on north-east slopes; 8,000-10,200 ft.

Scientific Names	Common Name	Legal Status	Suitable habitat characteristics
Draba asterophora var. macrocarpa	Cup Lake draba	R5S; TRPA	Steep, gravelly or rocky slopes; 8,400-9,300 ft.
Draba cruciata	Mineral King draba	R5S	Subalpine gravelly or rocky slopes, ridges, crevices, cliff ledges, sink holes, boulder and small drainage edges; 7,800-13,000 ft.
Erigeron miser	starved daisy	R5S	Granitic rock outcrops; 6,000 ft. & above
Eriogonum luteolum var. saltuarium	goldencarpet buckwheat	R5S	Sandy granitic flats and slopes, sagebrush communities, montane conifer woodlands; 5,600-7,400 ft.
Eriogonum umbellatum var. torreyanum	Donner Pass buckwheat	R5S	Dry gravelly or stony sites; often on harsh exposures (e.g., ridge tops, steep slopes)
Helodium blandowii	Blandow's bog-moss	R5S	Bogs, fens, wet meadows, and along streams under willows.
Hulsea brevifolia	short-leaved hulsea	R5S	Red fir forest, but also in mixed conifer forests; found on gravelly soils; 4,900-8,900 ft.
Ivesia sericoleuca	Plumas ivesia	R5S	Vernally wet portions of meadows and alkali flats, vernal pools within sagebrush scrub or lower montane coniferous forest; often on volcanic soils; 4,300-7,200 ft.
Lewisia kelloggii ssp. hutchisonii	Kellogg's lewisia	R5S	Ridge tops or flat open spaces with widely spaced trees and sandy granitic to erosive volcanic soil; 5,000-7,000 ft.
Lewisia kelloggii ssp. kelloggii	Kellogg's lewisia	R5S	See Lewisia kelloggii ssp. hutchisonii
Lewisia longipetala	long-petaled lewisia	R5S; TRPA	North-facing slopes and ridge tops where snow banks persist throughout the summer; often found near snow bank margins in wet soils; 8,000-12,500 ft.
Meesia uliginosa	broad-nerved hump-moss	R5S	Bogs and fens, but also very wet meadows.
Orthotrichum praemorsum	orthotrichum moss	R5S	Shaded, moist habitats of east side of Sierra Nevada rock outcrops; up to 8,200 ft.
Peltigera gowardii	Goward's water fan	R5S	Cold unpolluted streams in mixed conifer forests.
Pinus albicaulis	whitebark pine	C; R5S	Subalpine and at timberline on rocky, well-drained granitic or volcanic soils.
Rorippa subumbellata	Tahoe yellow cress	C; R5S; TRPA; CA-E; NV-T	Endemic to the shore zone of Lake Tahoe, typically in back beach areas between 6,223 and 6,230 ft.

Notes:
There are no federally threatened, endangered, or proposed plant species known to occur or with known suitable habitat within LTBMU. This list includes all R5 Sensitive plant and fungi species with known occurrences or known suitable habitat on LTBMU.

Legal status: C—Candidate for federal listing under the Endangered Species Act (US Fish and Wildlife Service 2011b); R5S—Regional Forester's Sensitive Species List, Region 5 (USDA Forest Service 2013a); TRPA—Tahoe Regional Planning Commission Sensitive Species (Tahoe Regional Planning Agency 2012); CA-E—Considered endangered by the State of California (State of

California Department of Fish and Game 2012); NV—CE—Considered critically endangered by the State of Nevada (State of Nevada 2005)

[1] For branched collybia, surveys are only effective when fruiting bodies are visible. This species typically fruits in late fall -early winter. The extent to which aboveground fruiting bodies are correlated with the abundance of underground structures is unknown. When a survey does not find the fruiting body, the species could still be present at the site. Because of this detection difficulty, it is important to manage habitat in a state that is suitable for fungi.

[2] An alternative framework for the management of Sensitive fungi is pending Regional Forester approval (expected in 2013).

Aggregation of Species by Habitat Type

While the 28 species analyzed vary widely in their ecological requirements and life history characteristics, many occur in similar broad habitat types where the effects of proposed management are comparable. Major habitat types—General Forest, Subalpine, Aspen, Meadow, Montane Riparian—were derived from California Wildlife Habitat Relationship (CWHR) vegetation types—consistent with the Forest Vegetation and Wildlife Sections of Chapter 3. Plant habitats associated with fine-scale features that are not capture by courser CWHR classification include Shoreline and Rocky Habitat. Each species was assigned to a minimum of one habitat type, but may be assigned to more, if it had broader habitat requirements. The following types have been selected to represent the species being addressed in this analysis:

General Forest

The General Forest habitat type consists of Jeffrey Pine, White Fir-Mixed Conifer, Red Fir and Lodgepole Pine forest types. Each of these forest types and their current condition is described in detail in the Forest Vegetation Specialist Report; these are summarized briefly below:

Jeffrey Pine Forest—Jeffrey pine (*Pinus jeffreyi*) forests occur on drier sites from 6224 ft. to approximately 8,000 ft. and currently dominates an estimated 17% of LTBMU. Associates include sugar pine (*Pinus lambertiana*), lodgepole pine (*Pinus contorta var. murryana*), incense-cedar (*Calocedrus decurrens*), and white fir (*Abies concolor*). Western white pine (*Pinus monticola*) and red fir (*Abies magnifica*) replace sugar pine and white fir respectively at higher elevations.

White Fir-Mixed Conifer Forest—generally occurs from 6,224 ft. to about 7,000 ft. and currently dominates an estimated 33% of LTBMU. White fir is dominant but this forest type also includes Jeffrey pine, incense cedar, and sugar pine.

Red Fir Forest—Red fir forests typically replace white fir-mixed conifer on similar moist but well drained soils between elevations of 7,000 to 8,500 feet, mostly on north and east aspects and currently dominates an estimated 12% of LTBMU.

Lodgepole Pine Forest—Lodgepole pine forest type occurs at variety of elevations, often on azonal soils (e.g., sites that are either too wet or too dry or rocky for more competitive species to dominate the stand.) Lower elevation lodgepole pine stands are primarily found on wet soils or in areas of cold air drainage, where air and soil temperatures are unfavorable for other species.

Species found in general forest are: *Boechera rigidissima* v. *demota, Dendrocollybia racemosa, Eriogonum luteolum* var. *saltuarium, Eriogonum umbellatum var. torreyanum, Helodium blandowii, Hulsea brevifolia, Lewisia kelloggii ssp. hutchisonii, Lewisia kelloggii ssp. kelloggii,*

Subalpine

Subalpine zone occurs from approximately 8,200 ft. to treeline (9,000-10,000 ft.) and is comprised of a mosaic of forest, woodland, meadows, rock outcrops, and shrub vegetation types. The most common forest type in the subalpine is mixed subalpine woodland, with white bark pine (*Pinus albicaulis*), mountain hemlock (*Tsuga mertensiana*), and species from the upper montane, such as red fir, lodgepole

pine and western white pine. Stands tend to be open on sandy soils and rocky slopes. Many species form krummholz.

Species found in the subalpine are: *Boechera tiehmii, Boechera tularensis, Draba asterophora* var. *asterophora, Draba asterophora* var. *macrocarpa, Eriogonum umbellatum* var. *torreyanum, Lewisia longipetala, Pinus albicaulis*

Aspen

The aspen forest type occurs at elevations ranging from lake level to over 9000 feet and currently dominates less than 1% of LTBMU. Stand sizes range from less than a quarter acre to 130 acres, with half of the stands being 0.8 acres or smaller. Approximately 35% of the Basin's aspen stands are found within a 300-foot elevation zone above the shoreline of Lake Tahoe, mostly growing in the broad bottomlands of west side canyons.

Species found in aspen stands are: *Boechera rigidissima v. demota, Botrychium lineare, Botrychium lunaria, Botrychium minganense, Botrychium montanum, Bruchia bolanderi*

Meadows

Meadows areas characterized by the presence of water is at or near the surface for most of the growing season and dense graminoid (grasses, sedges, rushes) and forb cover, with or without a shrub component (Weixelman et al. 2011). In this analysis, this habitat type includes ground-water-dependent communities such as seeps, springs and fens. Meadows occur from lake level to almost 10,000 feet. While meadows account for a small percentage of the overall Lake Tahoe Basin landscape, they are ecologically important because they plays a crucial role in hydrologic processes, erosion control, nutrient cycling, and habitat for many plant and animal species (Manley et al. 2000). Meadows are a subset of the stream environment zone (SEZ) as defined in the both the current and revised Forest Plan.

Species found in meadows are*: Botrychium ascendens, Botrychium crenulatum, Botrychium lineare, Botrychium lunaria, Botrychium minganense, Botrychium montanum, Bruchia bolanderi, Helodium blandowii, Ivesia sericoleuca, Meesia uliginosa,*

Montane Riparian

These are areas occur adjacent to streams and rivers and is often characterized by plant species that are tolerant of seasonal flooding, such as willow and alders. Riparian zones occur from lake level to almost 10,000 ft. They can be found under dense canopies of mixed conifer forest, within aspen stands, or as the primary canopy vegetation. They are a subset of the SEZ as defined in the both the current and revised Forest Plan.

Species found in montane riparian areas are: *Botrychium ascendens, Botrychium crenulatum, Botrychium lineare, Botrychium lunaria, Botrychium minganense, Botrychium montanum, Bruchia bolanderi, Peltigera hydrothyria*

Shorelines

This habitat type includes the shorelines of Lake Tahoe Basin's large lakes—Lake Tahoe and Fallen Leaf, Cascade, Upper Echo, and Lower Echo Lakes. Shoreline habitat ranges from relatively narrow rocky outcrops to wide, open, sandy beaches or connections to lagoons and wetlands. The Lake Tahoe Basin, the interface of the lake and other aquatic and terrestrial ecosystems are often relatively biologically diverse (Manley et al. 2000, Murphy and Knopp 2000); the largest wetlands in the Lake Tahoe basin and

the only barrier beaches and lagoons are located next to shorelines of large lakes. It is a subset of the SEZ as defined in the current and revised Forest Plan.

Species found along shorelines are: *Rorippa subumbellata*

Rocky Habitats

Rocky habitats encompass a spatially disparate and diverse group of habitat types including, but are not limited to: talus and scree fields; rock outcrops and boulders; rocky, steep slopes and ridge tops; granitic, sandy soils; shallow, volcanic soils; and thin, rocky soils in conifer forests. They range in size from a single large glacial erratic to multi-acre talus fields.

Species found in rocky habitats are: *Boechera tiehmii, Draba asterophora var. asterophora, Draba asterophora var. macrocarpa, Draba cruciata, Erigeron miser, Eriogonum umbellatum* var. *torreyanum, Hulsea brevifolia, Lewisia kelloggii ssp. hutchisonii, Lewisia kelloggii ssp. kelloggii, Lewisia longipetala, Orthotrichum praemorsum, Pinus albicaulis*

Indicators & Major Activity Categories

Because the revised Forest Plan does not authorize project-level activities, it is not particularly meaningful to assess the effects to botanical resources through quantitative indicators such as number of occurrences or acres of suitable habitat affected. Site-specific effects to occurrences and habitat will be addressed in subsequent project-specific environmental analysis. Instead, the following indicators form the basis for this analysis and are defined and discussed below:

- Species Conservation Strategy type—Active or Passive; an active approach uses watershed restoration and forest health treatments to achieve desired conditions for TEPCS species, whereas passive restoration relies on natural processes.
- Trend in abundance—decreasing, stable, or increasing; trend in abundance (number of TEPCS plant occurrences) is estimated by comparing current risks to species and the risks that may arise or be mitigated by proposed management activities
- Trend in habitat condition—decreasing, stable, or increasing; trend in habitat condition is estimated by comparing current habitat condition and the habitat condition that would likely result from proposed management activities.

The environmental consequences of the following major categories of activities are discussed as follows:

- Species Conservation Strategies
- Vegetation management
- Watershed and Aquatic Habitat Restoration
- Recreation / Access and Travel Management

Some activities are not specified because they are a combination of activities from the above list. For example, aspen enhancement and meadow restoration may include hand and mechanical thinning and prescribed fire. Other activities are not discussed because they are not likely to substantial affect botanical resources.

Assumptions

The following assumptions have been made:

- Actions comprising each program and sub-program area are consistent with pertinent resource federal and state law and current and proposed revised Forest Plan standards and guidelines.

- Current and future actions for threatened, endangered (T&E) and candidate species restoration and recovery are consistent with conservation strategies, interim prescriptions, and recovery plans.
- Current and proposed revised Forest Plan components (i.e., desired conditions, standard and guidelines, etc.) invoke unit-specific habitat and species conservation elements, which are meant to be consistent with the intent of federal law and state code/statue.

Data Sources

Basic information describing the life history, ecology, pollination biology, and specific habitat requirements is lacking for most of the LTBMU populations of analyzed species. The scientific literature and internal government documents (i.e., species-specific conservation assessments) were utilized for the analysis whenever available; however more frequently the analysis of effects was based on observations by qualified individuals, field experience, unpublished monitoring results, and studies of comparable species.

3.4.4.2 Overview of the Affected Environment

Species Diversity

The vascular plant flora of the Tahoe Basin is a subset of the northern High Sierra Nevada geographic sub region (nSNH) within the California Floristic Province (CFP) (Baldwin et al. 2012). A Mediterranean-type climate—hot dry summers and cool wet winters—characterizes the CFP; there are only five such areas in the world—all of which are considered biodiversity hotspots (Dallmann 1998). CFP flora consists of nearly 5800 species, of which 28% are endemic; the high level of endemism is related to the topographic, geologic, and climatic diversity of California(Ornduff et al. 2003, Baldwin et al. 2012). Lake Tahoe Basin flora represents a much restricted subset of the CFP, due to the Basin's small elevation and climate band—it only ranges from 6,000-10,000ft and experiences a relatively short cool summer—and its relatively homogenous geologic makeup dominated by glaciated granite which includes few serpentine or volcanic soils. Plant species diversity estimates for the Lake Tahoe Basin range from 1,000-1,800 vascular species (Graf 1999, Manley et al. 2000); project-level floristic surveys conducted by the Forest Service have recorded approximately 1,100 vascular species and approximately 190 species of non-vascular species (USDA Forest Service 2013b). There are approximately 70 species that are endemic to the Sierra Nevada that are known to occur in the Lake Tahoe Basin (Manley et al. 2000, Murphy and Knopp 2000)

It is difficult to reconstruct what botanical species—including TEPCS plants—were historically present prior to the 1844 discovery of Lake Tahoe by John C. Fremont. Collections made by John Torrey during Fremont's expeditions include the first collections of plants from the Tahoe area (Torrey 1854). While a steady stream of botanists have visited and collected in the Tahoe Basin—starting with William H. Brewer in 1860 and continuing through the 1900's with botanical studies made by Gladys L. Smith who published two floras, many of the collections were made primarily at personal vacation locations, and were not focused on providing a comprehensive floristic survey (Smith 1984). During the Comstock Era (1849-1900), trees in the Lake Tahoe basin were harvested to support mining operations. Only the inaccessible steep slopes of original forest remained untouched. Many of the plants found in early years were not found during the field work for Smith's 1983 flora—apparently now historic occurrences only (Smith 1984). The current plant species diversity may be much lower than it was only 200 years ago.

Management Status of Analyzed Species

As stated in the methodology above, this analysis focuses on TEPCS species at risk of not maintaining viable populations. There are no Threatened, Endangered, or Proposed plant species on the LTBMU. There are two species which are candidates for listing under ESA—whitebark pine and Tahoe yellow

cress (TYC). Candidate species receive no statutory protection under ESA (USFWS 2011); candidate management is dictated by the management direction of the agency upon which the species occurs. However, the USFWS encourages conservation efforts for candidate species because they are, by definition, species that may warrant future protection under the ESA (USFWS 2011). One species—Tahoe yellow cress—is considered endangered by the State of California and critically endangered by the State of Nevada, which provides statutory protection on non-federal lands, but does not influence management on NFS lands.

All 28 species analyzed—including the two Candidate species—are on the Regional Forester's Sensitive Plant Species List (Table 3-23). Forest Service Sensitive species are those plant species identified by a Regional Forester for which population viability is a concern, as evidenced by: (a) significant current or predicted downward trends in population numbers or density; (b) significant current or predicted downward trends in habitat capability that would reduce a species' existing distribution (FSM 2670.5). Under the 1982 Planning Rule, Forest Service requires a review of all activities or programs that are planned, funded, executed, or permitted for possible effects on federally listed or Forest Service sensitive species and develop and implement management practices to ensure that species do not become threatened or endangered because of Forest Service actions (FSM 2672.4). Five of the Sensitive species are also considered Sensitive by TRPA (Table 3-23); TRPA prohibits projects and activities in the vicinity of sensitive plants and their associated habitat that are likely harm, destroy or otherwise jeopardize plants or habitat, unless their significant adverse effects are fully mitigated (TRPA 2012).

There are seven species with no known occurrences—only suitable habitat—on LTBMU and three species known only from historic records (Table 3-24); due to their absence, no species-specific management direction has been developed for these species on LTBMU.

With the exception of whitebark pine, all species with known occurrences on LTBMU are monitored on a 5-year basis with interim annual monitoring of occurrences that exhibit large changes (McKnight and Engelhardt 2012). Long-term monitoring protocols have been developed for four of the five flowering plant species known to occur on LTBMU—Tahoe draba, Cup Lake draba, long-petaled lewisia, Tahoe yellow cress (Pavlik 2002, Engelhardt and Gross 2011b, Engelhardt and Gross 2011a). The fifth flowering species—Galena rock cress—requires further taxonomic study prior to the development of a monitoring strategy. It is difficult to distinguish in the field and often hybridizes with Pioneer rockcress (*Boechera elkoensis*) (Morefield 2002). In Flora of North America and the New Jepson Manual, *A. rigidissima* var. *demota* was synonymized under *Boechera rigidissima* (Al-Shehbaz and Windham 2003, Baldwin et al. 2012). There is an interagency conservation strategy in place for Tahoe yellow cress (Pavlik 2002). There is a range-wide restoration strategy for whitebark pine and a regional conservation strategy and unit-wide mapping effort are both underway (Keane et al. 2012; D. Ikeda pers. comm.). The remaining flowering plants are managed using the general species diversity provisions of the Forest Plan.

Eleven of the species are cryptogams—species that reproduce by spores without flowers or seeds—including four mosses, one lichen, and six ferns. These cryptogams are found primarily in moist to wet places—areas generally bounded by the TRPA SEZ designation. These species are managed using the general species diversity provisions of the Forest Plan, though due to their coincidence in SEZs, their habitat has been shielded from development as well as fuels treatments by the TRPA SEZ guidelines (Tahoe Regional Planning Agency 2012). A long-term monitoring protocol has been developed for broad-nerved hump-moss at Grass Lake Research Natural Area.

Table 3 24. Management Status and Rarity of TEPCS Species

Scientific Name	Common Name	Life form	Legal Status	Global Rarity Rank	State Rarity Rank	CRPR / NNHP Rarity Rank	Occurrences known on LTBMU
Boechera rigidissima (=Arabis rigidissima var. demota)	Galena Creek rock cress	V	R5S	G3T3	S1 / S2	1B.2 / W	5
Boechera tiehmii	Tiehm's rock cress	V	R5S	G2	S2.3 / S1	1B.3 / W	1
Boechera tularensis	Tulare rockcress	V	R5S	G2	S2 / --	1B.3 / --	1 unconfirmed historic record near Emerald Bay
Botrychium spp							
Botrychium ascendens	upswept moonwort	V / C	R5S	G3	S2.3 / S1	2.3 /	6
Botrychium crenulatum	scalloped moonwort	V / C	R5S	G3	S2.2 / S1?	2.2/ W	4
Botrychium lineare	slender moonwort	V / C	R5S	G2?	S1.3 / --	1B.3 / --	Suitable habitat only
Botrychium lunaria	common moonwort	V / C	R5S	G5	S2? / --	2.3 / --	Suitable habitat only
Botrychium minganense	Mingan moonwort	V / C	R5S	G4	S2 / --	2.2/ --	2
Botrychium montanum	western goblin	V / C	R5S	G3	S1.1 / --	2.1 / --	3
Bruchia bolanderi	Bolander's candle moss	V / C	R5S	G3	S3 / S1	2.2 / --	7
Dendrocollybia racemosa[1,2]	branched collybia	F / C	R5S	G2G3	-- / --	-- / --	1 historic record near Tahoe City
Draba asterophora var. asterophora	Tahoe draba	V	R5S; TRPA	G2T2	S2 / S1	1B.2 /	3
Draba asterophora var. macrocarpa	Cup Lake draba	V	R5S; TRPA	G2T1	S1 / --	1B.1 / --	1—includes entire species range
Draba cruciata	Mineral King draba	V	R5S	G2	S2.3 / --	1B.3 / --	1 unconfirmed historic record near Dick's Peak
Erigeron miser	starved daisy	V	R5S	G2	S2.3 / --	1B.3 / --	Suitable habitat only

Scientific Name	Common Name	Life form	Legal Status	Global Rarity Rank	State Rarity Rank	CRPR / NNHP Rarity Rank	Occurrences known on LTBMU
Eriogonum luteolum var. saltuarium	goldencarpet buckwheat	V	R5S	G5T1	S1	1B.2 / --	Suitable habitat only
Eriogonum umbellatum var. torreyanum	Donner Pass buckwheat	V	R5S	G5T2	S2.2 / --	1B / --	Suitable habitat only
Helodium blandowii	Blandow's bog-moss	V / C	R5S	G5	S1.3 / --	2.3 / --	2
Hulsea brevifolia	short-leaved hulsea	V	R5S	G3	S3/ --	1B.2 / --	Suitable habitat only
Ivesia sericoleuca	Plumas ivesia	V	R5S				Suitable habitat only
Lewisia kelloggii ssp. hutchisonii	Kellogg's lewisia	V	R5S	G4T2T3	S2S3 / --	3.3 / --	Suitable habitat only
Lewisia kelloggii ssp. kelloggii	Kellogg's lewisia	V	R5S	G4T2T3	S2S3 / --	3.3 / --	Suitable habitat only
Lewisia longipetala	long-petaled lewisia	V	R5S; TRPA	G2	S2.2 /--	1B.3 / --	5
Meesia uliginosa	broad-nerved hump-moss	B / C	R5S	G4	S2 / --	2.2 / --	2
Orthotrichum praemorsum	orthotrichum moss	B / C	R5S				1
Peltigera gowardii	Goward's water fan	L / C	R5S	G4	S3.2 / --	-- / --	2
Pinus albicaulis	whitebark pine	V	C; R5S	G3G4	-- / --	-- / --	Estimates range from 1,000-20,000 acres
Rorippa subumbellata	Tahoe yellow cress	V	C; R5S; TRPA; CA-E; NV-T	G1	S1 / S2	1B.1 / T	4*

Notes: TEPCS: Threatened, Endangered, Proposed, and Candidate Species
Lifeform: B—Bryophytes; C—Cryptogam; F—Fungi; L—Lichen; V—Vascular plants
Legal status: C—Candidate for federal listing under the Endangered Species Act(US Fish and Wildlife Service 2011b); R5S—Regional Forester's Sensitive Species List, Region 5(USDA Forest Service 2013a); TRPA—Tahoe Regional Planning Commission Sensitive Species(Tahoe Regional Planning Agency 2012); CA-E—Considered endangered by the State of California(State of California Department of Fish and Game 2012); NV—CE—Considered critically endangered by the State of Nevada (State of Nevada 2005)
Global Rarity Rank: G1—Critically Imperiled (At very high risk of extinction due to extreme rarity—often <5 populations, very steep declines, or other factors); G2—Imperiled (At high risk of extinction or elimination due to very restricted range, very few populations, steep declines, or other factors).; G3—Vulnerable (At moderate risk of extinction or elimination due to a restricted range, relatively few populations, recent & widespread declines, or other factors); G4—Apparently Secure (Uncommon but not rare; some cause for long-term concern due to declines or other factors); G5—Secure (widespread & abundant); G#G#(Range Rank)—a numeric range rank (e.g., G2G3) used to indicate the range of uncertainty about the exact status of a taxon or ecosystem type; T# (intraspecific taxon)--status of intraspecific taxa (subspecies or varieties) using same criteria as global rank(NatureServe 2012).

State Rarity Rank: CA: S1—Less than 6 occurrences, less than 1,000 individuals or less than 2,000 acres; S2—6-20 occurrences, 1,000-3,000 individuals or 2,000-10,000 acres; S3—21-80 occurrences, 3,000-10,000 individuals or 10,000-50,000 acres; S4—Apparently secure; S5—Secure. Threat suffixes: 0.1—very threatened; 0.2—threatened; 0.3—no current threats known(California Natural Diversity Database (CNDDB) 2012). NV: S1—Critically Imperiled; S2—Imperiled; S3—Vulnerable; S4—Apparently Secure; S5—Secure; same criteria as global rank(NatureServe 2012).
California Rare Plant Rank (CRPR) Rank: formerly known as "CNPS rank"; 1A—presumed extinct in CA; 1B—Rare or Endangered in CA & elsewhere; 2—Rare or Endangered in CA, but more common elsewhere; 3—Review list (plants that need more information); 4—Watch List (plants of limited distribution). CNPS 1B Threat Suffixes: 0.1—Seriously endangered in CA (over 80% of occurrences threatened / high degree & immediacy of threat); 0.2—Fairly endangered in CA (20-80% occurrences threatened); 0.3—Not very endangered in CA (<20% of occurrences threatened or no current threats known) (California Native Plant Society (CNPS) 2012).
Nevada Native Plant Society (NNPS) Rank: E—Endangered (believed to meet the ESA definition of endangered); M—Marginal/Disjunct (rare &/or possibly distinct, & potentially vulnerable, in the Nevada portion of its range, but much more widespread & secure outside Nevada); PE—Possibly Extirpated (historically native to Nevada, but may no longer survive in the wild); T—Threatened (believed to meet the ESA definition of threatened); W—Watch list species (potentially vulnerable to becoming Threatened or Endangered) (Nevada Natural Heritage Program (NNHP) 2010).
Occurrences on LTBMU: Derived from the Natural Resource Inventory System (NRIS) accessed in June 2013 (USDA Forest Service 2013b). Except for whitebark pine, occurrence delineation follows the California Natural Diversity Database (CNDDB) guidelines.
*Using CNDDB guidelines, there are four TYC occurrences; however, TYC is better described as a single metapopulation with several sites that may or may not be occupied annually based on lake levels(Pavlik 2002).

Threatened, Endangered, Proposed, and Candidate Species

Because the revised Forest Plant presents new management strategies for Threatened, Endangered, Proposed, and Candidate species, they are briefly summarized below. There are no Threatened, Endangered, or Proposed plant species on the LTBMU. Effects will be discussed by habitat type, except for Species Conservation and Habitat Restoration strategies.

Whitebark pine (*Pinus albicaulis*)

This 5-needle white pine has broad distribution at high elevation and timberline zones in California, Idaho, Nevada, Oregon, Washington, Wyoming, Alberta, and British Colombia(NatureServe 2012). In California, whitebark pine has been recorded on National Forest System lands in Six Rivers, Klamath, Modoc, Shasta-Trinity, Lassen, Tahoe, Eldorado, Lake Tahoe Basin Management Unit, Stanislaus, Sierra, Inyo, and Sequoia National Forests. While the species has a broad geographic range, precise information regarding the abundance and distribution of stands is limited.

This species occurs on slopes and ridges near timberline, often with cold windswept exposures, resulting in geographically isolated stands(Arno and Hoff 1989). In the Sierra Nevada and Cascade Ranges of California, whitebark pine often occur as pure or nearly pure stands in the subalpine zone, where it regularly defines the upper tree line and often forms krummholz cushions. This species generally occurs on cryochrept soils—cold-climate soils lacking development—that are moderately to poorly draining, nutrient poor and from granitic or basaltic origins (Fryer 2002). Soils on LTBMU are of andesite, granodiorite, tuff breccia and volcanic origins (Maloney et al. 2012).

There is a high level of uncertainty regarding the abundance and distribution of whitebark pine on LTBMU. Currently, the best available spatial data for estimating LTBMU's whitebark pine abundance and distribution is a combination of the Potential Natural Vegetation (PNV) data in the Terrestrial Ecological Unit Inventory (TEUI) and the Region 5's Existing Vegetation data (EVeg). An assessment of these datasets, the methodology of how estimates were produced, and maps of estimated distribution within the project and botany analysis area are provided in the Biological Evaluation for Threatened, Endangered, Proposed, Candidate, and Sensitive (TEPCS) Plants Species. Estimates of the abundance of whitebark pine on LTBMU range from approximately 1,500 acres to over 24,000 acres (Table 3-25).

Table 3 25. Range of estimated whitebark pine abundance on LTBMU

Data source	Stand type	Acres
EVeg	Whitebark pine—Dominant	1,518
Eveg + TEUI overlap	Whitebark pine—Dominant	5,079
TEUI	Whitebark pine—Dominant	9,877
EVeg	Whitebark pine—Potential	17,791
EVeg + TEUI	Whitebark pine—Potential	24,387

Mortality data collected in multiple studies throughout its range strong suggest that whitebark pine is in range-wide decline (US Fish and Wildlife Service 2011a, Keane et al. 2012). The primary threat to whitebark pine across its range is a synergistic combination of climate change, white pine blister rust (WPBR), periodic mountain pine beetle (MPB) outbreaks and fire exclusion (Millar et al. 2004b, US Fish and Wildlife Service 2011a, Keane et al. 2012). Under conditions resulting from fire exclusion, weakening by WPBR, and climate-related drought events, mountain pine beetle outbreaks can be stand-replacing events that kill 80-95 percent of suitable host trees(Keane et al. 2012). In 2009, whitebark pine on an estimated 2,000,000 acres were killed(US Fish and Wildlife Service 2011a).

When compared to other parts of the range, such as the Rockies, California has experienced relatively low mortality of whitebark pine, potentially due to the lower incidence of WPBR(Dunlap 2010, Millar et al. 2012); however, recent monitoring and research results suggest that this may be changing (Gibson et al. 2008, Forest Health Protection (FHP) 2012). There are isolated stands in California that have experienced stand-replacing mortality events, including areas in the Warner Mountains and the Inyo National Forest (M. MacKenzie, personal communication; C. Millar, personal communication). On LTBMU, one-time demographic data from eight stands indicates relative stability of the whitebark pine population, except near Mt. Rose where stands may be in decline (Maloney et al. 2012). While native bark beetles are present, the primary threat to whitebark pine on LTBMU is non-native white pine blister rust. Since its detection in the 1920's, the pathogen has caused unprecedented decline and mortality in white pines--including whitebark—across the West(Aubry et al. 2008). On LTBMU, whitebark pine stands on the north shore exhibit the highest WBPR (>60%) and the south shore has the lowest WPBR incident (1-20%) (Maloney et al. 2012).

Compared to other TEPCS plants in the Sierra Nevada, analysis and management of the effects to whitebark pine presents distinctive challenges. Most other TEPCS species are not so widely distributed—both within and among NFS units—and most TEPCS populations consist of relatively isolated occurrences, rather than multi-acre stands. Maintenance of viability these types of populations can often, though not always, be effectively managed through avoidance of occurrences during management activities using tactics such as control area and "flag-and-avoid" guidance. However, for certain management activities on LTBMU—especially those associated with high elevation portions of ski areas, it is infeasible to avoid entire whitebark pine stands due to its widespread distribution, its large physical size, and its relatively large average stand size. The long life span of whitebark pine presents additional challenges for management. Cones are first produced at 20-30 years of age on good sites, but on most sites, trees do not reach full cone production until 60 to 100 years of age (McCaughey and Tomback 2001). Therefore, direct and indirect impacts to whitebark pine stands may have relatively long-term effects on the stand's viability.

In addition, the majority of whitebark pine management guidance and strategic planning is focused on protecting and restoring lands with high white pine blister rust mortality, high mountain pine beetle

mortality, or high fire danger (e.g.(Aubry et al. 2008, Greater Yellowstone Coordinating Committee Whitebark Pine Subcommittee (GYCC) 2011, Keane et al. 2012)). The conceptual models used to produce strategies for heavily pathogen-infested populations do not adequately address management of relatively uninfested populations, such as the LTBMU's, and, for the most part, other populations throughout the Sierra Nevada.

Tahoe yellow cress (*Rorippa subumbellata*)

This perennial forb is endemic to the shore zone of Lake Tahoe. It is typically found in back beach areas between elevations of 6,233 to 6,230 ft. Occurrences of Tahoe yellow cress fluctuate with lake water levels, which are related to dam regulation and climate. Besides high water levels, which reduce available habitat, potential threats include development, pier construction, and trampling from increasing recreational use on the beaches. During low lake levels of drought years, the population can swell substantially; 20,000 plants were counted in 2002, the second year of below normal precipitation. However, during high water years, many of the large-numbered populations are underwater and only small populations exist above water; in 2009, only 24 occurrences were located. The Conservation Strategy (2002) set the minimum number of population sites thought to be necessary to sustain Tahoe yellowcress at 26.

The Conservation Strategy for Tahoe Yellow Cress and its implementation provide a framework for the adaptive management of Tahoe yellow cress. The Conservation Strategy outlines goals to protect, improve, promote, and monitor the species with the intent to preclude federal listing of the species by full implementation of the Strategy. The Strategy also includes instructions on when to perform annual surveys around the Lake—a data set that has been collected since 1979. In the current Forest Plan, Tahoe yellow cress is managed through a “threshold” concept that mandates a preserving a minimum number of TYC-occupied sites.

R5 Sensitive Species

Because the discussion of effects to R5 Sensitive species will be aggregated by habitat type, narrative descriptions of the remaining 26 R5 Sensitive Species known to occur or have suitable habitat on LTBMU are reserved for the revised Forest Plan FEIS's Biological Evaluation for Threatened, Endangered, Proposed, Candidate, and Sensitive (TEPCS) Plants Species.

Habitat condition

Below is a brief summary of habitat conditions that are particularly important for considering the effects to TEPCS plant species. An extensive description of the current condition of the various forest types included in General Forest can be found in the FEIS Forest Vegetation Specialist Report, an extensive description of the current condition of fire and fuels can be found in the Fire and Fuels Section of Chapter 3, and an extensive assessment of how climate change may impact forest planning and how forest planning may impact climate change can be found in the Climate Change section of Chapter 3.

Across all habitat types, there are changes in temperature, precipitation, and fire behavior associated with climate change that are likely to impact TEPCS species. Mean annual temperature has risen by about two degrees Fahrenheit and precipitation has increased during the last century in the Lake Tahoe Basin (Safford 2010). Overall, there appears to be a strong upward trend in air and lake temperature, rainfall intensity, a shift from snow to rain, earlier seasonal snowmelt events, and increased inter-annual variability in the Lake Tahoe Basin (Coats 2010). Since the 1980's, the Sierra Nevada has been experiencing an increase in frequency and severity of forest fires, with increases in the mean and maximum fire size, total burned area, and fire severity (Westerling et al. 2006, Miller et al. 2009); in general, forest fire increases are attributed to the interaction between climate change and increased fuel loading (Flannigan et al. 2000, Miller et al. 2009).

Both latitudinal and altitudinal range shifts for plants have been documented and attributed to temperature changes associated with climate change (Walther et al. 2005, Parmesan 2006, Lenoir et al. 2008). Lenoir et al. (2008) found that two-thirds of the species they investigated in the Alps shifted up in elevation, with larger shifts in distribution for alpine species and species with faster life cycles. Changes in water availability may play a crucial role in vegetation shifts in California's Mediterranean climate. In a study of 64 plant species in California, climate changes have resulted in a significant downward shift in species' optimum elevations tracking regional changes in climatic water balance rather than temperature (Crimmins et al. 2011). Furthermore, individual species will respond differently to changing climate (Parmesan 2006, Hawkins et al. 2008); this may result in the formation of novel vegetation communities. This illustrated that climate-related changes can interact in a variety of unusual ways that influence vegetation. Anticipating future effects of changing climate to ecosystems will be challenging, since climate projections are inherently uncertain and climate-related stressors are variable and complex.

Even though the type, scope, and duration of climate-related effects are not yet well understood, climate change is still predicted to become a major threat to biodiversity in the 21st century (Dawson et al. 2011). Models of future plant distributions indicate that anywhere from a tenth to fully one-half of all terrestrial plants species will be threatened with extinction as a result of climate change (Thomas et al. 2004, Hawkins et al. 2008). An assessment of California's plant taxa under four different climate models suggests that over two-thirds of California plant species are expected to experience range reductions of more than 80% over the next century (Loarie et al. 2008). Many of the factors that have made at-risk species currently vulnerable to extinction—such as a small geographic range, ecological niche, or elevation gradient—are likely to be exacerbated in a changing climate.

General Forest

The primary factors affecting forest conditions in the Lake Tahoe Basin remain the Comstock era logging that removed most of the Jeffrey pine forest in the late 19th century and the exclusion of fire for more than 100 years (see Forest Vegetation section of Chapter 3). Analysis of forest structure and fire scars in the Lake Tahoe Basin suggest that its contemporary forests have more and smaller trees, more basal area, less structural variability, and trees with a more clumped spatial distribution than presettlement forests (Taylor 2004). Likewise, forests in the Lake Tahoe Basin are severely departed from historic fire conditions, with over 90% of the Basin characterized as moderately or severely departed from historic fire return intervals (i.e., expected number of years between fires) and 98% of its land area not experiencing any fire since 1910 (see Fire and Fuels section of Chapter 3). Higher stand densities have resulted in higher risk of bark beetle and fire mortality. While late-seral old-growth stands did not likely represent a large portion of the presettlement vegetation in the Lake Tahoe Basin, their extent has decreased and they have denser understories, more firs and incense cedar, and a higher incidence of pathogens (Manley 2004). This has resulted in a higher than expected quantity of mid-seral stands, with white and red fir—shade tolerant, low fire-tolerant conifers—dominating large areas that might otherwise be dominated by pines (see Forest Vegetation section of Chapter 3). The dense, homogenous and simplified structure of forests in the Lake Tahoe Basin has likely reduced the potential to support diverse species assemblages. As a result, there is likely less suitable habitat for both early seral plant species—such as Galena Creek rock cress—and late-seral species—such as branch collybia.

Subalpine

Subalpine forests in the Lake Tahoe Basin do not exhibit as severe a departure from historic conditions as forests at its lower elevations, though there are emerging risks for these habitats. There has been virtually no entry for logging (Manley et al. 2000). Modern stand composition was indistinguishable from historical composition, though there has been a noted increase is small diameter trees (Dolanc et al. 2013). The fire return interval is so long—estimated at 400 years—that a century of fire suppression has not yet missed a single fire cycle (see Fire and Fuels section of Chapter 3).

Subalpine and mountaintop communities are considered at particular risk to climate change. Because of the physical limitations for range shifts, species already restricted to the tops of peaks have no space to migrate upward (Hawkins et al. 2008). Mountain top species are also at risk of displacement by plants from lower elevations that shift upwards in response to higher temperatures (Walther et al. 2005). Furthermore, in the past decade, select subalpine forest stands in the Sierra Nevada have been severely affected by mountain pine beetle outbreaks with increased mortality attributed to extended drought conditions associated with climate change (Millar et al. 2004a, Forest Health Protection (FHP) 2012).

Aspen

In the Lake Tahoe Watershed Assessment, aspen forest types were prioritized as one of nine Ecologically Significant Areas due to their high associated biological diversity and rarity on the landscape ((Manley et al. 2000). Plant diversity associated with aspen stands is often substantially higher than other surrounding forest types (Kuhn et al. 2011, McCullough et al. 2013). While it is likely that aspens stands have consistently represented only a very small portion of the land area of the Lake Tahoe Basin, their extent may also be restrict by advancing conifer succession (Shepperd et al. 2006). Aspen stands rely upon moderate disturbance (e.g., wildfire, avalanches) to create forest openings with sufficient sunlight for suckers to grow; eventually more stand tolerant trees—namely conifers in the Sierra—colonize the stands and begin to overtop the aspen, leading to their eventual decline and also severely limit the possibility of aspen suckering (Shepperd et al. 2006). Due to the high level of development in the Lake Tahoe Basin, there are limited tools for attaining the necessary level of disturbance (Shepperd et al. 2006) .

Meadows

Past land use and recurrent droughts have impaired natural function and processes of many meadows in the Lake Tahoe Basin. Approximately half of the Basin's meadows have been permanently lost, fragmented, or altered (Manley et al. 2010). Urbanization in the mid- to late-20th century resulted in the filling and nearly permanent alteration of critical wet meadows and marshes; the Tahoe Keys development, for example, filled, fragmented, and highly altered 750 contiguous acres of the once intact Rowland's Marsh (Manley et al. 2000). Although grazing is no longer prevalent in meadows in the Lake Tahoe Basin, there are often substantial legacies—in particular, altered species composition and altered hydrology—in areas formerly open to grazing in the Sierra Nevada (Dull 1999). Ongoing recreation activities represent a substantial threat to meadows through soil compaction, erosion, muddiness, loss of vegetative groundcover and changes in species composition (Leung and Marion 1999). Furthermore, certain meadow types—namely high elevation or alpine meadows—have extremely low resource recovery rates, requiring long periods to recover from even limited degradation (Leung and Marion 1999). There is also concern that conifer encroachment—mainly from lodgepole pine—and non-native species invasion may impact meadow species diversity in the Sierra Nevada (Manley et al. 2010, California Invasive Plant Council 2011, McCullough et al. 2013). Montane meadows have been identified as one of the most vulnerable and impacted habitat types of the Sierra Nevada, and meadow ecosystems are an important focus area for restoration efforts in the Lake Tahoe Basin.

Montane Riparian

Many of the forested SEZs in the Lake Tahoe Basin—which includes the montane riparian areas—are currently overstocked with small diameter trees and have increased fuel loads as a result of fire suppression activities. Furthermore, because SEZs were frequently avoided during fuels treatments over the past several decades, overstock may have been exacerbated. Similar to meadows, montane riparian areas have been degraded by decades of grazing and recreation (Manley et al. 2000); associated impacts include water diversion, water storage structures, denudation of vegetation, and erosion. Concerns over the clarity and water quality of Lake Tahoe have made SEZs a focus area for restoration activities (see Water Quality section of Chapter 3).

Shoreline

Most shorelines along large lakes in the Lake Tahoe Basin have been extensively developed as recreation sites (Pavlik 2002). Few shorelines—especially sandy shores that are the primary habitat for Tahoe yellow cress—remain undeveloped and available for use as habitat.

Rocky habitats

In general, rocky habitats have not been the focus of intensive management activities, such as timber harvesting, grazing, or recreation. Most remain relatively undisturbed, though some areas—especially popular mountain tops and trailside areas—have been denuded by visitor use.

Vulnerability of Analyzed Species

While rarity by itself does not indicate a species risk of extinction, it is often related to a species vulnerability to extirpation or extinction, given that many of the factors attributing to a species rarity—such as uncommon habitat, limited dispersal mechanisms, highly specialized pollination syndromes—may be disrupted by small changes resulting in vulnerability. Except for whitebark pine, the species analyzed fall into three general categories of rarity: a) plants restricted to uncommon habitats; b) plants with narrow geographic ranges; and c) plants that have broad distribution in more common habitats, but are seldom seen or occur in such low numbers as to be considered rare. Whitebark pine doesn't fit these categories, as it is widely distributed across Western North American mountain ranges. It is considered at risk due to an idiosyncratic combination of climate change, fire suppression and pathogen outbreak, mainly in the Rocky Mountain sections of its range (US Fish and Wildlife Service 2011a, Keane et al. 2012). Species with uncommon habitats include climatic relics—species that require habitat conditions that are no longer prevalent due to changes in climate—such as long-petaled lewisia—as well as plants occur only in highly restricted habitats that are of a more recent origin and may never become common. The majority of the species analyzed fall into this category: long-petaled lewisia; all of the species associated with wet habitats—aspens, meadows, riparian area; Tahoe yellow cress which is restricted to the shoreline of Lake Tahoe; and Tahoe draba and Cup Lake draba which are found only above 8,000ft on rocky or gravelly slopes (Halford and Nowak 1996, Pavlik 2002). These plants have specific needs met by a unique combination of habitat factors not often duplicated and which are highly vulnerable to changes in environmental conditions. Plants with a narrow geographic range—such as Galena rock cress, Tiehm's rock cress, and *Orthotrichum praemorsum*—are less vulnerable to small changes in environmental conditions, but are vulnerable to regional climatic changes. For plants that have broad distribution in more common habitats, but are seldom seen or occur in such low numbers as to be considered rare, such as moonworts or Goward's water fan, the reasons for their rarity are not clearly evident, though uncommon reproductive strategies may play a role in limiting occurrence size (Peterson 2010, Farrar 2011).

The primary threat to biodiversity across North America is habitat destruction and degradation (Wilcove et al. 1998). Activities that can destroy and degrade habitat include but not limited to: utility, road, facility, and home construction and maintenance; motorized vehicle use; livestock grazing; mining; timber management; fire suppression; and non-motorized recreation such as camping, hiking, biking, and horseback riding. While several of these activities are considered under the revised Forest Plan, they can also occur on adjacent lands that are not subject to Forest Service management direction. As such, they may increase the risk of endangerment for TEPCS plants on NFS lands.

Nearly all 28 species have experienced a loss or degradation of habitat to human development or anthropogenic interventions, such as fire suppression, though the degree of habitat alteration varies substantially. Among the highest impacted, Tahoe yellow cress habitat has been severely reduced by recreation and residential development along the shoreline of Lake Tahoe (Pavlik 2002). Conversely, there has been relatively minimal habitat loss for the subalpine and mountain top species found

predominantly in wilderness areas, such as the lewisias, the drabas, Tiem's rock cress, and Donner Pass buckwheat. While some anthropogenic habitat degradation is irreversible (e.g., shoreline home and pier construction), the effects of some anthropogenic stressors—such as fire suppression or invasive species introduction—may be reversed or reduced through active conservation and restoration.

In addition to habitat alteration, climate change presents risks to already vulnerable species. If conditions for pollinators do not keep pace with those for their host plants, there may be a disruption in synchrony between plants and pollinators, leading to further species declines across the food chain (Hawkins et al. 2008). Decline of certain key species (e.g., canopy species, pollinators) may trigger a cascade effect of local extinctions among associated species and could lead to larger changes in ecosystems. In the face of changing environmental conditions, plants have two options—migrate to more suitable habitat or adapt to new conditions. Species with fast generation times and wide ecological tolerances—traits often associated with early-seral and invasive species—are more likely to survive than species with specific habitat requirements or long generation times (Hawkins et al. 2008, Willis et al. 2010). Rare species often have small ecological tolerances, which suggest these species may be less successful in adapting to climate change.

3.4.4.3 Environmental Consequences

Species Conservation Strategies

If the general species and habitat guidance provided in the LRMP is considered sufficient to maintain viability, then the species is considered secure and was not addressed specifically in the EIS. If the general guidance was considered insufficient, then the species was considered not secure and species specific management direction guidance was developed. This process is outlined more extensive in Appendix E—Species Diversity. Tahoe yellow cress and whitebark pine were the only species considered not secure and species-specific conservation strategies for each species were incorporated into the revised Forest Plan.

Under Alternative A, the current Forest Plan addresses species conservation through a threshold concept—mandating a minimum number of sites is preserved for each species. In the action alternatives (B, C, D, and E), species conservation is managed through a species conservation area (SCA) concept—conserving and enhancing suitable habitat for species, albeit currently occupied or not (e.g., Special Status Species Habitat Areas). This shift in focus allows greater flexibility for managing species in changing climate conditions as it is not tied to a specific number or location of TEPCS occurrences, but rather to the provision of suitable habitat which offers greater opportunities for species to migrate as necessary. For a species like Tahoe yellow cress, in which the extirpation of certain occurrences and creation of new occurrences is an expected result of the species metapopulation dynamics, the establishment of Special Status Species Habitat Areas again provides a greater ability to adapt with changing conditions. As such, the action alternatives represent a more adaptive and active approach to species conservation.

The current Forest Plan (Alternative A) does not provide a species-specific strategy for whitebark pine. In Alternative B, C, and D, whitebark pine is addressed as a component of the subalpine forest, but the strategy, objectives, and design features do not specifically address the threats that have bought whitebark pine under consideration for listing under ESA—namely climate change, fuels management, white pine blister rust, and mountain pine beetle. Alternative E provides a more comprehensive strategy for whitebark pine conservation, including: development of a unit-wide conservation strategy, a proactive approach to managing whitebark pine stands of high conservation or restoration priority to improve resilience after disturbance and resistance to pathogens, assessment of management activities for the risk of establishment or spread of white pine blister rust (WPBR) among whitebark pine stands, and conservation of whitebark pine genetic diversity. As such, Alternative E represents a more adaptive and active approach to whitebark pine conservation.

Alternatives A, B, C, and E allow for an active restoration approach to whereas Alterative D relies on natural processes. This has implications for invasive plant management (discussed in the Invasive Plants Section), habitat restoration, and species conservation. For many species, past management activities have altered or reduced their habitat so substantial that conservation—or eventually recovery—is unlikely without active interventions, such as out planting, habitat improvement, habitat recovery, invasive plant control, or protection from ongoing managed activities (e.g., beach recreation near Tahoe yellow cress occurrences). As such, Alternatives A, B, C, and E are more likely to promote species conservation.

Vegetation Management

Vegetation management across all alternatives focuses on fuels reduction, early seral forest creation, type conversion (fir to Jeffrey pine and mixed conifer), and stand resiliency. Treatments are focused in the Wildland Urban Interface (WUI) for the first ten years of the Forest Plan. Across all habitat types, under all of the alternatives, there are risks associated with vegetation management for the introduction and spread of invasive plants; these risks are outlined in the Invasive Plants section. Invasive plants are the second leading cause of species decline and extinction in North America (Wilcove 1999). Across treatment types, vegetation management present risks of trampling TEPCS plants resulting in reduced vigor or mortality; these risks are greater with mechanical treatments that utilize heavy equipment. Indirectly, vegetation treatments can have substantial effects on TEPCS habitat: they can remove desirable vegetation and compact soil, degrading suitable habitat; enhance suitable habitat for early seral species; or protect suitable habitat from high severity fire in areas with excessive fuel loads.

Across all habitat types under all alternatives, fire—prescribed, managed, or wild—can destroy TEPCS plants and suitable habitat, though the alternatives differ in how much they are predicted to modify fire behavior. Prescribed and managed fires are expected to be of lower intensity and severity than wildfires. High intensity and high severity fires present a greater risk to TEPCS species for several reasons: greater likelihood of fatal damage to TEPCS plants; greater risk of habitat destruction; longer timeframe to suitable habitat recovery due to canopy plant mortality, burning of soil organic material, post-fire erosion; and larger fires and unplanned ignitions may affect greater range of habitats that would not carry smaller intensity fires—rocky habitats, aspens, meadows, riparian areas, subalpine areas. Within the WUI, all alternatives allow for comparable rates of thinning and burning treatments to modify fire behavior. Outside the WUI, Alternative C would provide the most treated acres followed by Alternatives A, B, and E, and Alternative D would provide the least. Alternative D would have the greatest potential for habitat and plant loss from high severity wildfire.

General Forest

Because vegetation treatments are focused in the general forest type, they would have the greatest impact on TEPCS plants dependent on these habitats. Alternatives A, B, C, and E allow for active management of the general forest; this is likely to reduce fuel loads and increase resiliency after fire, potentially benefitting TEPCS species with a low to moderate fire tolerance. In alternative C, there is the potential for more and faster conversion of mid-seral stages to early-seral stages; this would also occur in Alternatives B and E but at a slower rate. Alternatives B, C, and E promote a more diverse forest structure, creating a greater diversity of microhabitats, which could potentially benefit a greater diversity of species. Alternative C would likely involve the least amount of repeated treatments in the same area, which may reduce the direct risks to plants as well as indirect risk to habitat. Alternatives A and D provide more focus on late seral forest structure—through active management or natural processes, respectively—and may provide more habitat for TEPCS species reliant upon this habitat type, such as branched collybia.

Subalpine

Alternative A does not focus vegetation management in this habitat type and would have little to no effect on the associated species. Alternatives B, C, and E would allow vegetation management in subalpine areas, including prescribed fire, thinning for fuels reduction, and active conservation treatments to benefit whitebark pine (e.g., thinning, pathogen treatment, planting of blister rust resistant whitebark pine); during the life of the Forest Plan, Alternative C is expected to treat the most acres of subalpine forest. These proposed actions would likely improve the health and resilience of whitebark pine stands. Indirectly, improvements to whitebark pine stands—a major component of subalpine vegetation—may also improve habitat for other subalpine TEPCS plants. In Alternative D, there would be decreased emphasis on mechanical thinning and a limitation on cutting trees for forest health objectives; instead the preferred tools for vegetation management would be underburning and management of natural ignitions. This may increase the timeframe required to meet forest health desired conditions, including desired conditions for whitebark pine.

Aspen

All alternatives allow for the implementation of aspen community restoration projects. After these initial treatments are completed, the alternatives will differ in their approach to aspen restoration. Alternatives A, B, C, and E would continue to actively restore communities, with Alternative C would treat more acres than Alternatives A, B, or E; these alternatives would likely provide the greatest benefit to aspen communities and their TEPCS associates. Alternative D would allow natural process to drive aspen restoration. Given the shift in species composition towards conifers and the increased fuel load that has accumulated from years of fire suppression, untreated aspen stands—and the TEPCS plants that depend upon this habitat type—may be more susceptible to high severity fires. In high severity fires where the litter layer is more likely to be consumed, moonworts in particular are more likely to perish; moonwort spores are generally concentrated in the litter layer and require appreciable moisture at the soil surface—often held in the litter layer—for sexual reproduction (Farrar and Johnsongroh 1990, Farrar 2011). Furthermore, given the legacy of effects associated with fire suppression—conifer encroachment and increased fuel loads are likely to persist without active interventions— passive restoration may be insufficient to sustain the quantity and distribution of aspen communities necessary to support viable populations of aspen-dwelling species.

Meadows

Vegetation treatments prescribed in Alternatives A, B, C, and E would allow for treatment of conifers encroaching in meadows. If more meadows are maintained, this would likely provide more habitats for meadow-associated TEPCS plants. In Alternative D, conifers would be allowed to encroach upon meadow habitats, potentially decreasing habitat for meadow-associated TEPCS plants.

Montane Riparian

Vegetation treatments would likely have minimal effect on montane riparian habitats because design criteria targeted at protecting SEZs would encompass these habitats; SEZ design criteria are similar across all alternatives.

Shorelines

Vegetation treatments are not expected to occur along the shorelines and would therefore have minimal effect on this habitat type and its associated TEPCS plants.

Rocky Habitats

Vegetation treatments are not expected to occur—in fact they are often infeasible—in rocky habitat and would have minimal effect on this habitat type and its associated TEPCS plants.

Watershed and Aquatic Habitat Restoration

General Forest

Watershed and aquatic habitat restoration is not focused on this habitat type and would have little to no effect on the associated TEPCS species.

Subalpine Forest

Watershed and aquatic habitat restoration is not focused on this habitat type and would have little to no effect on the associated TEPCS species.

Aspen

A critical component of improving conditions in Lake Tahoe watersheds is implementation of watershed and aquatic habitat restoration, in particular stream channel restoration projects. Watershed and aquatic habitat restoration is geographically focused in SEZs—which includes some portions of wet aspen stands—and has substantial potential to affect aspen-associated TEPCS species. Under current conditions, some stream channels exhibit unstable channel banks and have eroded and incised to the point that they are no longer hydrologically connected to adjacent floodplains. Restoration projects currently in progress would be implemented under all of the alternatives and would address the bulk of the unstable channel reaches that have been identified on NFS lands in the Lake Tahoe Basin; these projects are expected to be completed within the next 15 years.

Beyond the currently planned restoration projects, under Alternatives A, B, and C, and E, LTBMU would continue planning for implementation of both large and small scale restoration projects to remove existing active stressors in degraded stream channels (e.g., poorly designed stream channel crossings, hydrologic diversions) and address systems that are out of equilibrium—as exhibited by headcuts, incision, accelerated bank erosion—as a result of past land use practices, climate change or other stressors not under the control of the USFS management. Under Alternative D, future projects would not be planned to actively restore degraded stream channels and systems that are out of equilibrium would be allowed to adjust through natural processes. As a result, it may take several decades longer to achieve geomorphic equilibrium and subsequent improvement to suitable habitat for TEPCS plant species.

Watershed and aquatic habitat restoration can involve substantial ground disturbance. While all alternatives provide design criteria targeted at minimizing impacts to TEPCS from ground disturbance, there may be sub-lethal damage or mortality of individual TEPCS plants or degradation of habitat as a result of activities associated with restoration. Conversely, since these activities are targeted at improving aquatic habitat or stream function, they are likely to benefit TEPCS plants through the provision of more and/or higher quality aspen habitat in the long term. Because the revised Forest Plan does not authorize site-specific activities, it is difficult to evaluate the magnitude of the risks and benefits associated with watershed and aquatic habitat restoration on any given TEPCS plant occurrence or a given species in total.

Alternative A would continue to provide for watershed and aquatic habitat restoration, but with the emphasis on water quality. Alternatives B, C, and E would likely provide the greatest benefit to aspen habitats because they allow for active restoration emphasizing aquatic habitat improvement, but they would also present risks associated with ground-disturbance. Alternative D would likely be the least beneficial because no further watershed or aquatic habitat restoration would occur after current projects are implemented; if natural processes are allowed to drive restoration, the timeframe to achieve high quality habitat may likely be extended beyond the life of this Forest Plan, which could negatively affect TEPCS through the long-term persistence of marginal/lower quality habitat.

Meadows

Watershed and aquatic habitat restoration is geographically focused in SEZs—which includes most meadows—and has substantial potential to affect meadow-associated TEPCS species. The effects to meadow habitat are expected to be the similar to those for aspen stands, which are discussed above.

Montane Riparian

Watershed and aquatic habitat restoration is geographically focused in SEZs—which includes almost all montane riparian habitat—and has substantial potential to affect riparian-dependent TEPCS species. The effects to riparian habitat are expected to be the similar to those for aspen stand, which are discussed above.

Shorelines

While watershed and aquatic habitat restoration is not focused in this habitat type, there may be opportunities for restoration associated with lagoons, back bays, or riparian areas that extend to the water edge. In these select cases, effects to shoreline habitat are expected to be the similar to those for aspen stands, which are discussed above.

Rocky Habitats

Watershed and aquatic habitat restoration is not focused on this habitat type and would have little to no effect on the associated TEPCS species.

Recreation / Access and Travel Management

Recreation use levels are expected to increase under all alternatives. Increased visitor use can increase the risk of direct and indirect effects to TEPCS plants species. Visitors may trample plants resulting in reduced reproductive potential or mortality (Liddle 1991). They may collect TEPCS plant, intentionally for collections or incidentally (Schemske et al. 1994). There are also substantial indirect effects from increase visitor use—namely the degradation of suitable habitat. Visitors may trample vegetation associated with TEPCS habitat. Creation of unauthorized trails by cyclists and OHV riders results in compacted surfaces that are highly susceptible to erosion because they are not designed to control runoff. Visitors can create new use trails that cut through meadows, altering meadow and fen hydrology(Leung and Marion 1999).

In addition to increased visitor use, the proposed recreation site expansion also presents risks to TEPCS plants. Recreation site development may result in destruction of some individual plants. There are also substantial indirect effects from recreation expansion including, but not limited to, destruction of habitat during facility construction; degradation of suitable habitat through reduced vegetation cover, soil compaction, and increased erosion from increased foot and vehicle traffic. Across all habitat types, under all of the alternatives, there are also substantial risks for the introduction and spread of invasive plants associated with recreation; these risks are outlined in the Invasive Plants section of Chapter 3. The location of recreation sites as well as the intensity of their use can substantially influence the amount of associated damage and disturbance. But since the revised Forest Plan does not provide specific locations for recreation expansion, there is a relatively high level of uncertainty regarding the risk associated with new recreation sites.

Alternatives A, B, and C would allow for recreation expansion up to 10%, 5%, 15%, respectively, whereas Alternative D would allow up to a 15% reduction. Alternative E would allow a 5% increase in developed site acres, day use parking, and ski area operational footprint acres, and a 10% increase in overnight accommodation units. Therefore, Alterative C presents the highest risk to TEPCS plants and habitat associated with recreation, whereas Alternative D presents the lowest risk, and Alternatives A, B, and E are relatively comparable.

Across habitat types, designation of wilderness could afford TEPCS species that occur within them additional protection from disturbance by drastically restricting the type of allowed management activities; this can be highly beneficial to species conservation. Designation of the backcountry land management area would offer similar protection from disturbance, since permanent roads would not be a suitable use and management activities to support administration and dispersed camping would be minimal. The Dardanelles and Freel Peak areas have not been extensively floristically inventoried; there could be additional suitable habitat for TEPCS. However, because wilderness designation restricts the available management techniques allowed in the designated area, it may also slow species conservation actions. For example, if thinning is needed to increase the resistance of a high priority whitebark pine stand to mountain pine beetle and the stand is in wilderness, power tools cannot be utilized without the Regional Forester's consent. This could substantial delay or even halt treatment; in the interim, plants or habitat may be adversely affected. Alternative D allows for the largest area of potential wilderness designation, followed by Alternative C and then Alternatives A, B, and E. However, in Alternative E, the total amount of backcountry is comparable to the amount of proposed wilderness. The number of TEPCS occurrences known within the proposed backcountry plus proposed wilderness is comparable across alternatives, with 117 known occurrences received additional protection in Alternatives A, B, C, and E and 124 known occurrences in the Alternative D.

None of the alternatives propose a programmatic expansion of the LTBMU's road system. However, the alternatives differ in the quantity and type of trails allowed. In terms of hiking and equestrian trails, Alternatives C allows for the least miles, while Alternative A, B, D, and E all allow more in equal quantity. For mechanized trails, Alternatives A, B, and E allow for the most miles, followed by Alternative C, with Alternative D having the least amount of mechanized trails. For motorized trails, Alternatives D allows for the most trails while Alternative A, B, C, and E all allow less in equal quantity. The location of access routes can substantially influence their potential for damage and disturbance. For example, routes located upstream of fens may divert water, alter fen hydrology, and the area may no longer support fen-associated TEPCS plants. Many potential impacts to TEPCS species can be controlled through design features, but some may be associated with dispersed recreation or unauthorized trail development which is difficult to preempt. Since the revised Forest Plan does not provide specific locations for added access routes, there is a relatively high level of uncertainty regarding the risk these new routes present.

Over snow recreation is a component of all alternatives. In general, TEPCS are both spatially and temporally shielded from direct effects from over snow recreation by current management direction specifying required snow depths and limiting season of use. However, TEPCS may be affected indirectly if over snow activities result in changes to soil productivity or hydrology substantial enough to degrade suitable habitat. Over-snow recreation can compact snow and increase spring runoff. Potential expansion of the season of use earlier into spring or later into fall would increase the potential for direct plant damage as well as indirect habitat alteration. However, as outlined in the Soils and Water Quality and Water Quantity sections of Chapter 3, effects from over snow recreation are likely to be minimal—without substantial variation by alternative—and therefore do not present a substantial risk to TEPCS plants.

General Forest

The effects to general forest habitat types are expected to be similar to those described in the general discussion of recreation effects provided above.

Subalpine

Ski resort expansion presents the greatest risk to TECPS plants found in subalpine areas of all proposed activities. There are few other proposed activities with as great a potential to directly impact subalpine TEPCS plants. While over snow recreation is not likely to directly affect plants, the construction of ski

runs, ski lifts, and summer use facilities can result in considerable damage and destruction of plants. The expansion of the season of use to include more summer activities increases the risk of direct effects, as summer visitors may trample or collect TECPS plants whereas winter visitors are both temporally and spatially distanced from TECPS plants (other than whitebark pine) Indirect adverse effects to their suitable habitat can also occur through habitat degradation or destruction. These effects are compounded by the potential effects of climate change. Subalpine species are probably the most susceptible to habitat loss through climate change, as some species have a narrow elevation range, situated at the top of the Sierra Crest. There is no place for these species to migrate, if their habitat is reduced by upslope shifts in vegetation or changes in water availability. At particular risk are Tahoe draba, Galena rock cress, and whitebark pine, which have documented occurrences on and near the operational footprints of LTBMU's ski resorts. Alternatives A would allow for the most expansion—an almost two-fold increase above the other alternative. Of the action alternative, Alternative C allows for more expansion than Alternatives B and E, while Alternative D would not allow any new ski area development. As such, Alternative A presents the greatest risk, while Alternative D presents the lowest risk.

Aspen

The effects to aspen habitat types are expected to be similar to those described in the general discussion of recreation effects provided above.

Meadows

Because their hydrology is highly susceptible to erosion, meadow habitats are at the greatest risk from dispersed recreation. The types of impacts generated from dispersed recreation activities will be similar in all alternatives but the intensity can vary with increased visitation. More access—as measured by miles of trails—will create more opportunities for dispersed activities. In terms of hiking and equestrian trails, Alternatives C allows for the least miles, while Alternative A, B, D, and E all allow more in equal quantity. For mechanized trails, Alternatives A, B, and E allow for the most miles, followed by Alternative C, with Alternative D having the least amount of mechanized trails. For motorized trails, Alternatives D allows for the most trails while Alternative A, B, C, and E all allow less in equal quantity. Because Alternatives A, B, and E allow for the most amount of trails and therefore the higher likelihood of dispersed recreation, they present a higher risk to TEPCS plants associated meadow habitat.

Montane Riparian

The effects to montane riparian habitat types are expected to be similar to those described in the general discussion of recreation effects provided above.

Shorelines

The shoreline habitat type would be impacted by beach going activities, for the most part trampling. There would be no difference among the alternatives for dispersed recreation. Alternative C would allow the most expansion of developed recreation and would therefore negatively impact species in this habitat type. Alternative A would not change the amount of recreation currently allowed in this habitat type. TEPCS species locations would be protected, but conflicts with developed recreation areas would still occur. Alternatives B and E would allow expansion of developed recreation sites but included standards and guides to protect TEPCS species and their suitable habitat. Alternative D would not allow any further recreation development and so would have the least amount of affects to this habitat type.

Rocky Habitats

The effects to General forest habitat types are expected to be similar to those described in the general discussion of recreation effects provided above.

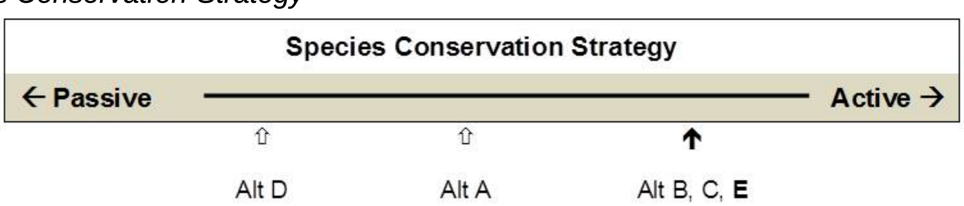
3.4.4.4. Analytical Conclusions

Table 3 26. Comparison of Consequences by Alternative, Threatened or Endangered Plant Species

	Alt. A	Alt. B	Alt. C	Alt. D	Alt. E
Trend in abundance (TYC only) **Trend in habitat condition**	Stable or increasing abundance and similar or improving habitat condition due to active management of occurrences and habitat (restoration, invasive species treatment).	Similar to Alternative A. Compared to Alt C, potentially greater abundance and more high quality habitat due to less recreation development.	Stable or decreasing abundance and stable or decreasing habitat condition due to the most amount of recreation development of all alternatives (higher risk of trampling and/or, habitat degradation; increased vectors for invasive plants).	Stable or decreasing abundance and stable or decreasing habitat condition due to no active habitat restoration and less invasive plant treatment	Similar to Alternative B.
Trend in abundance	Stable to increasing due to active management of occurrences and habitat (restoration, invasive plant treatment).	Similar to Alternative A. Compared to Alternative C, potentially greater abundance due to less recreation development.	Stable or decreasing due to the most amount of recreation development of all alternatives (higher risk of trampling and/or, habitat degradation; increased vectors for invasive plants).	Stable or decreasing due to no active habitat restoration and less invasive plant treatment.	Similar to Alternative B.

Comparison of Environmental Consequences by Alternatives

Species Conservation Strategy



The alternatives vary substantial in their ability to adaptively manage TEPCS plant conservation efforts. Alternatives B, C, and E allow for an active management approach to invasive plants and habitat restoration, more flexibility to respond to climate change and other substantial changes in habitat conditions such as wildfire, and the ability to conserve unoccupied suitable TEPCS habitat. Alternative A allows for an active approach to restoration and invasive plant management, but is primarily focused on water quality objectives and manages TEPCS occurrences for a certain threshold quantity instead of

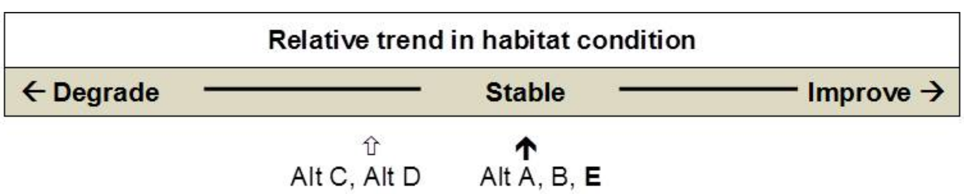
managing suitable habitat to allow populations to respond to change. Alternative D relies on natural processes for restoration and markedly limits invasive plant management, though it does provide the same flexibility to respond to change and to conserve unoccupied suitable habitat.

Trend in species abundance

In terms of relative abundance compared to the no-action alternative (Alternative A) as estimated by number of occurrences, Alterative B is likely to be similar to Alternative A—with abundance remaining stable or increasing slightly due to active conservation of known occurrences and a moderate risk of adversely impacting occurrences through recreation expansion and vegetation treatments. In Alternative C, abundance is likely to be stable to slightly decreasing due to risk of losing occurrence through greater amount of recreation expansion and the higher rate of mechanical vegetation treatments. In Alternative D, abundance will likely be stable to slightly decreasing due to the increased risk of high severity wildlife which could destroy occurrences. Alternative E is similar to Alternative B.

Trend in habitat condition

In terms of the condition of suitable habitat for TEPCS plants, when compared to the no-action alternative (Alternative A), Alternative B is likely to be very similar, within stable to improving habitat conditions resulting from a combination of improvements through active habitat restoration, invasive plant management, and continued vegetation treatments structure that may be countered by a degradation or destruction resulting from recreation expansion and less focus on late seral enhancement. Habitat conditions in Alternative C are likely to be stable to slightly decreasing due to the greater level of recreation development (higher risk of trampling; habitat degradation; increased vectors for invasive plants). Habitat conditions in Alternative D would likely be stable to slightly decreasing due to a lack of an active restoration and invasive plant treatment program, though this may be countered by a creation of disturbed habitats through restoration or mechanical fuels treatments.



How the Alternatives Maintain or Achieve the Desired Conditions

All of the alternatives provide for the conservation of known botanical resources in their current locations through the assessment of resource impacts during the project planning process and the inclusion of design criteria during all management activities.

Alternative A

Short-term achievement of desired conditions would result from active management of TEPCS species occurrences and the conservation and restoration of habitat through active restoration, invasive species treatment, and avoidance measures. However, long-term species viability may be affected by static occurrence-based conservation areas and the extensive future expansion of recreation infrastructure

proposed in this alternative. Specifically, the expansion of ski areas—both spatially (larger permit areas) and temporally (more summer uses)—in combination with the likely reduction of habitat due to climate change may affect whitebark pine, Tahoe draba, and other subalpine plant species, and increased recreation use of shoreline areas may affect Tahoe yellow cress.

Alternative B

Short-term achievement of desired conditions would result from active management of TEPCS and the conservation and restoration of habitat through active restoration, invasive species treatment, and avoidance measures. The use of Special Status Species Habitat Areas would also provide for conservation and active restoration of habitat in the longer term, resulting in the long-term achievement of desired conditions.

Alternative C

This alternative may help achieve the desired condition for some botanical resources, but not for all botanical resources. Those botanical resources with suitable habitat that intersects proposed fuels treatment areas may benefit from the increased thinning proposed in this alternative, as their habitat may be more resistant to stand-replacing fire and beetle kill; this would be particularly beneficial to whitebark pine. However, this alternative may not achieve the desired condition for other botanical resources. Specifically, Tahoe yellow cress and subalpine may be negatively affected due to degradation of shoreline and subalpine that may result from the more extensive recreation expansion allowed in this alternative.

Alternative D

This alternative would not meet the desired condition for most botanical resources because it does not provide opportunities for active management of some substantial threats to botanical resources—namely climate change, wildfire, and invasive species. However, this alternative may be superior in addressing the desired conditions for Tahoe draba by creating a Freel Peak Wilderness and keeping ski resorts at current acreage.

Alternative E

Similarly to Alternative B, short-term achievement of desired conditions would result from active management of TEPCS and the conservation and restoration of habitat through active restoration, invasive species treatment, and avoidance measures. The use of Special Status Species Habitat Areas would also provide for conservation and active restoration of habitat in the longer term, resulting in the long-term achievement of desired conditions. Furthermore, it provides additional conservation measures for important whitebark pine stands, which may improve their long-term viability.

3.4.5. Terrestrial Invasive Plants

3.4.5.1. Introduction

In 2003, the Chief of the U.S. Forest Service identified invasive species—including terrestrial invasive plants—as one of four critical threats to the National Forest System (NFS) (Bosworth 2003). Invasive plants pose a serious threat to ecosystem function because of their ability to displace native species, alter nutrient and fire cycles, decrease the availability of forage for wildlife, and degrade soil structure (Bossard et al. 2000). Invasive plants are considered the second leading cause of native species decline and extinction in North America (Wilcove et al. 1998). Invasive plants can also greatly reduce the recreational and aesthetic values of forestlands.

Many of the activities managed by the Forest Service have the potential to introduce or spread invasive plants. Both national and regional Forest Service management direction prioritize prevention of invasive plant introduction and spread on NFS lands by considering invasion risks during project planning and—to the extent feasible—incorporating invasive plant prevention measures into all activities (Exec. Order No. 13112, (USDA Forest Service 2000, 2011). In the Sierra Nevada, the Sierra Nevada Forest Plan Amendment directs national forests to conduct invasive plant risk assessments during project planning (IPRA; formerly known as 'Noxious Weed risk Assessment' until terminology was clarified by national direction) (USDA Forest Service 2004b). The following section is a summary of the methodology used to produce the Invasive Plant Risk Assessment for the revised Forest Plan and the risks detailed in the IPRA.

Methodology

Invasive Plant Risk Assessment Process

Potential effects from invasive plants in presented in the context of the risk of introduction and spread associated with proposed activities, rather than effects to specific resources; these resource-specific effects are addressed in other resource sections, as appropriate. For a programmatic document at the unit level that does not authorize site-specific activities, the risks for introduction and spread as well as the ecological impacts associated with each invasive plant species of management concern are similar enough to be analyzed collectively, rather than individually. Detailed species accounts are included in the FEIS's Invasive Plant Risk Assessment.

On LTBMU, an established invasive plant risk assessment process has been used to evaluate projects involving ground-disturbance activities since 2004—when the Sierra Nevada Forest Plan Amendment required national forests in the Sierra to conduct such assessments(USDA Forest Service 2004b) . That process has been adapted—with very little modification—to evaluate the five alternatives of the revised Forest Plan. Invasive plant risk is assessed by examining the following seven factors:

- Inventory
- Known infestations in the analysis area
- Vectors not-dependent on proposed action
- Habitat vulnerability
- Vectors expected to result from proposed action
- Habitat alteration expected to result from proposed action
- Invasive plant management strategy

Factors 1-3 are not dependent on the management activities proposed by each Alternative; rather, they address the context within which risk of each Alternative are evaluated. Factors 3-6 specifically address the risks associated with each Alternative. Factor 7 is not included in the LTBMU's project-specific IRPA, but has been added to address differences between the revised Forest Plan alternatives in how known invasive plant infestations will be managed.

Indicators

Based upon the existing IPRA process, the following indicators have been selected to summarize the relative risks associated with each Alternative:

- Trend in abundance of invasive plant infestations
- Risk of new introductions and risk of spread from known infestations

Because the revised Forest Plan does not authorize project-level actions, it is difficult to assess invasive plant risks in quantitative terms. There are not set criteria for the indicator categories used in this analysis, though the criteria used to assess factors at the project-level are followed to the extent possible; they are detailed in the FEIS's Invasive Plant Risk Assessment. Rather, using the six risk factors, a qualitative assessment of invasive plant risk is produced for each Alternative as well as an assessment of the risk of each Alternative relative to the other alternatives.

Assumptions

In addition to the common assumptions listed in Section 3.3, the following assumptions have been made:

- All Alternatives will authorize ground-disturbing activities, therefore requiring a risk assessment
- LTBMU will continue to coordinate invasive plant management activities with MOU partners and agencies.
- Existing infestations will continue to spread without active treatment.
- High priority infestations will continue to be treated on NFS lands, through the quantity will depend on funding.

3.4.5.2. Overview of the Affect Environment

Inventory

No surveys were conducted specifically to address the invasive plant risk associated with the revised Forest Plan. Current inventory for the invasive plants of management concern on LTBMU was derived from the Forest Service's Natural Resource Inventory System (NRIS)—which is the database of record for invasive species data. The data set includes all invasive plant infestations documented on NFS lands

through project surveys and invasive plant treatments as well as incidental reports. NRIS data is quality controlled by the unit's data steward and is considered the best available information for NFS lands. Data for non-NFS lands in the Lake Tahoe Basin was obtained from the Lake Tahoe Basin Weed Coordinating Group (LTBWCG)—a bi-state coalition of 20+ partners formed to stop the introduction and spread of invasive weeds in the Lake Tahoe Basin. LTBWCG was deemed the most reliable and comprehensive repository of non-NFS invasive plant data within the Lake Tahoe Basin because of its 10+ years of coordinated invasive plant tracking.

Invasive Plants of Management Concern on LTBMU

There are at least 200 non-native plant species known to occur on LTBMU—many of which are not actively managed on LTBMU and are not addresses in this analysis. This analysis focuses on those invasive plant species that pose a substantial risk to resource and are prioritized for management; currently, the LTBMU maintains a list of 35 invasive plants of management concern (Appendix E). Methodology for species selection for inclusion and their subsequent prioritization for treatment are detailed in Appendix E—Species Diversity. In general, species are prioritized for management based upon invasion potential, potential resource impacts, and effectiveness of available management and control methods (USDA Forest Service 2010, Gross and Olin 2011).

Species Known on LTBMU

Of the approximately 154,850 acres of NFS lands comprising the LTBMU, only a very small percentage is infested with invasive plants. After the 2012 field season, a total of 574 infested acres—0.003% of LTBMU—were mapped (Table 3-27). However, this is likely a substantial underestimate, as three species—cheatgrass, Eurasian milfoil, and wooly mullein—are not mapped and several others are likely under-mapped.

Non-NFS lands constitute approximately 22% of the Lake Tahoe Basin. In this area, there are an additional 224 infestations of species on the LTBMU invasive plant list documented by LTBWCG members (Lake Tahoe Basin Weed Coordinating Group 2013). The LTBWCG list contained only 18 of the species on the LTBMU list. As such, for 17 species, there is a data gap for non-NFS lands and there are likely undocumented infestations. Furthermore, there may be additional infestations within the Lake Tahoe Basin that have not been documented and reported by the LTBWCG, especially on private lands.

Table 3 27. Acreage, quantity, and relative percentages of known mapped invasive plants infestations

Scientific Name	Common Name	Number of Infestations	Acres	Percentage
Acroptilon repens	Russian thistle	1	0.04	0.01%
Cardaria draba	heart-podded hoary cress	1	0.03	0.00%
Cardaria pubescens	globe-podded hoary cress	1	0.37	0.06%
Carduus nutans	musk thistle	2	0.63	0.11%
Centaurea diffusa	diffuse knapweed	2	0.04	0.01%
Centaurea maculosa	spotted knapweed	2	0.04	0.01%
Chondrilla juncea	rush skeletonweed	1	0.04	0.01%
Cirsium arvense	Canada thistle	20	1.67	0.29%
Cirsium vulgare	bull thistle	283	432.92	75.39%
Conium maculatum	poison hemlock	1	1.48	0.26%
Cytisus scoparius	Scotch broom	4	0.13	0.02%
Hypericum perforatum	St. Johns wort	31	67.60	11.77%
Isatis tinctoria	Dyer’s woad	1	0.38	0.07%
Lepidium latifolium	perennial pepperweed	17	3.42	0.59%
Leucanthemum vulgare	oxeye daisy	37	47.81	8.33%
Linaria dalmatica	Dalmatian toadflax	16	10.64	1.85%
Linaria vulgaris	yellow toadflax	11	2.76	0.48%
Onopordum acanthium	Scotch thistle	1	0.33	0.06%
Potentilla recta	sulfur cinquefoil	4	3.95	0.69%
Rubus discolor	Himalayan blackberry	1	0.00	0.00%
Grand Total		437	574.27	100.00%

Derived from 2012 NRIS data

Table 3 28. Infestations on Non-NFS lands within the Lake Tahoe Basin

Scientific name	Common name	Number of infestations
Acroptilon repens	Russian knapweed	2
Cardaria pubescens	hoary cress	3
Centaurea diffusa	diffuse knapweed	16
Centaurea maculosa	spotted knapweed	70
Cirsium arvense	Canada thistle	8
Isatis tinctoria	Dyer's woad	2
Lepidium latifolium	perennial pepperweed	71
Linaria spp.	Toadflax (combined)	34
Linaria vulgaris	yellow toadflax	18
		224

Derived from LTBWCG 2012 invasive weed data

Bull thistle and cheatgrass present the greatest risk for introduction and spread due to their pervasiveness across the Lake Tahoe Basin. Of the mapped invasive species, bull thistle (*Cirsium vulgare*) is by far the most common invasive plant species treated on LTBMU with 283 sites totaling ~433 acres. Most

infestations are less than 0.5 acres and manual treatment has proven effective at these small sites (Olin 2010). As of the last systematic prioritization of invasive plant species on LTBMU in 2011, bull thistle was still considered a moderate priority species for treatment (Gross and Olin 2011).

While bull thistle is the most extensively mapped invasive plant, cheatgrass represents the greatest threat to ecosystem function and native species habitat on LTBMU. Though not mapped in NRIS, it is known to occur in every USGS quad within LTBMU and has spread exponentially since 2009 (Engelhardt, personal communication). The conversion of Great Basin rangeland from native perennial grasses to cheatgrass is one of the most severe ecological degradations in the United States (Mack 1981, Dantonio and Vitousek 1992). Cheatgrass invasion shortens fire return interval and alters nutrient cycling, resulting in increased fire hazard and the displacement of native plant communities, particularly those dominated by sagebrush (*Artemisia* spp.) (Evans et al. 2001, Brooks et al. 2004). Most available treatment methods have proven ineffective for control of cheatgrass on a large scale (Bossard et al. 2000). Therefore, prevention is considered critical in cheatgrass management.

While not as pervasive as bull thistle or cheatgrass, the 19 other invasive plant species known on LTBMU also present a substantial invasive risk and threat to resources. Species accounts, including current inventory and treatment, are detailed in the FEIS's Invasive Plant Risk Assessment.

Species Listed but not Currently Known on LTBMU

Only 21 of the 35 species on the LTBMU invasive plant list have been found on NFS lands in the Basin. The other species are included because they have been found elsewhere in the Basin or are suspected to be within 25 miles of the LTBMU administrative boundary. Proximity of these species increases the likelihood of introduction on LTBMU. They are: tree of heaven (*Ailanthus altissima*), purple starthistle (*Centaurea calcitrapa*), yellow starthistle (*Centaurea solstitialis*), squarrose knapweed (*Centaurea virgata ssp. squarrosa*), teasel (*Dipsacus fullonum*), stinkwort (*Dittrichia graveolens*), purple loosestrife (*Lythrum salicaria*), Medusahead (*Taeniatherum caput-medusae*), and salt cedar (*Tamarix sp.*)

Vectors Not Dependent on Proposed Action

Invasive plant introduction occurs when plant propagules are moved from one infestation—the "seed source"—to new and often uninvaded habitat. In general, any activity that moves soil or plant parts—especially seeds—from one location to another has the potential as a vector for invasion (Radosevich 2002). There are many vectors that will continue to present a risk of invasion, regardless of which Forest Plan Alternative is selected. These include natural vectors—such as wind, water, and wildlife movement—as well as human-generated vectors including but not limited to: interstate commerce; utility, road, facility, and home construction and maintenance; horticultural sales; motorized vehicle use; livestock grazing; mining; timber management; fire suppression; and non-motorized recreation such as camping, hiking, biking, and horseback riding. While several of these activities are considered under the revised Forest Plan, they can also occur on adjacent lands that are not subject to Forest Service management direction. As such, they aid in the dispersal of invasive plants to NFS lands.

Habitat Vulnerability

Whether they originate from human causes (e.g., road construction, thinning) or natural causes (e.g., wildfire, windfall), disturbed habitats often have a higher susceptibility to invasions than those with long periods in late successional phases (Radosevich 2002). Plant introduction may be the direct result of destruction of vegetation, or it may indirectly result from changes in resource levels, such as light or moisture, or other conditions (Parendes and Jones 2000, Kuhn and Klotz 2007). Either way, previously disturbed areas are at greatest risk for invasion. On LTBMU, disturbed areas are largely comprised of developed and dispersed recreation sites; established and unauthorized access routes; vegetation treatment units; areas adjacent to developed areas, such as urban lots; and wildfire areas. As there are no active grazing allotments, no active mining operations, and no timber sales on LTBMU, these activities pose a

low risk of habitat degradation. While disturbed areas are found in most plant communities on LTBMU, they are concentrated at lower elevations—below 8,000 feet—in relatively xeric communities dominated by grasses and forbs. These areas often provide seed sources for weeds moving into the less-invaded parts of the unit.

Over the past decade, a number of large wildland fires have occurred on the Forest—namely the Angora and Gondola Fires. Wildfires can expose soil surfaces, reduce shade, decrease competition from native species, and contribute to soil nutrient pulses; all of these factors create conditions favorable to the establishment and spread of invasive plants (Zouhar et al. 2008). Monitoring conducted after the Angora fire revealed a three-fold increase in the area infested with bull thistle and a 25-fold increase in the area infested with perennial pepperweed, indicating that wildlife areas are highly susceptible to invasion on LTBMU (Olin 2009). However, fire alone will not necessarily result in increased rates of invasion into burnt areas (Klinger et al. 2006). Non-fire disturbances associated with fire management, such a fireline construction, present substantial risks for invasion (Benson and Kurth 1995, Merriam et al. 2006). In some cases, the risks from suppression and fuels management activities may exceed the risk presented by the fire itself.

Other than these recent events, the effect of specific past activities on invasive plants on LTBMU is largely unknown. While it is often difficult to draw definitive conclusions regarding the effects of past activities, the high level of past activity combined with the current level of infestation, suggest that past activities have contributed significantly to the introduction and spread of invasive plants on LTBMU and that present activities will continue to pose a high risk of habitat alteration. The implications of climate change for habitats and invasive species is discussed in the Climate Change section of Chapter 3.

3.4.5.3. Environmental Consequences

Vectors Expected to Result from Proposed Action

Vegetation Management

Fuel treatments can create disturbance that may promote invasion by invasive plant species. Depending on the intensity, severity, size, and seasonality of a fuel treatment, increased availability of light, water, and nutrients may result (Covington et al. 1997, Gundale et al. 2005); these conditions can favor spread of non-native plants (Hobbs and Huenneke 1992, Brooks 2003). Response of invasive plants to fuel treatments may also vary by treatment method, such as prescribed fire or use of heavy equipment, hand tools, or chemicals(Brooks 2007). For example, invasive seed may be carried by humans and mechanical equipment used in some types of fuel reduction treatments. This can increase propagules pressure of invasive species, which is an important factor in predicting the likelihood of invasion (D'Antonio et al. 2001, Lockwood et al. 2005). Proximity of access routes to treated areas can increase the likelihood of invasion (Birdsall et al. 2012).

In post-implementation inspections of 46 project implemented on LTBMU since 2005, new and expanding invasive plant infestations were highest in mechanically thinned fuels treatments (Rowe et al. 2013). While this monitoring did not address the specific mechanisms that facilitated invasion, it is probable that the off-road use of heavy equipment was at least in part a factor. Soil containing invasive plant propagules can adhere to machinery, be dispersed to uninfested areas, and result in new infestations (Hodkinson and Thompson 1997). The use of infested machinery is considered a substantial vector for incidental introduction (USDA Forest Service 2001, Kowarik and Von der Lippe 2007, van der Meulen and Sindel 2008). On LTBMU, machinery is often imported from lower elevations (e.g., Sacramento Valley, Minden-Gardnerville area). In California, invasive plant species richness is generally greater at lower elevations (Randall et al. 1998, Dark 2004). So, use of imported equipment presents a high risk of introduction.

The rate and type of fuels treatments varies by alternative and are discussed in detail in the Fire and Fuels Section. Alternative D allows for the highest annual rate of prescribed burning, followed by Alternative C, with Alternative A, B, and E all allowing comparable rates. In the Wildland Urban Interface, the rate of thinning and fuels reduction is the same for Alternatives A, B, C and E, but Alternative D allows for substantially less mechanical thinning—250 acres/year (ac/yr) compared to 500 ac/yr for other alternatives. For other management areas, Alternative C allows for a nearly two-fold increase in the number of acres per year treated mechanically compared to Alternatives A, B, and E, though Alternative C is designed to meet forest vegetation objectives with fewer entries at a given stand. No mechanical treatments are allowed in other management areas in Alternative D. Based upon the substantially higher rate of mechanical thinning, Alternative C presents the greatest risk of increasing vectors as a result of vegetation management.

Watershed and Aquatic Habitat Restoration

Active stream channel restoration often necessitates the use of heavy equipment to reshape the stream channel or place large woody debris. The use of heavy equipment in restoration presents the same risks associated with its use in vegetation management. Habitat restoration projects often import materials—namely gravel, top soil, fill, erosion control products, and seed for revegetation. If these materials originate in infested areas, invasive plant propagules may be incorporated into the materials and then dispersed to uninfested areas when the materials are used (Kowarik and Von der Lippe 2007). The use of imported materials is considered a substantial vector for the introduction and spread of invasive plants (USDA Forest Service 2001, 2004a, 2011, Nevada Department of Agriculture 2013). In Alternatives A, B, C, and E, watershed and aquatic habitat restoration would occur at roughly the same level, whereas it would be greatly reduced in Alternative D. As such, Alternative D presents a lower risk of increasing vectors as a result of watershed and aquatic habitat restoration.

Recreation

The primary vectors associated with recreation activities are the movement of invasive propagules along access routes by visitors, vehicles, livestock, and bicycles; these risks are discussed in the next section—Access and Travel Management. Materials—namely gravel, top soil, fill, erosion control products, and seed for revegetation—are often imported during the construction on new recreation sites. If these materials originate in infested areas, invasive plant propagules may be incorporated into the materials and then dispersed to uninfested areas when the materials are used.

On LTBMU, grazing is primarily an incidental use associated with recreation activities, such as outfitter-guide activities and other equestrian recreation. There are no active grazing allotments on LTBMU and none are expected to become active under any alternatives. Fredrick's Meadow is currently under special use permit and the permittee may be allowed to rest, confine, or graze stock. The greatest risk from equestrian recreation is the use of imported forage (e.g., straw, hay, silage). Propagules from invasive plants growing in or near cultivated fields can be harvested with the fodder and dispersed to uninfested areas with its use (Brooks 2007, Kowarik and Von der Lippe 2007). Due to the high level of risk associated with forage, numerous federal and state agencies had adopted weed-free forage programs, including the Nevada Department of Agriculture and the California Department of Food and Agriculture (West 2012, Nevada Department of Agriculture 2013). Horse feces can also transport invasive propagules, though the likelihood is relatively low (Campbell and Gibson 2001, Gower 2008).

The risk from vectors will increase with increased recreation expansion. Alternatives A, B, and C would allow for recreation expansion up to 10%, 5%, 15%, respectively, whereas Alternative D would allow up to a 15% reduction. Alternative E would allow a 5% increase in developed site acres, day use parking, and ski area operational footprint acres, and a 10% increase in overnight accommodation units. Therefore, Alterative D presents the lowest risk of vectors associated with recreation, whereas Alternative C presents the highest risk, with Alternative A, B, and E being relatively comparable.

Access and Travel Management

Access routes—whether they are major highways, general forest roads, motorized vehicle trails, non-motorized trails, or utility corridors—are often the primary conduit for introduction and establishment. Access routes contribute to dispersal of invasive plants because they (1) create suitable habitat by altering environmental conditions, (2) make invasion more likely by stressing or removing native species, and (3) allow for easier movement by wild or human vectors (e.g., on clothes, shoes, hooves, and tires) (Trombulak and Frissell 2000). Route density is highly variable on LTBMU, but in general there are more routes near developed area and in the Wildland Urban Interface. Trails are of particular concern to managers because they may provide a route for invasive plant dispersal into wildlands by linking the front country to the backcountry. Areas next to trails often include more non-native species and higher non-native cover the surrounding vegetation ((Dickens et al. 2005, Potito and Beatty 2005, Wells et al. 2012). Visitation rates have been positively correlated to the presence of non-native plants (Lonsdale 1999). Use of both motorized access routes and non-motorized trails has been a component of recreation on LTBMU for many years and is expected to increase. As recreational use increases, the number of invasive plants and the area they occupy can also be expected to increase.

None of the alternatives propose a programmatic expansion of the LTBMU's road system. However, Alternative C would allow increased access for passenger vehicles by improving road surfaces and opening some currently closed routes, thereby increasing the vectors for invasion. All alternatives allow for some increase in the quantity of trails open to hiking and equestrian use, though most additions are currently in use as unauthorized routes, so there would not likely be an increase in vectors. Alternative A, B, and E allow for the additional motorized trails. The location of access routes can substantial influence their potential as vectors; access routes that connect infested areas (e.g., existing recreation sites, trailheads, developed area) to uninfested areas represent the highest risk. But since the revised Forest Plan does not provide specific locations for added access routes, there is a relatively high level of uncertainty regarding the risk these new routes present. Overall, the differences among alternatives in trail quantity and type are small—less than 10% difference between alternatives. Nonetheless, since access routes represent the primary vector for infestation, any increase in access routes represents an increased risk for invasive plant introduction and spread.

Habitat Alteration Expected to Result from Proposed Action

Vegetation Management

Use of mechanical equipment and prescribed burning can result in soil disturbances that favor nonnative plant establishment (Hobbs and Huenneke 1992, Lonsdale 1999, Brooks 2007, Zouhar et al. 2008). The difference in quantity and type of vegetation treatments between alternatives is discussed in the previous section—Vectors Expected to Result from Proposed Action. Because high severity wildfires can produce large disturbance areas with conditions favorable to invasion, proposed activities that modify fire behavior—promoting lesser severity fires—may also reduce the risk of larger scale habitat alteration and reduce the probability of invasion.

Watershed and Aquatic Habitat Restoration

Active stream channel restoration often necessitates the use of heavy equipment to reshape the stream channel or place large woody debris. The use of heavy equipment in restoration presents the same risks associated with its use in vegetation management. The difference in quantity of watershed and aquatic habitat restoration activities between alternatives is discussed in the previous section—Vectors Expected to Result from Proposed Action.

Recreation

The most substantial risks from recreation are associated with high vector potential of roads and trails. However, dispersed recreation— activities that occur outside of developed recreation sites in more remote areas of NFS lands, including off-trail hiking, camping, motorized and non-motorized vehicle use, and horseback riding—can trample plants, reduce native vegetation cover, and result in degraded habitat (Liddle 1991). The types of impacts generated from dispersed recreation activities will be similar for all alternatives but the intensity can vary with increased visitation. More access—as measured by miles of roads and trails—will create more opportunities for dispersed activities. Differences among alternatives in amount of roads and trails is discussed in the previous section— Vectors Expected to Result from Proposed Action.

Construction and maintenance of new recreation sites can result in disturbed conditions that favor invasive plant introduction and spread. Differences among alternatives in amount of recreation expansion are discussed in the previous section—vectors expected to result from proposed action. The location of recreation sites as well as the intensity of their use can substantial influence amount of associated habitat alteration. Recreation use levels are expected to increase under all alternatives. But since the revised Forest Plan does not provide specific locations for recreation expansion, there is a relatively high level of uncertainty regarding the risk associated with new recreation sites.

Access and Travel Management

While the primary risk from access routes is their role as vectors introducing invasive plants to uninfested areas, construction and maintenance of roads and trails can remove native vegetation, resulting in disturbed conditions that favor invasive plant introduction and spread. The differences between alternatives in the quantity and location of access routes is discussed in the previous section—Vectors Expected to Result from Proposed Action.

Terrestrial Invasive Plant Management Strategy

Coordination

In all alternatives, LTBMU will continue to coordinate invasive plant management activities with MOU partners and agencies and, to the extent feasible, support invasive plant research.

Prevention

All alternatives include standards and guidelines targeted at reducing vectors for introduction and spread. These standards and guidelines include screening materials and equipment for invasive plants; required use of weed-free straw; required use of invasive-free gravel, fill, topsoil, mulch, and other materials; cleaning of equipment used off-road during project implementation; avoidance of infestations when selecting staging areas and landing. Additional invasive prevention measures may be employed on a project-by-project basis, depending on the risks presented by proposed activities and the feasibility of implementation. Risk will continued to be evaluated through the IPRA process. The current Forest Plan does not include invasive plant prevention standards and guidelines (USDA Forest Service 1988); rather, these standards and guidelines are derived from the Sierra Nevada Forest Plant Amendment and national Forest Service manual direction (USDA Forest Service 2004b, 2011). In Alternatives B, C, D, and E, invasive plant prevention standards and guidelines are included in the revised Forest Plan. Regardless of the associated management direction, the general prevention strategy is consistent across all alternatives.

Control

All alternatives allow for an integrated invasive species management approach that evaluates all available control methods, including biological, cultural, mechanical/physical, and chemical techniques, as well as

addresses potential adverse effects to native species, human health, ecosystem processes, or other resources on NFS lands.

Alternatives A, B, C, and E allow for an active approach to terrestrial invasive plant management whereas Alterative D promotes a passive approach. In alternative A, B, C, and E, both moderate and high priority infestations would be considered for treatment. Funding may dictate that only a portion of these infestations are treated, but they would all be considered. In alternative D, only high priority infestations would be considered for treatment. This would result in an increase in the quantity and size of moderate priority infestations which could adversely impact native species, ecosystem function, and other resource values.

In alternatives A, B, C, and E, active restoration techniques—namely revegetation with native plants—would be considered for post-treatment management of infestations. In alterative D, restoration would rely on natural processes—namely seed bank germination and natural recruitment from nearby seed sources. Revegetation with native plants can improve the structure and function of habitats previously infested with invasive plants (DiTomaso 2000, Masters and Sheley 2001). As such, the recovery time of previously infested areas may be extended or retreatment of reestablished infestations may be required, which may adversely impact resources as well as cost more than active restoration.

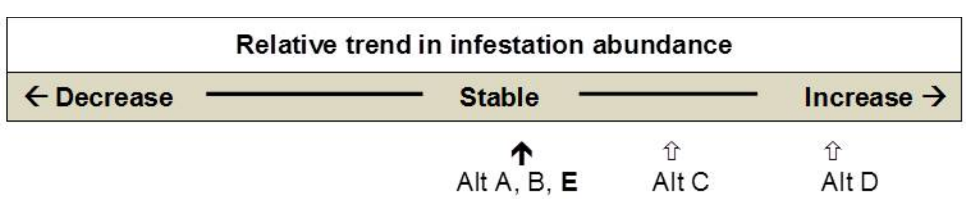
While Alternative A allows for an active management approach, the current Forest Plan does not provide any guidance on how to prioritize invasive plants species and infestations for management whereas Alternatives B, C, D, and E emphasize Early Detection and Rapid Response (EDRR). EDRR focuses on finding new, small, or previously unknown infestations prior to or in the initial stages of its establishment and then taking quick and immediate actions taken to eradicate, control, or contain infestations within a relatively short time (USDA Forest Service 2011). This is a priority management technique for the Forest Service because it reduces the costs and impacts of treating larger infestations (USDA Forest Service 2011).

3.4.5.4. Analytical Conclusions

Comparison of Environmental Consequences by Alternatives

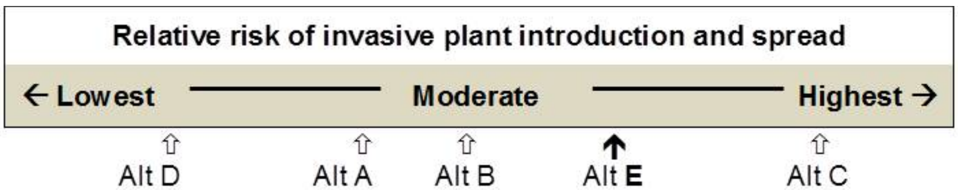
Relative trend in invasive plant infestation abundance

For Alternative A, the relative trend of infestations is expected to remain stable or increase slightly because the proposed activities present a moderate risk of creating new infestations, while an active invasive plant treatment and restoration program is expected to reduce or eradiate some infestations. Alternative B and E are similar to alternative A, in that they allow for an active invasive plant treatment and restoration program while having a similar level of risk of new infestations due to proposed activities. Alternative C would likely result is an increased abundance on infestations—though still moderate—due to more mechanical fuels treatment (more habitat alteration) and more recreation expansion (more habitat alteration, more vectors for spread). Alternative D would likely result in an increased abundance of infestations due to the limitation of invasive plant treatment to high priority species and the reliance on a passive approach to restore those areas impacted by invasive plants.



Relative Risk of Invasive Plant Introduction and Spread

For Alternative A, the relative risk of invasive plant introduction and spread is moderate, but the risk would be somewhat reduced by an active prevention program. Alterative B is similar to Alternative A, but the risk of introduction and spread may be greater due to more recreation expansion (more habitat alteration, more vectors) or lower due to less mechanical fuels treatment (less habitat alteration). Alternative C has slightly more risk than Alternative A due to more mechanical fuels treatment (more habitat alteration) and highest level of recreation expansion (more habitat alteration, more vectors). Alternative D has slightly less risk than other alternatives due to the expectation that there will be less ground disturbance if there are fewer mechanical vegetation treatments and restoration projects (less habitat alteration, fewer vectors). Alternative E is similar to B, but risk may be greater due to more recreation development (more habitat alteration, more vectors).



How the Alternatives Maintain or Achieve the Desired Conditions

All alternatives include standards and guidelines for the prevention of new invasive plant infestations and treatment of high priority invasive plant species and infestations. Under all alternatives, projects involving ground-disturbance will continue to be assessed for invasive plant risks and invasive plant management measures will be incorporated into all management activities. As such, all alternatives are within acceptable levels of risk and meet the desired conditions for the prevention and prioritized control on invasive plants on NFS lands.

3.4.6. Built Environment

3.4.6.1. Introduction

This section evaluates and discloses the potential environmental consequences on the built environment that may result from the alternatives. The built environment includes administrative buildings, developed recreation facilities, dams, water systems, and other facilities.

Methodology

The built environment was analyzed by reviewing existing facilities, needs, and funding and comparing those facilities to the desired conditions per all alternatives. Data was collected from Infra databases, the existing forest plan, the Facility Master Plan, and from the accessibility Transition Plan.

Assumptions

In the analysis for this resource, the following assumptions have been made:

Opportunities for BMPs will be identified and prioritized for funding, analysis and implementation.

Facilities will be managed to achieve recreation and administrative management goals.

Facilities will be managed to achieve resource management goals.

3.4.6.2. Overview of the Affected Environment

The 1988 Forest Plan defined the following goals:

1. Facilities Goal: To provide administrative facilities such as offices, shops, storage, housing, and communication to support the work force.
2. Energy Goal: Improve energy efficiency related to national forest activities in support of national policy.

The overarching theme is to provide for a sustainable built environment that supports the forest's mission. Sustainability refers to the ability to operate and maintain the facility through changing needs and funding levels. Adaptability and purpose of the built environment are important considerations for design, construction, and operation.

Current Conditions and Trends

There are 12 administrative sites containing 32 buildings and 13 trailer pads. Many structures need replacement or reconstruction, and some sites need additional application of water quality BMPs.

There are 15 dams on the LTBMU. Fallen Leaf dam has been owned and operated by the Forest Service since 1951. Nine small dams were built by the California Department of Fish and Game in the 1940's to enlarge existing lakes in order to maintain stream flows and improve fish habitat. Management responsibility for these nine dams has recently been transferred to the Forest Service. Heavenly Valley Creek dam is under Forest Service jurisdiction, although managed by the ski area for domestic, dust control, irrigation, and snowmaking uses.

The Echo Lake Dam was built in the 1890s and is operated by the El Dorado Irrigation District. It diverts water into the American River system to generate electricity and supply water for irrigation.

There are three other privately owned dams on national forest land but they do not affect management activities. Although physical conditions are suitable, new hydroelectric development is unlikely because of environmental protection requirements.

The LTBMU Facilities Master Plan (USFS 2004f) identifies buildings for decommission, reconstruction or replacement. Several facilities are in need of rehabilitation or decommissioning, including the cabin at the Old Mill site at Fallen Leaf Lake, Meeks Fire Station, Round Hill Pines Resort, Camp Richardson Resort cabins and several other buildings throughout the basin.

The LTBMU is in the process of exploring partnerships with local organizations to co-locate administrative facilities, such as fire stations, barracks, and office space. In addition, partnerships are being explored to facilitate redevelopment and improved utilization of recreation facilities.

The Tahoe Regional Planning Agency requires that Best Management Practices (BMPs) be installed on developed parcels in South Lake Tahoe by October 15, 2006. While the Supervisor's Office and Spooner Summit station are in compliance, currently other administrative facilities are not.

In 1998, the LTBMU completed the first of two plans needed to bring the unit into compliance with universal accessibility standards. The Transition Plan identifies and prioritizes sites where there are obstacles to accessibility associated with activities, programs or services offered at certain facilities. This is of particular relevance to special use permitting because private businesses permitted to operate on Forest Service Lands are required to comply with the "higher level of the two accessibility standards" (Americans with Disabilities Act Accessibility Guidelines and Architectural Barriers Act). The Architectural Barriers Act of 1968 (ABA) requires that facilities that are built, bought, rented, or leased by, for, or on behalf of a Federal agency must comply with the accessibility guidelines. Section 504 of the Rehabilitation Act of 1973 requires that no person can be denied participation in a federally conducted or assisted program or activity solely because that person has a disability. Universal access defines those programs and facilities in which barriers to participation or access are not present.

The 1999 Accessibility Action Plan, the second LTBMU accessibility report, focused on identifying and prioritizing facility renovation projects to bring them up to ABA standards. Forty upgrades projects were identified in the plan including campgrounds, administrative sites, trail heads, parking and bathroom facilities, lookout areas, beaches, picnic areas, visitor centers and special use permit areas.

Major Changes Since 1988

The Supervisor's Office was completed in May 2003. It was built to save money on high lease costs, improve employee efficiency, and to provide managed parking. This facility was built using the best available energy conservation, landscaping, security, and building resources. It is located in central South Lake Tahoe on land owned by the Lake Tahoe Community College, and is accessible to public transportation. Most LTBMU employees' work stations are now in this facility, although some remain at the Meyers Work Center and other facilities such as fire stations.

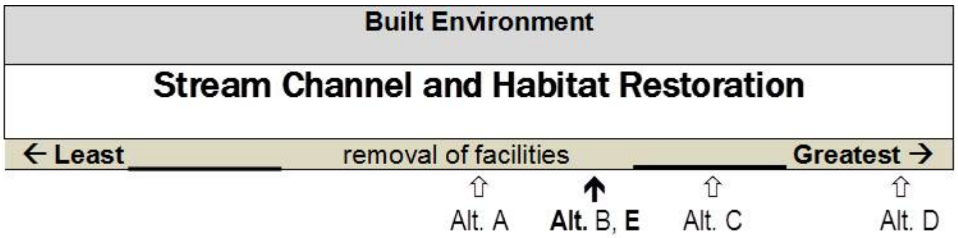
Spooner Fire Station was completed in 2011, Meyers work center buildings A, B and C are undergoing remodel, and the William Kent House and garage have been decommissioned. The Nevada Beach campground and day use areas have been upgraded with current BMPs. Upgrades at the Fallen Leaf Campground have been systematically completed and include restroom replacements and relocation of camp sites out of sensitive areas. Currently 21 out of 53 restrooms (with sewer connections) have been replaced around the LTBMU. The remaining 32 restrooms are not to standard.

National, regional and local codes and regulations continue to be established and upgraded for buildings, dams, and utility systems (e.g., water, sewage, solid waste, electrical, and plumbing facilities and systems). Many of the Forest Service's facilities are developed for outdoor recreational use, such as campgrounds, picnic areas, and hiking trails. ABA guidelines pertaining to the built environment do not provide adequate guidelines and design criteria for outdoor recreational facilities. For this reason the Forest Service Outdoor Recreation Accessibility Guidelines and the Forest Service Trail Accessibility

Guidelines were developed to establish design criteria specific to outdoor recreation environments and accessibility guidelines.

3.4.6.3. Environmental Consequences

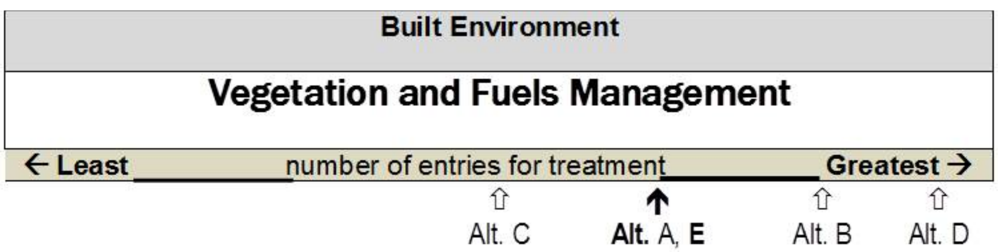
Stream Channel and Habitat Restoration



The effects upon the built environment from stream channel and habitat restoration management activities could result in removal of facilities in areas identified for restoration. Removal of facilities could occur in concert with removal of access and primary parking.

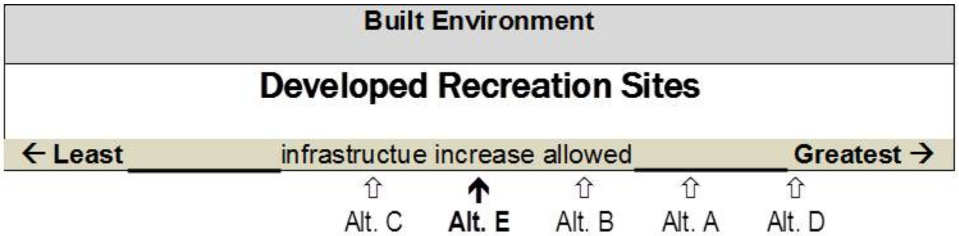
Alternative D would result in a net loss of facilities, primarily because facilities that were removed for ecological restoration would not be replaced. Alternatives A, B, C, and E would result in less facility removal, would have a potential for a net increase in recreation facilities, and would have similar consequences.

Vegetation and Fuels Management



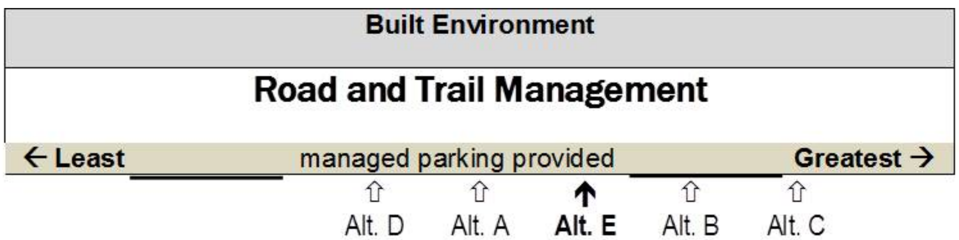
Effects from vegetation and fuels management would likely have a long term beneficial impact upon the built environment due to the creation of defensible space. Alternative C would achieve the desired condition for fuels the quickest, followed by Alternatives B and E, then Alternative A and finally Alternative D.

Developed Recreation Sites



Alternative D would result in less developed recreation sites and consequently less built environment, primarily because sites that are removed would not be replaced. Alternative C would allow the increase of developed recreation infrastructure to meet demand. Alternative A would maintain existing levels and Alternatives B and E would allow for an increase in the built environment compared to existing levels of developed recreation infrastructure, although not the extent of Alternative C.

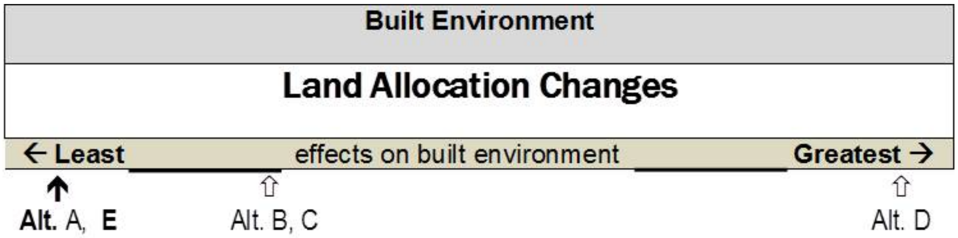
Road and Trail Management



All Alternatives manage a similar number of miles of roads with minor differences between road maintenance levels and anticipated authorized motorized use, as well as a similar number of miles of trails within the designated trail system. Alternatives B, C, D, and E provide for management of currently un-managed parking. Alternative C provides for the greatest increase in managed parking compared to Alternative A, while Alternative D provides for less overall managed parking than Alternative A. Development of managed parking has the potential to increase the built environment, specifically with regard to restrooms and public information stations associated with developed parking areas.

Transit services are common to all Alternatives. These have been evaluated, tested and tried, and additional bicycle facilities are being developed. In the future additional facilities are anticipated to support public transit as an alternative to the private automobile.

Land Allocation Changes



Land allocation changes within each alternative would likely have little effect upon the built environment with the exception of Alternative D which would propose new wilderness areas and which may affect the Meiss Historic Cabin. If a wilderness were established the historic cabin may be kept, moved, exempted from wilderness requirements, or removed. If the cabin were kept, maintenance activities would have to meet wilderness requirements.

3.4.6.4. Analytical Conclusions

Effects upon the built environment between alternatives are for the most part minor. Alternative D would have the greatest reduction of the built environment, while Alternative C would have the greatest potential increase in the built environment.

Comparison of Consequences by Alternative

Alternative A

This alternative would continue the existing trends of restroom replacement, installation of site BMPs and addressing deferred maintenance through decommissioning or capital improvements.

Alternative B

Similar to Alternative A, this alternative would continue along existing trends of restroom replacement, installation of site BMPs and addressing deferred maintenance through decommissioning or capital improvements.

Alternative C

Alternative C would allow for a potential increase in the built environment over all of the other alternatives.

Alternative D

This alternative would result in the greatest decrease in the built environment over other alternatives. While this alternative would most effectively reduce deferred maintenance, unmanaged conditions may result in resource impacts and not meet public expectations.

Alternative E

Similar to Alternative B, this alternative would continue along existing trends of restroom replacement, installation of site BMPs and addressing deferred maintenance through decommissioning or capital improvements.

How the Alternatives Maintain or Achieve the Desired Conditions

All alternatives would meet the desired conditions; however, there are differences in timing, economics, and the extent to which the desired conditions for the built environment would be met.

Alterative A is trending towards meeting desired conditions.

Alternative B would meet the desired conditions in a relatively short time frame.

Alternative C would meet the desired conditions for the built environment the quickest.

Alternative D would meet desired conditions but would result in the least amount of built environment.

Alternative E would meet the desired conditions in a relatively short time frame.

3.4.7. Climate Change

3.4.7.1. Introduction

The topic of climate change has emerged, in part, as an issue raised during public scoping and collaboration. This section evaluates the environmental consequences from climate change on Alternatives A, B, C, D, and E.

There are three primary documents that are currently guiding the Forest Service regarding Climate Change. The Strategic Framework for Responding to Climate Change is a guiding document on how the Forest Service aims to sustain health, diversity, and productivity of forest and grasslands in the present and future (USDA 2008.). The National Roadmap for responding to Climate Change provides an overview of the strategies that National Forests are working on to adjust and prepare for climate change adaptation and to reduce greenhouse gas mitigation (USDA 2011a). The Climate Change Performance Scorecard is a 10 point scorecard that addresses four dimensions (organizational capacity, engagement, adaptation, and mitigation) that every National Forest and Grassland reports their progress on, on an annual basis (USDA 2011b). This provides a method for Forests to track their accomplishments in incorporation of climate change into management actions. The 10 scorecard elements are: Employee Education, Designation of a Climate Change Coordinator, Program Guidance, Science and Management Partnerships, Assessing Vulnerability, Adaptation Actions, Monitoring, Carbon Assessment and Stewardship, and Sustainable Operations. Examples are provided for addressing each element in the scorecard guidance document.

Methodology

We qualitatively evaluated the five alternatives and the environmental response from climate change using headers linked to the four issue areas (watershed health, aquatic ecosystems, terrestrial ecosystems, and recreation-access-and travel management).

The current climate trends were compared to future predicted trends. This provided information on future implications for the LTB in regards to climate change. The effects of the alternatives were synthesized based on the following six adaptation and/or mitigation strategies: (1) building adaptive capacity of ecosystems through ecological restoration, (2) enhancing watershed function, (3) sequestering forest carbon, (4) reducing existing stresses, (5) sustainable operations, and (6) fostering science-management partnerships and public education. The four issue areas are found in all of these adaptation and mitigation strategies. Watershed Health and Aquatic Ecosystems are primarily discussed under 2 and 4. Terrestrial ecosystems are primarily discussed under 1, 3, and 4. Recreation and Access and Travel Management are primarily discussed
under 5.

Assumptions

The Affected Environment section discusses climate trends expected in the LTBMU. These general trends were used to analyze the environmental consequences. We used the best available science and scenarios most relevant to the Lake Tahoe Basin for this analysis. The six adaptation and/or mitigation strategies discussed are based on current literature. We are making the assumption that these actions will have positive rather than adverse effects, however given the high degree of uncertainty from the complexity of ecosystem and climate interactions this assumption may be false. The FS Plan includes a strategy for addressing the risk and uncertainties in climate change.

3.4.7.2. Affected Environment

For the Lake Tahoe Basin Management Unit and the surrounding Sierra Nevada, climate variability and weather events such as rain and snow storms, droughts, heat waves, floods, and lightning storms are an

integral part of the natural environment. The Sierra Nevada is the highest mountain range in North America's only area of Mediterranean-type climate. As such, the range receives large amounts of winter snowfall, followed by a 3-5 month summer drought. The temporal misalignment of precipitation and growing season is a characteristic of Mediterranean-type climates, and leads to ecosystem patterns that are driven principally by water availability but also to a great extent by dry-season fire. Increasing changes in climate and disturbances projected for the future are expected to lead to substantial alterations in California forests and the ecosystem services they provide (Field et al. 1999, Moser et al. 2009). The International Panel on Climate Change (IPCC 2007) has identified future impacts of temperature warming, changes in precipitation, extreme weather events, severe droughts, earlier snowmelt, increasing wildfire activity, and other changes that could significantly affect forest ecosystems.

Although science has been investigating various aspects of climate change on forests for decades, our knowledge of how plants and ecosystems will respond to a changing climate and how to react appropriately at local or regional levels where management actions are effected is still very limited (Wiener 2006, Solomon 2008). Uncertainties about outcomes will require flexibility, and land management strategies based on current or historical conditions may need to be adjusted or replaced with approaches that support adaptation to changing conditions (USFS 2008; Wiens et al., in press).

Forests can play an important role in both mitigating and adapting to climate change. Mitigation measures focus on strategies such as carbon sequestration by natural systems, increasing carbon storage in wood products, providing renewable energy from woody biomass to reduce fossil fuel consumption, and reducing environmental footprints. Adaptation measures address ways to maintain forest health, diversity, productivity, and resilience under uncertain future conditions. Adaptation and mitigation activities must also complement each other and balance with other ecosystem services (USFS 2008).

Specifics regarding many mitigation measures, such as the appropriate calculations for carbon offsets and how to consider carbon sequestration rates, are still being developed, so most focus at the Forest level at this time is on the use of management options to improve resilience and adaptability of native ecosystems under changing conditions. Over the 15-year life of the Forest Plan, as issues are better understood and appropriate measures are identified, climate change strategies can be adjusted through the adaptive management process.

Summary of current climate and climate-related trends in the Lake Tahoe Basin

(From Safford 2010, contained in Appendix D)

Mean annual temperatures in the LTBMU planning area have risen by about 2 degrees Fahrenheit over the last century, with most of the change occurring in nighttime temperatures. The occurrence of nighttime freezing temperatures has decreased over the last century, and for the first time on record, the annual mean minimum temperature at lake level is now above freezing. The average number of days in a year on which the average air temperature remains below freezing has dropped by 27 days since 1910. The Lake Tahoe Basin (LTB) rise in nighttime temperatures is higher than in most California locations and may be linked to the thermal mass of Lake Tahoe, whose surface waters have increased in temperature by one degree F in only the last 25 years. Over the last century, mean annual precipitation has risen by almost 7 inches per year, but there is very high (and increasing) interannual variability. At lake level, the balance of snow to rain has been shifting toward the latter: at the beginning of the last century, more than 50% of precipitation fell as snow; today the average is about 34%. Snowpack measurements show a strong downward trend across northern California over the last ½ century. Although some years continue to bring significant snowfall, the average springtime snow water equivalent at measured locations near Lake Tahoe has dropped by >70% in many cases.

Changes in temperatures and amounts and timing of precipitation have led to earlier peak streamflows in most Sierra Nevada streams, with higher spring flows and lower summer flows. Streamflow data show

that peak snowmelt in the LTB is occurring 2½ weeks earlier today than at the beginning of the 1960's. Forest fire frequency, size, total area burned, and – in some forest types – severity have all been increasing in the Sierra Nevada over the last two to three decades. Non-fire driven mortality of adult trees also appears to be increasing in lower and middle elevation forests in the Sierra Nevada, but not at higher elevations (>7500 feet), where warming temperatures have lengthened the short summer growing season. Studies of terrestrial vertebrate animals, birds, and butterflies show that many species have been shifting their ranges toward higher elevations, probably in response to warming temperatures and changing precipitation patterns.

Summary of projected future trends in and around the Lake Tahoe Basin

(From Safford 2010, Appendix D)

Although climate change models vary in their projections for the latter half of the 21st century, all predict significant warming (about 4 to 9° F in mean annual temperatures by 2100) in the northern Sierra Nevada, most expect precipitation to remain similar or slightly reduced compared to today. Raising the LTB's mean annual temperature by 9° is the equivalent of dropping the elevation by over 2500 feet. Most models also agree that summers will be drier on average than they are currently, regardless of levels of annual precipitation. Models project a continuously increasing rain:snow ratio and earlier runoff dates for the next century, with decreased snowpack and growing-season stream flow. The most extreme future emissions scenarios project stream inflows into Lake Tahoe may drop 20-40% by 2100. Hydrological modeling projects lower spring and summer runoff in most Sierra Nevada river basins, but winter and early spring runoff is projected to be higher under most climate scenarios, as higher temperatures cause snow to melt earlier. Flood potential in Sierra Nevada rivers that are fed principally by snowmelt (i.e., higher elevation streams) is projected by most models to rise, principally due to earlier dates of peak daily flows and the increase in the proportion of precipitation falling as rain. If overall precipitation increases over time, streamflow volumes during peak runoff will increase even more, leading to notably higher flood risk in downstream locations.

Vegetation and fire modeling linked to future climate scenarios suggests that the area of conifer-dominated forest in the Sierra Nevada will decrease, as hardwood species respond positively to warmer nighttime temperatures and changing disturbance regimes (and especially if precipitation increases). Many scenarios also expect grassland area to increase at lower and middle elevations, as woody vegetation retracts in the face of increased fire frequency. Increased fire activity in the Sierra Nevada may also increase chaparral, which would increase forest heterogeneity and influence the future fire regime (Nagel and Taylor 2005). Current trends of increasing fire activity and burned area are expected to continue under almost all future climate scenarios, and some models project increases in fire intensity as well. Additionally, Loudermilk et al. (2013) modeled multiple climate scenarios coupled with landscape disturbance modeling (LANDIS-II) over the next century. Their results suggest that increasing temperatures and wildfire activity may decrease establishment ability of subalpine and upper montane trees.

Potential implications of climate trends for Lake Tahoe Basin ecosystems

To this point, a climate change vulnerability assessment has not been carried out for the Lake Tahoe Basin, however a number of climate change adaptation assessments have been completed for areas including or neighboring the LTB. As a case study within a broader national assessment, Joyce et al. (2008) carried out a preliminary climate change adaptation evaluation for the Tahoe National Forest on the Sierra Nevada west slope; the Tahoe National Forest borders the LTBMU on the northwest. In May, 2011, The Nature Conservancy completed an adaptation assessment for the Northern Sierra Partnership (NSP) (Low et al. 2011), an alliance of non-governmental organizations focused on conservation in the northern Sierra Nevada. Although the Lake Tahoe Basin falls within the NSP area of interest, it is itself not a focus area for NSP conservation efforts.

The Low et al. (2011) report integrates climate projections, forecasts of the response of major habitat types, and management simulations to determine where northern Sierra Nevada ecosystems may be at greatest risk from projected future climate changes, and what conservation strategies might be most cost-effective for reducing or adapting to climate risks for selected at-risk ecosystems. Based on literature review and expert input, the authors expect the following ecological impacts to result from climate change:

- More frequent, larger fires
- Higher tree mortality during longer growing season droughts
- Longer periods of low stream flows
- Longer periods of groundwater recharge during colder months
- Increased dispersal of non-native species
- Greater conifer and deciduous tree species recruitment and growth in meadows/wetlands/riparian areas due to drought and CO_2 fertilization
- Impaired recruitment of willow and cottonwood due to modified hydrology
- Faster growth of fast-growing native tree species
- Increased recruitment of high-elevation trees
- Increased dispersal of pinyon pine and juniper in shrublands

In their analysis, Low et al. (2011) used a comparison of current vegetation distribution vs. areas of probable future persistence to develop an index of direct "climate stress". The authors found that red fir and lodgepole pine forests, area of montane sagebrush, and aspen were more likely than other major vegetation types to lose habitat under future climates (excluding disturbances and other non-climate factors). Those least likely to suffer *direct* climatic stress were mixed conifer and pine-dominated forest types, blue oak, and subalpine forests.

Low et al. (2011) also modeled distributions of vegetation successional (seral) stages within different vegetation types, and compared baseline models (which they assumed represented the natural range of variability [NRV]) against current conditions and future projections. They found that the vegetation types that are currently most departed from NRV are riparian and wet meadow types, followed by aspen, big sagebrush, and yellow (ponderosa and Jeffrey) pine-dominated conifer forests. Vegetation types under the greatest risk of loss, invasion, and/or conversion under future climate warming were, in this order: (1) wet meadows; (2) riparian systems; (3) big sagebrush; (4) yellow pine-dominated conifer forests; (5) other sagebrush ecosystems.

As a case study within a broader national assessment, Joyce et al. (2008) carried out a preliminary climate change adaptation evaluation for the Tahoe National Forest on the Sierra Nevada west slope; the Tahoe National Forest borders the LTBMU on the northwest. Joyce et al. (2008) identified the following key climate change impacts to the northern Sierra Nevada:

- Combined effects of continued warming, declining snowpack, and earlier stream runoff threaten longer summer droughts and greater soil moisture deficits during the growing season. This will increase stress that an already long, dry Mediterranean summer imposes on vegetation and wildlife
- Increased fuel build-up and risk of uncharacteristically severe and widespread forest fire
- Longer fire seasons; year-round fires in some areas
- Higher-elevation insect and disease and wildfire events
- Increased interannual variability in precipitation, leading to fuel build-up and causing additional forest stress. This situation promotes fire vulnerabilities and sensitivities
- Increased water temperatures in rivers and lakes and lower water levels in late summer
- Increased stress to forests during periodic multi-year droughts; heightened forest mortality

- Decreased water quality as a result of increased watershed erosion and sediment flow
- Increased likelihood of severe floods
- Loss of seed and other germplasm sources as a result of population extirpation events

Safford (2010; see Appendix D), identifies other potential impacts of ongoing and future climate change, including changing geographic distributions of animal and plant species, and changing patterns of dominant vegetation composition and structure.

3.4.7.3. Environmental Consequences

Climate change is one of the greatest challenges to sustainable management of forests and human well-being because rates of change will likely exceed many ecosystems' capabilities to naturally adapt. Rapidly changing climate and associated agents of change, such as amplified fire regimes, insects and diseases, atmospheric contaminants, and invasive species, have resulted in recent impacts to forest ecosystems and resources in the LTB and surrounding Sierra Nevada. Anticipating future effects of changing climate to these ecosystems will be challenging, since climate projections are inherently uncertain and climate-related stressors are variable and complex. An adaptive management approach that incorporates the best available science information, monitors ecological conditions, and adjusts management approaches based on these conditions is crucial in an era of rapidly changing climate.

The first step in addressing climate change is to carefully assess the associated risks and vulnerabilities for the natural and human communities. Vulnerability assessments are one management strategy that may be utilized to guide management for climate change. In order to build resilience we must understand the vulnerabilities, including projected environmental changes, key values at risk, and the sensitivity of those values at risk to projected change. A vulnerability assessment spans the range of ecosystems and values at risk to identify the relative vulnerability of ecosystem components and their ability to adapt to increased stress. In turn, this helps prioritize where management actions may focus in order to maintain healthy, resilient ecosystems and protect human communities. A collaborative approach to vulnerability assessment (including management, research, and the public) can help to avoid fragmented, piecemeal approaches that lack public support. Development of vulnerability assessments is being undertaken separate from Forest Plan revision. A Sierra-Nevada Regional effort is underway that will cover California Forests in the Sierra Nevada. This work will continue regardless of which alternative is selected.

An effective management strategy to changing climate must be flexible, responsive, incremental, and reversible (Millar et al. 2007). This will be especially challenging in forest ecosystems of the LTB and surrounding Sierra Nevada that are typified by homogeneous canopy structure and heavy fuel loads, resulting from decades of fire exclusion and intensive logging (McKelvey and Johnston 1992, Murphy and Knopp 2000, North et al. 2007). Both adaptation strategies and mitigation strategies will be necessary to manage forest ecosystems in the context of changing climates and amplified fire regimes (Millar et al. 2007, Stephens et al. 2010). Adaptation strategies increase the resilience of ecosystems and resources to climate change impacts (IPCC 2007). Promotion of key ecological processes, heterogeneity in forest structure, biodiversity, and reduced surface and ladder fuels conducive to restoring wildland fire are examples of effective adaptive strategies for Sierra Nevada ecosystems in the face of changing climate (Stephens et al. 2010). Mitigation strategies seek to reduce the long-term severity of climate change by lowering the concentration of greenhouse gases in the atmosphere. Examples of mitigation strategies include carbon sequestration in ecosystems, renewable energy to reduce fossil fuel consumption, and reduction in carbon footprint through sustainable practices and operations. If we actively manage ecosystems before climate-related effects induce change, long term management goals may be attained more effectively with fewer resources. Short term adaptations build resistance and resilience so that ecosystems are better able to withstand change, while long term adaptations are needed to avoid thresholds being crossed where one ecosystem abruptly transitions into another (Blate et al. 2009).

Below, the alternatives are compared with respect to their predicted relative abilities to support six adaptation or mitigation strategies that are current focus areas for Forest Service response to climate change (USFS 2008, 2011). These strategies are: (1) building adaptive capacity of ecosystems through ecological restoration, (2) enhancing watershed health, (3) sequestering forest carbon, (4) reducing existing stresses, (5) sustainable operations, and (6) fostering science-management partnerships and public education.

Building adaptive capacity of ecosystems through ecological restoration

Ecological restoration is a major focus area for forest managers throughout the Sierra Nevada. A prerequisite for restoration is the identification of current condition and trend in the focus forest type, and the identification of historical reference conditions that can provide guidance as to the nature of "proper function" in ecosystem processes and the capacity of certain forest structures and functions to be "resilient" to environmental change. Climate change is projected to become one of the main drivers of extinction and habitat loss (Dawson et al. 2011). It is widely thought that restoration practices based on a thorough understanding of past, pre-EuroAmerican settlement conditions are more likely to be sustainable over time. Adaptive capacity of biological and landscape level diversity to climate change depends on both intrinsic factors (e.g., species, ecosystem type, genetics) and extrinsic factors (e.g., rate of change, additional stressors) (Dawson et al. 2011). Restoration and protection of habitats may be critical for increasing species and ecosystem adaptive capacity to climate change, depending on the individual species and/or ecosystem specific; both positive and negative effects on species have been identified due to a changing climate (Dawson et al. 2011). Litell et al. (2012) and Blate et al. (2009) recommend several adaptation strategies that can be linked to building adaptive capacity of ecosystems through ecological restoration:

- Increase landscape diversity
- Implement treatments that restore resilience at large spatial scales
- Reduce fuel loads in forests
- Develop silvicultural treatments to reduce drought stress
- Treat large-scale disturbance as a management opportunity and integrate it in planning
- Increase use of managed wildfire for multiple objectives
- Maintain biological diversity
- Develop corridors/habitat connectivity for species migration and habitat protection
- Review genetic guidelines for reforestation

Increase landscape diversity

All alternatives increase landscape diversity to some extent. A desired condition of the forest plan is that stand and landscape conditions provide a diversity in vegetation types, stand structures, and species compositions that resembles patterns resulting from the interaction of natural disturbance regimes (e.g., wildland fire, insect and disease outbreaks, landslide and avalanche, windthrow, flooding, pre-Comstock aboriginal manipulations), variations in the physical landscape (e.g., elevation, soils, site productivity, aspect, slope), and the reigning climate.

Alternatives B, C and E focus on managing for forest structural heterogeneity and landscape diversity, which will increase resilience to stressors. As new data become available, updated reference conditions may be applied when and where appropriate. Alternatives B, C and E provide flexibility in order to meet heterogeneity within the natural range of variability. Alternative A has the potential to increase landscape diversity in early and late seral forests; however this alternative has absolute canopy closure limits so there isn't 100% flexibility. Alternative D depends on natural events, such as wildfire, to increase landscape diversity.

Alternatives A and D restrict vegetation treatments in old forest ecosystems under the old forest emphasis area. Alternatives B, C and E do not use the old forest emphasis designation, but instead old growth is preserved wherever it occurs and mid-seral forests are promoted for future late-seral conditions (mid-seral forest is also where we will be creating early-seral forest).

Reduce fuel loads and promote resilience

All alternatives reduce fuel loads in the Wildland Urban Intermix (WUI) where community safety is the first fuels priority. Alternatives B, C and E emphasize active ecological restoration to restore resilience and protect natural resources in both the WUI and across the landscape. These alternatives provide the greatest flexibility for ecological restoration.

Under certain circumstances, trees greater than 30 inches DBH may be removed in alternatives B, C and E to achieve forest health, restoration, and safety goals. Alternative A only allows removal of trees greater than 30 inches DBH for hazard tree removal or to enable equipment operation. After existing projects are implemented, Alternative D allows only trees less than 12 inches DBH to be removed outside of the defense zone in order to facilitate safe use of prescribed fire and natural ignitions. Hand thinning limitations in alternative D may not result in sufficient openings as trees get larger, especially if large scale disturbances are absent on the landscape.

Silvicultural treatments in alternatives B, C and E would be designed within the natural range of variability to provide greater resilience to insect outbreaks and drought. Alternative C would reduce the number of treatment entries compared to alternatives B and E by reducing stand densities towards the lower end of the natural range of variation. Alternative D vegetation management outside WUI includes some hand thinning to manipulate stand structure for forest health and to facilitate burning, the focus would be to let natural processes operate to restore and promote resilience.

Alternatives C and D would recommend Dardanelles Roadless Area for addition to the National Wilderness Preservation System. Additionally, Alternative D would recommend Freel Roadless Area for addition to the National Wilderness Preservation System. Any additional wilderness area will reduce the acres available for some forms of restoration practices utilized for building adaptive capacity and promoting resilience.

Integrate disturbance processes into management

A desired condition of the forest plan is that disturbance processes occur in the ecosystem within the natural range of variability, and, where this is not feasible due to inherent risks, surrogates (e.g., prescribed fire, thinning) are used carefully to effectively mimic natural disturbance. Disturbance processes and/or their surrogates create and maintain forest conditions that are well-adapted to current and future climates.

Alternatives B, C, D and E have more flexibility to use large scale disturbance, including wildland fire, as management opportunities than alternative A, which has aggressive fire suppression guidance. Alternatives B, D, and E provide the greatest flexibility, allowing planned and unplanned ignitions to be utilized for forest health restoration purposes in all fire management zones except the WUI defense zone, although Alternatives B and E have fewer restrictions to thinning to facilitate safe use of fire than Alternative D. Alternative C allows planned and unplanned ignitions to be utilized for forest health restoration purposes in all fire management zones except the WUI Defense and Threat zones. Alternative A only allows unplanned ignitions to be used for resource objectives in the Desolation Wilderness

However, managed wildfire alone is challenging and may not be the appropriate choice in many situations, especially as ignitions occur near the WUI. Forests in the Lake Tahoe Basin and other public and private lands in the eastern Sierra Nevada have been greatly altered by human management over the

past 150 years. EuroAmerican settlement has led to more homogenous forest structure and a shift to higher stand densities and more fire intolerant species (Beaty and Taylor 2008). High fuel loads combined with the homogenous forest structure can lead to uncharacteristically severe wildfire. Alternatives with the most flexibility for reducing high fuel loads will provide more opportunities for the safe use of managed wildfire.

Maintain biological diversity and provide habitat connectivity

Biological diversity will be maintained and improved in Alternatives A, B, C and E. Alternatives B, C and E would promote active mitigation and restoration strategies to ensure sufficient quality habitat is available for target species. Habitat connectivity would be provided for unobstructed movement sufficient for survival, migration, reproduction, and dispersal given the potential effects of climate change on habitat and species and trophic level biodiversity will be considered during project planning and design. In addition, alternatives B, C and E include management direction to protect and restore habitat for target species and to allow restoration activities in PACs.

Although Alternative A does not include specific measures for active restoration to improve biological species and habitats, active management would still occur in some instances. Alternatives A and D do not allow restoration activities in PACs. After completion of currently planned projects, Alternative D would not use active restoration to maintain or improve biological diversity; natural processes would control ecosystem diversity. Alternatives A and D do not specifically consider habitat connectivity, however alternative D may provide habitat connectivity due to decreased recreational opportunities. On the other hand, Alternative D could decrease biological diversity due to passive management, which could potentially increase stressors.

Utilize silvicultural genetic strategies to promote forest resiliency and adaptability

Alternatives B, C and E provide specific strategies for incorporating species mix, stocking density, or use of genetically superior or pest resistant planting stock, to restore landscapes and improve adaptability under climate change. Alternatives B, C and E also recommend that restoration activities use species and populations that are adapted to current and likely future conditions to successfully reestablish resilient ecosystems after disturbances. Alternative A does not specifically mention reviewing genetic guidelines for reforestation, however other Forest Service direction may still provide guidance on this (e.g., FSM 2600). Alternative D would not use reforestation, because this alternative would focus on natural reforestation.

Enhancing watershed health

Climate change is projected to become one of the main drivers of extinction and habitat loss (Dawson et al. 2011). Adaptive capacity of biological and landscape level diversity to climate change depends on both intrinsic factors (e.g., species, ecosystem type, genetics) and extrinsic factors (e.g., rate of change, additional stressors) (Dawson et al. 2011). Restoration and protection of habitats may be critical for increasing species and ecosystem adaptive capacity to climate change, depending on the individual species and/or ecosystem specific; both positive and negative effects on species have been identified due to a changing climate (Dawson et al. 2011). Litell et al. (2012) and Blate et al. (2009) recommend several adaptation strategies for building adaptive capacity that can be linked to enhancing watershed function:

- Increase landscape diversity
- Implement treatments that restore resilience at large spatial scales
- Maintain biological diversity
- Develop corridors/ habitat connectivity for species migration and habitat protection

Landscape diversity will be maintained and improved in alternatives A, B, C and E. Alternative A focuses primarily on restoration of streams and watershed processes, while alternatives B, C and E increases

emphasis on aquatic habitat improvement with equal emphasis on stream process, water quality, and aquatic habitat components. These alternatives recognize the need for restoring resilience into watershed systems and their associated habitats specifically to better enable them to adapt to changing climate conditions. Alternative D does not use active restoration to build adaptive capacity. Restoration would only occur where existing projects are planned or where infrastructure has accelerated degradation. The assumption behind this alternative is that the natural processes would be responsible for setting the pace to achieve equilibrium with existing and future stressors. Fire suppression activities have led to an increase in biomass, which can lead to nutrient mobilization impacts on water quality during wildfires (Miller et al. 2010). Alternative D has the least protection for water quality due to the increased potential for wildfires burning at increased frequency and severity (Karam et al. 2013, Miller et al. 2010, Johnson et al. 2007).

Biological diversity and development of corridors/habitat connectivity for species migration and habitat protection is discussed under building adaptive capacity of ecosystems through ecological restoration.

Sequestering forest carbon

Forests are recognized as a carbon sink; however management techniques vary for managing forests with frequent fire regimes to maximize carbon storage while minimizing carbon emissions during planned and unplanned fires. The risk of losing stored carbon to disturbance is important to consider when developing management prescriptions (Hurteau et al. 2009). In the short term, overgrown fire-suppressed stands may contain more carbon than a treated forest until a large disturbance event occurs. Hurteau and North (2009) found that while untreated forested stands had the greatest carbon storage in the presence of wildfire these stands had the largest total carbon emissions. They found that maximizing carbon in the presence of fire was best achieved with treatments designed for a lower stand density with large fire resistant trees. North and Hurteau (2009) found that in seven years 'burn only' and 'understory thin' treatments had net positive carbon stocks, while the 'overstory thin', and 'overstory thin and burn' treatments had net negative carbon stocks. The 'understory thin and burn' treatment had a net negative carbon balance after 7 years; however tree growth rates suggested that this treatment would become a net positive balance after an additional several years.

Loudermilk et al. (2013) found that due to the legacy effects of Comstock logging and fire suppression, the forests of the LTB continue to be C sinks over the next century, regardless of fuels treatments. This study is based on landscape disturbance modeling (LANDIS-II) incorporating multiple climate change scenarios and relative increases in wildfire. However, the wildfire activity is a conservative estimate. The authors note that should actual wildfire activity be greater than their estimate, LTB forest may likely become C neutral or a C source.

Fuel treatments are important in forests where fire suppression has caused a deviation from historic fire regimes, causing hazardous fire conditions. Montane forests in the Lake Tahoe Basin and other public and private lands in the eastern Sierra Nevada have been greatly altered by human management over the past 150 years. EuroAmerican settlement has led to more homogenous forest structure and a shift to higher stand densities and more fire intolerant species in montane forests (Beaty and Taylor 2008). High fuel loads combined with the homogenous forest structure can lead to uncharacteristically severe wildfire. In the montane zone of the Lake Tahoe Basin the average pre-settlement fire return interval ranged from 8 to 17 years (Beaty and Taylor 2009, Taylor 2004). Current fire frequency is at one of its lowest points in the last 14,000 years. The paleo-record suggests that climate warming will increase fire episode frequency as regional drought intensifies (Beaty and Taylor 2009, Taylor 2004).

Restoration in subalpine and upper montane fuel treatments in higher-elevation red-fir, lodgepole pine, whitebark pine, mountain hemlock forests may not be warranted or may be needed at a smaller scale compared to montane forests. Subalpine forest composition, structure, and function are largely within the

natural range of variation, except for in relation to total tree densities (Meyer 2013). A decrease in the density of large-diameter subalpine trees and an increase in smaller diameter trees is largely the result of logging and recent climatic warming (Meyer 2013). While fire frequency and severity and mountain pine beetle outbreaks are still within the natural range of variation, these disturbances are projected to increase with climate change (Meyer 2013).

Various authors have recommended different mitigation strategies for sequestering carbon in areas with a frequent fire regime:

- Develop vegetation treatments to achieve a lower overall stand density with large fire resistant trees (Hurteau and North 2009);
- Reduce surface and ladder fuels (Hurteau and North 2010, North et al. 2009);
- Store carbon in wood products or use it as a biomass fuel (Millar et al. 2007);
- Avoid uniform high density forest conditions vulnerable to severe disturbance (Millar et al. 2007), mimic natural disturbance patterns;

While the above mitigation strategies can be helpful for carbon sequestration, carbon storage is a complex issue that has much debate within the scientific community. These above strategies are not meant to be exhaustive, but rather are presented as ideas for forests specifically that have a frequent fire regime. Treatments need to be balanced with potential for natural disturbance; harvesting frequency and the structural retention influence the carbon storage of each site and the more intensive a treatment is the greater the reduction of carbon (Nunery and Keeton 2010).

Alternatives B, C and E will retain the highest level of forest carbon over the coming century due to a reduction in stand replacing fires. Treatments under these alternatives focus on restoration across the landscape to achieve forest structural heterogeneity and landscape diversity and lower stand densities dominated by fire resistant trees. Alternative C will have fewer entries than alternatives B and E, which will reduce emissions during project implementation. Alternative A focuses on treatments in the WUI, which will also retain high levels of forest carbon. Alternative D will retain the greatest amount of carbon over the short term; however in the presence of a large wildfire this alternative is likely to retain the least amount of carbon because treatments outside the WUI are limited and these stands will have greater densities than in other treatments.

The use of wood products for biofuels is not discussed under any alternative and the potential carbon sequestration value of wood varies depending on use (Lauk et al. 2012), length of use, and decomposition process; however it may be an option for alternatives A, B, C and E which allow post disturbance timber harvest. Alternative A allows post disturbance timber harvest for commercial value. Alternative B, C and E consider post disturbance timber harvest after concerns for safety, habitat, soils, and water resources are met to meet restoration objectives. Post fire timber harvest is not proposed in alternative D, which in addition to not using the wood products for biomass or alternative products, may slow overall recovery of the forest and thus slow carbon accumulation from regenerating forest species.

Reducing existing stresses

Climate change is one of the greatest drivers of ecological change. Restoration and protection of habitats and removal of stressors unrelated to climate is one of the most important adaptation options for building ecosystem resilience in response to climate change (Blate et al. 2009, Dawson et al. 2011). Litell et al. (2012) and Blate et al. (2009) recommend several adaptation strategies that can be linked to reducing existing stresses:

- Implement early detection/rapid response for non-native invasive species and undesirable resource conditions
- Implement treatments that restore resilience at large spatial scales

Early detection/rapid response will be utilized in alternative B, C and E for aquatic and terrestrial non-native invasive species. Alternative A provides direction for early detection/rapid response of terrestrial species only. Alternative D focuses on allowing natural processes to control the rate of recovery. This alternative does not utilize early detection/ rapid response as an adaptation strategy. Restoration actions would only occur to remove stressors, focusing only on the removal of high priority species or where directed by law.

Alternatives B, C and E include language specifically intended to promote resilience to stressors including resilience to fire, changing climate, disease, and insect outbreaks. Alternative D promotes resilience to stressors by reducing recreation impacts from humans on resources under certain circumstances. Alternative A does not include specific language to promote resilience to stressors.

Sustainable operations

Healthy forests are directly linked to sustainable consumption. The Forest Service is committed to reducing our environmental footprint, and including these principles into our programs, practices, and policies. Litell et al. (2012) and Blate et al. (2009) recommend several adaptation strategies that can be linked to sustainable operations:

- Implement treatments that restore resilience at large spatial scales
- Expand recreational opportunities across all four seasons
- Match engineering of infrastructure to expected future conditions
- Redesign roads and trails to withstand increases in rainfall intensity

All alternatives consider recreational opportunities across all four seasons. However, recreational capacity is greatest in Alternative C meeting the greatest visitor demand and lowest in Alternative D, which has the most unmet demand for recreation. Alternatives B and E have the greatest sustainable benefit, because it links recreational demand to improvements in ecological sustainability, which will restore resilience. Alternative A includes expansion of recreation infrastructure and development of new sites to meet predicted future demands after safety and resource impacts are assessed. Alternatives B and E focus on deferred maintenance and modification of existing facilities to achieve ecological, social and economic sustainability. Expansion could occur in general forest or within existing facility footprints when facilities are modified or displaced. These alternatives would also increase overnight accommodation sites. Alternative C would provide the greatest number of overnight accommodation units, the greatest number of day use parking spaces, and greatest number of developed acres. Alternative D would not replace recreation lost to ecological restoration, financial constraints or conflicts with other resources. Recreational infrastructure would not increase or expand to accommodate increased demand. While alternative D improves ecological conditions, this alternative does not provide for increased recreational demand; this could lead to an increase in unmanaged recreation which could lead to additional ecological problems due to the lack of infrastructure in a place where approximately 5.7 million visitors visit annually.

All alternatives continue developed ski area recreation. Climate models project a continuously increasing rain:snow ratio and earlier runoff dates for the next century, with decreased snowpack and growing-season stream flow. Alternative A allows for the greatest expansion of ski area operational boundary acres and Alternative D allows the least amount of expansion, with the potential for a decrease in total acres; the potential for an increase in the operational footprint acres from greatest to smallest goes: A, C, E/ B, and then D. Expanding recreational opportunities to other seasons in ski areas will become increasingly important.

While alternative D does increase recommended wilderness acres, it decreases overall recreational capacity (described in preceding paragraphs). Alternatives A and B continue management of existing wilderness and inventoried roadless in accordance with current plans and policies. Alternatives C and D

would recommend Dardanelles Roadless Area for addition to the National Wilderness Preservation System. Additionally, Alternative D would recommend Freel Roadless Area for addition to the National Wilderness Preservation System and would shift 12,000 acres from General Conservation to Backcountry Management Area. Alternative E would add Stanford Rock Backcountry Area, shifting approximately 3,800 acres from General Conservation to Backcountry.

All of the alternatives use Access and Travel Management (ATM) planning to identify routes, crossing upgrade and BMP needs, and restoration and reroute opportunities that will protect and enhance natural resources. This process will assist engineering with matching infrastructure to expected future conditions. Alternative A would expand the non-motorized trail system and construction of trailhead parking. Alternatives B, C, D, and E would formalize the ATM planning process and would revisit ATM projects after implementation to adaptively manage and determine the effectiveness of their implementation and to address new and remaining issues. Alternative C would increase vehicle access to the forest on passenger vehicle routes, decrease percentage of challenging vehicle routes, and would increase developed parking. Additionally, Alternative C would decrease trails for mechanized use, but non-motorized use is allowed on all routes. Alternative D would reduce the maintenance level of roads and trails compared to current maintenance level, which would increase the percentage of primitive and challenging trails.

The Forest Service has concurrent Executive Orders and statutory requirements to reduce the environmental footprint for all federal agencies. Under all alternatives, the LTBMU will reduce its environmental footprint and decrease greenhouse gases emitted through implementation of sustainable practices in its day-to-day operations.

All alternatives promote the use of public transport through the development of multi-modal transit stops, which will reduce greenhouse gases emitted. During the summer recreation, Alternative C would provide the greatest amount of managed parking, while alternatives A, B,, and E would reduce roadside parking, with alternative D containing the least amount of managed parking. The reduction in managed parking may lead to an increase in the use of public transportation, which could reduce GHG. During winter recreations, dispersed parking would increase under alternatives B, C, and E and remain the same under alternatives A and D.

Fostering science-management partnerships and public education

Many of our climate change activities will require assistance from technical climate experts. Long term science-management partnerships facilitate adaptive management of public lands (Vogel et al. 2007). Science based adaptation is critical because if management actions are monitored then we can increase certainty about climate impacts (Litell et al. 2012). Litell et al. (2012) and Blate et al. (2009) recommend several adaptation strategies that can be linked to fostering science-management partnerships and public education:

- Promote education and awareness about climate change among resource staff and local publics
- Collaborate with a variety of partners on adaptation strategies and to promote ecoregional management
- Enhance research partnerships
- Expand conservation education programs to include climate change
- Seek opportunities to educate national forest visitors on climate change

The Forest Service provides guidance on educating resource staff about climate change. The LTBMU will continue to educate resource staff under all alternatives in regards to climate change.

In 2010 the LTBMU participated in a climate change working group that partnered with: California Tahoe Conservancy, Nevada Division of Environmental Protection, Tahoe Metropolitan Planning Organization, Tahoe Regional Planning Agency, Tahoe Science Consortium, Tahoe Transportation

District, US Environmental Protection Agency, USFS – Lake Tahoe Basin Management Unit, Lahontan Regional Water Quality Control Board, US Army Corps of Engineers (USACE), and two Consultants who led the group. The LTBMU will continue to collaborate with partners on adaptation strategies under all alternatives.

Primary researcher institutions that the LTBMU currently collaborates with include the Tahoe Science Consortium, UC Davis, University of Nevada Reno, Pacific Southwest Research Station, Tahoe Regional Planning Agency, Desert Research Institute and Humboldt State University. The LTBMU will continue to enhance research partnerships under all alternatives.

While the alternatives do not contain a specific strategy for educating national forest visitors on climate change, these programs may still be developed depending on funding. An assumption could be made that opportunities for education would increase with an increase in developed recreation, although this is likely not linear. Alternatives with the greatest number of developed recreation acres, in decreasing order, are: C, A, B/E, D.

3.4.7.4. Analytical Conclusions

Comparison of Consequences by Alternative

The five alternatives are ranked by their overall ability to address the adaptation and mitigation strategies presented above:

- Building adaptive capacity of ecosystems through ecological restoration: B/C/E, A, D
- Enhancing watershed function: B/C/E, A, D
- Sequestering forest carbon: C, B/E, A, D
- Reducing existing stresses: B/C/E, A, D
- Sustainable operations: B/E, D, C, A
- Fostering science-management partnerships and public education: C, A, B/E, D

These alternatives were then assigned a numerical rank based on the weight of each of the six adaptation and mitigation strategies discussed (Table 3-29).

Table 3 29. Climate change adaptation and mitigation strategies numerical ranking by alternative

Adaptation/Mitigation Strategy	A	B	C	D	E
Building adaptive capacity of ecosystems through ecological restoration	2	3	3	1	3
Enhancing watershed function	2	3	3	1	3
Sequestering forest carbon	1	3	4	2	3
Reducing existing stresses	2	3	3	1	3
Sustainable operations	1	4	2	3	4
Fostering science-management partnerships and public education	3	2	4	1	2
Sum Numerical Rank of Each Alternative for addressing Climate Change	11	18	19	9	18

Overall alternatives C, B, and E are best prepared to address adaptation and mitigation strategies in response to climate change; alternatives A and D are least prepared. Alternative D may not implement the

adaptation and mitigation strategies identified, because this alternative primarily relies on natural processes, which reduces flexibility for managers to implement strategies.

How the Alternatives Maintain or Achieve the Desired Conditions

The Forest Plan has eight desired conditions that specifically mention climate. Additional climate language can be found in the Forest Plan strategies. Alternatives A, B, C, and E will be able to meet the desired conditions, with alternatives B, C, and E having the greatest ability to do so. Alternative D may not be able to meet the desired conditions during the life of the plan, because this alternative depends on passive management (after currently planned projects are implemented). The eight desired conditions are:

DC15: Watersheds have the following characteristics: A) They are resilient and recover rapidly from natural and human disturbances. B) They exhibit a high degree of connectivity along the stream, laterally across the floodplain and valley bottom, and vertically between surface and subsurface flows. C) They provide important ecosystem services such as high quality water, recharge of streams and aquifers, the maintenance of riparian communities, and moderation of climate variability and change. D) They maintain long-term soil productivity.

DC19: The LTBMU incorporates adaptation actions into management to increase resiliency and adaptive capacity of vulnerable resources.

DC22: Disturbance processes occur in the ecosystem within the historic range of variability, and, where this is not feasible due to inherent risks, surrogates (e.g., prescribed fire, thinning) are used carefully to effectively mimic natural disturbance. Disturbance processes and/or their surrogates create and maintain forest conditions that are well-adapted to current and future climates.

DC23: Stand and landscape conditions provide a diversity in vegetation types, stand structures, and species compositions that resembles patterns (figure 3) resulting from the interaction of disturbance regimes (e.g., wildland fire, insect and disease outbreaks, landslide and avalanche, windthrow, flooding, pre-Comstock aboriginal manipulations), variations in the physical landscape (e.g., elevation, soils, site productivity, aspect, slope), and the reigning climate. Forest structure should vary over the landscape in relation to topographic variables of slope, aspect, and slope position.

DC46: At the scale of the LTB as a whole, the area of high functioning meadow vegetation is higher than in 2009 and the trend is up and meadow wetness is maintained or increasing as determined by species composition. A high diversity of meadow types is represented in the LTB, and soil drying and conifer encroachment that is due to human management is halted and reversed. Meadows affected by soil drying and conifer encroachment due to climate effects may also be targeted for treatment, depending on management goals. Bare ground cover is reduced in many meadows. Healthy stands of willow, alder and aspen grow in appropriate places within and adjacent to meadows.

DC57: Terrestrial and aquatic habitat connectivity continues to provide unobstructed movement sufficient for survival, migration, reproduction, and dispersal given the potential effects of climate change on habitat and species.

DC62: Inherent genetic variability within native plant populations is conserved and is sufficient to respond and adapt to changing climates and environment conditions.

DC82: Forest conditions in whitebark pine stands are the result of natural ecological processes, which occur with little direct human influence. Stand density, age distribution, and structural heterogeneity are such that stands are resilient to disturbance (e.g., wildfire and climate change) and resistant to pathogen infestations (such as white pine blister rust and mountain pine beetle).

The strategies specific to climate change that help meet climate change specific desired conditions include:

- A vulnerability assessment will be completed at the Regional Level for the Sierra Nevada. The LTBMU will collaborate on local and regional vulnerability assessments.
- Vulnerability assessments related to climate change will be incorporated into management on the LTBMU as information is synthesized. Adaptation activities recommended for vulnerable resources will be considered and prioritized based on funding.
- Consider restoration of species and/or habitat identified as vulnerable to climate change during project planning.
- Restoration for individual species should be considered during habitat restoration, especially for vulnerable resources.
- Minimize management impacts to species that are vulnerable to climate change. Reduction of stress (e.g., human activities, invasive species) related to management will reduce the additive effects of non-climate stress.
- Reforestation strategies incorporate species mix, stocking density, or use of genetically superior (e.g., five-needle pines that are major gene resistant or slow resistant to white pine blister rust) or pest resistant planting stock, to restore landscapes and improve adaptability under climate change.
- Consider all levels of food web (trophic level) biodiversity (example predator/prey) during project planning and design to help mitigate climate change exposure to individual species and communities (e.g., from changes in phenology and habitat shifts).
- Consider habitat connectivity for species that may be impacted due to climate change by removing or modifying physical impediments to movements.
- Consider the potential for changed flow regimes as a result of climate change during the development of the aquatic organism passage management and monitoring plan.
- Identify and, as needed, protect refuge areas for rare plants with habitat that is likely to reduce or change due to climate change (e.g., subalpine & alpine habitat).
- Conserve whitebark pine genetic diversity by collecting and archiving seeds and growing and planting genetically diverse seedlings. Identify and collect seed from trees that exhibit some level of WPBR resistance. Where possible, protect valuable rust-resistant, seed-producing trees from future mortality caused by disturbance, climate change, and competition.
- Translate science behind the principles and methods for sustaining forests in changing climate into easily accessible tools and information to build environmental awareness, knowledge and skills.

3.4.8. Cultural Resources

3.4.8.1. Introduction

This section evaluates and discloses the potential environmental consequences on Cultural Resources that may result with the adoption of a revised land management plan. It examines the five alternatives for revising the 1988 LTBMU Forest Plan.

Methodology

No modeling was used for this analysis. It is a qualitative analysis.

Assumptions

In the analysis for this resource, the following assumptions have been made:

All specific projects that result from selection of any alternative will undergo separate National Environmental Policy Act and National Historic Preservation Act review before implementation.

3.4.8.2. Overview of the Affected Environment

As of December, 2011, approximately 68,982 acres have been surveyed (representing 44% of the LTBMU land), and 899 cultural sites have been recorded. Cultural evaluations of 254 sites determined 126 are eligible to be listed on the National Register of Historic Places and 128 are not eligible.

Most inventory and site recording has resulted from large forest health projects. Numerous small project-related inventories, including urban lots and grazing allotments, account for the rest of the survey. This pattern of inventory and site recording has resulted in concentrations of information with large gaps in the more remote portions of the forest that may bias the sample of archaeological resources. The majority of new future inventory opportunities will be funded through the units Section 110 program. (Historic Preservation Act of 1966) efforts.

Additionally, more recent inventories beginning with the East Shore project have included the intensive recording of transportation systems that were ignored during earlier inventories. This has left an uneven impression of the presence of these systems across the forest.

The East Shore project identified a pristine Historic Logging Landscape associated with the Comstock mining boom in Virginia City. Many of the sites within the area have been determined to be contributors to a National Register of Historic Places eligible Comstock Logging District. These sites range from an extensive array of Chinese associated woodcutter cabins, lumber milling sites, flumes, ditches and complex transportation systems. This east shore complex is unique because a single logging event took place in the 1870s to 1900, and then the area was not re-entered, leaving the historic landscape unaltered from more recent logging entries. Managing this large landscape presents challenges during fuels reduction and forest health projects.

Significant Native American milling complexes have been identified in the Meiss Lake, Freel Peak, and Mount Rose areas. Additional Section 110 inventory in similar remote high altitude could expand or further define these complexes.

The Cave Rock Traditional Cultural Property is an important traditional resource that has been identified and evaluated and will present management challenges due to the 2005 Forest Order restricting access to the area. These challenges result because the Code of Federal Regulations does not have a provision in Subpart B (36 CFR 261) for restricting activities. Under Subpart B, areas can only be closed. At Cave Rock, this has resulted in a complex temporary Forest Closure Order that closes the Cave Rock area, then

exempts some non-vertical areas within the closure so the public can access activities that are not in conflict with the management direction. Development of Subpart C (36 CFR 261) regulations in the Code of Federal Regulations that prohibit rock climbing at Cave Rock could help with these challenges. This area may need to be designated a Special Interest Area.

Groves of aspen trees carved by Basque sheepherders have been identified throughout the LTBMU and pose management challenges. These resources consist of carved information and art on living trees, many of which are reaching the end or have exhausted their life expectancy. Treatment of these fragile resources can be complex. These resources could be served by a management plan that provides guidance for recording the information, protecting the trees and carvings, preserving selected examples of the carvings and possibly sustaining them through traditional use.

A Memorandum of Agreement has been developed to restore and rehabilitate nine dilapidated historic cabins at Camp Richardson Resort. These contributors to the National Register of Historic Places Camp Richardson Resort Historic District have been neglected for over 20 years and are in danger of becoming unsalvageable. A focus of future management at Camp Richardson and other Historic resorts should be balancing historic preservation of contributing structures with the resorts' economic viability.

The structures at National Register eligible Glen Alpine Springs Resort are used under a life estate to Robert Fritchee and under a Memorandum of Understanding (MOU) to Historic Preservation of Glen Alpine Springs Inc. Oversight of the resort has been uneven over the duration of the current Land and Resource Management Plan. Some periodic activities may not be appropriately authorized under the MOU and some discussion has taken place regarding putting the resort under Special Use Permit. A Special Use Permit should continue to be pursued for appropriate authorization, management consistency, and ease of transition in the future when the life estate terminates.

3.4.8.3. Environmental Consequences

None of the alternatives will have direct effects to Cultural Resources provided that the assumption noted above is valid. Indirect impacts could accrue from several provisions in some alternatives.

3.4.8.4. Analytical Conclusions

No direct effects will result from the adoption of any of the alternatives.

Comparison of Consequences by Alternative

An indirect effect could accrue if the recommendation of the Dardanelles Inventoried Roadless Area for Wilderness designation in Alternatives C or D is acted upon by Congress. Recent court precedence suggests that historic structures in Wilderness areas cannot be maintained and must be allowed to decay. The Meiss Cabin and Barn are important historic properties within the Dardanelles Inventoried Roadless Area that have been determined to be eligible to the National Register of Historic Places. Unless provisions for maintaining these structures were included in the designation legislation, designation would result in an adverse impact from lack of maintenance. Additionally, historic dams are located at Showers, Dardanelles and Round lakes in the Dardanelles Inventoried Roadless Area. These structures have not been evaluated for their eligibility to the National Register of Historic Places, but similar adverse impacts could result from designation if they are determined eligible.

The same indirect effect would accrue under Alternative D with the addition of the dam at Star Lake within the Freel Inventoried Roadless Area which could also be adversely impacted.

Fuels treatments in Alternative B and E could have the long term indirect effect of reducing or eliminating impacts from wildfires to cultural sites with organic components. In the short term, impacts to cultural sites from treatment activities could occur.

Under Alternative C, the reduced number of entries needed would indirectly reduce the possibility of impacts to cultural sites from project activity while providing the same protection from wildfire as in Alternatives B and E. Wildland fire management for resource objectives could indirectly result in short term increased risk to cultural sites when fire is allowed to burn in areas where cultural inventories have not occurred.

The management of natural ignitions and under burning in Alternative D would have the most risk for indirect impacts to cultural sites while providing the same long term indirect benefits as Alternatives B, C, and E.

How the Alternatives Maintain or Achieve the Desired Conditions

All alternatives equally maintain the Desired Conditions.

3.4.9. Tribal Relations

3.4.9.1. Introduction

This discussion evaluates and discloses the potential environmental consequences on Tribal Relations that may result with the adoption of a revised land management plan. It examines five different alternatives for revising the 1988 Lake Tahoe Basin Management Unit Land and Resource Management Plan as amended (1988 forest plan).

Methodology

No modeling was used for this analysis. It is a qualitative analysis.

Assumptions

It is assumed that the LTBMU will continue its mandated Government to Government relationship with the Tribe.

3.4.9.2. Overview of the Affected Environment

The Washoe people are the original occupants of the land encompassed by the LTBMU and the lands administered by the LTBMU were managed by the Washoe for millennia before their displacement in the late 18^{th} and early 19^{th} centuries. Lake Tahoe is considered by the Washoe to be the center of their aboriginal territory and of great importance to their culture, livelihood and traditions (Washoe 2004). For many years Washoe tribal members had little presence at the lake and often felt unwelcome.

The Tribe has stated reestablishing a Washoe presence at Lake Tahoe, maintaining cultural traditions and language, reintroducing traditional environmental management practices, and increasing trade and commerce as primary goals at Lake Tahoe. Progress toward accomplishing these goals has been made during the life of the LRMP.

The LTBMU has a well-established long term relationship with the Washoe Tribe of Nevada and California (Tribe) that has sustained over the life of the LRMP through several tribal administrations and Forest Service Line Officers. During the life of the previous plan the LTBMU and Tribe have developed a Government to Government protocol agreement and three additional use agreements. The protocol agreement needs to be updated to include other forests with relationships with the Tribe.

The Agreement for Meeks Meadow traditional plant tending and uses and the agreement for collaborative wetlands conservation planning in the Baldwin/Taylor and Meeks Meadow areas have helped maintain and reintroduce traditional practices into the management of land and resources and Lake Tahoe.

Congressional legislation has conveyed approximately 24 acres of land to the Tribe at Skunk Harbor. Additionally, the LTBMU has produced the Environmental Analysis to issue the tribe a Special Use Permit for a Cultural Center at Taylor Creek. At Baldwin Beach day use area, the concessionaire reserves parking spaces for Washoe use and does not charge fees for tribal members. These endeavors have furthered the goal of reestablishing a Washoe presence at Lake Tahoe.

The Tribe successfully bid on the economic opportunity to manage Meeks Bay Resort, a Forest Service facility on the west shore of Lake Tahoe. This opportunity furthers the goal of increasing trade and commerce at Lake Tahoe.

3.4.9.3. Environmental Consequences

None of the alternatives will have direct effects to Tribal Relations provided that the assumption noted above is valid. Indirect impacts could accrue from provisions in the action alternatives, specifically fuels reduction treatments.

3.4.9.4. Analytical Conclusions

No direct effects will result from the adoption of any of the alternatives.

Comparison of Consequences by Alternative

Each of the Alternatives have fuels treatment components that would indirectly be beneficial to the Tribes management of their adjacent land in the Skunk Harbor area. Alternative D accomplishes treatments throughout the basin in the most traditional manner utilizing managed prescribed fire as a tool.

How the Alternatives Maintain or Achieve the Desired Conditions

All alternatives equally maintain the Desired Conditions.

WASHOE

"Wa She Shu E Deh" – Washoe Lands

A Commitment to Forest Ecosystem Restoration

The Significance of the Lake Tahoe Region to the Washoe Tribe

Lake Tahoe has been the center of the Washoe world for thousands of years. Their ancestral homelands consisted of more than 1.5 million acres from Honey Lake to the north, Antelope Valley to the south, the Sierra Nevada mountains to the west and the Virginia and Pine Nut Hills to the east. In the 1800s, the Washoe lost most of this land as a result of westward expansion by the United States. Current Washoe holdings include approximately 72,500 acres of land.

Responsible Stewards for Generations

For thousands of years, the Washoe lived off these lands. Every spring, they gathered on the shores of Lake Tahoe to hunt, fish, gather medicinal plants and celebrate tribal unity. In the fall, they moved to the Pine Nut Hills to gather pine nuts, one of their most valued foods and their sustenance during the long winters. Our ancestors lived in balance with their surroundings, taking care to preserve this sacred land and its resources.

The Washoe: Uniquely Qualified to Help Preserve Lake Tahoe

The Washoe have unique and important knowledge about managing Lake Tahoe's resources and contribute greatly to efforts to maintain a healthy ecosystem. Washoe conservation practices are based on an ancient understanding of the region's ecosystem and on their behalf that all living things are interdependent.

Their indigenous resources management experience includes Washoe pharmacology which involves the cultivation and harvesting of native plants for medicinal reasons. For generations, Washoe elders have passed down to younger members their vast knowledge of the tribes' traditional conservation practices in the Lake Tahoe basin.

Figure 3 25. Page from the Washoe Lands document "Lake of the Sky: Washoe Stewardship of Lake Tahoe" *(Washoe 2004)*

3.4.10. Fire and Fuels

3.4.10.1. Introduction

Changing fire patterns and fuel management are primary issues driving forest plan revision. Past management practices including fire exclusion have led to increasing forest density and fuel loads, and an overall decrease in structural and compositional heterogeneity. This over-crowding combined with three periods of drought since 1975 has led to beetle-caused mortality, further increasing the hazardous nature of fuel conditions.

Wildfire frequency, size, total annual burned area, and – in some forest types – fire severity, are all trending upward across the western U.S. (Westerling et al. 2011, Safford et al. 2011). It is believed that climate warming in conjunction with the increasing fuel loads are contributing to these trends (Miller et al. 2008, Flannigan et al. 2000). In recognition of this, federal wildland fire management policies have changed to allow more flexibility in fire management. In addition, our improved understanding of forest dynamics has provided more ecologically sound vegetation treatment practices. While some of these practices are not prohibited under our current direction, revising the forest plan will enable us to incorporate these policies and practices directly into our guiding documents providing goals, strategies, objectives, and standards and guidelines based on new science not available when the current plan was developed.

Here we summarize the results of the fire and fuels program environmental consequences analysis. The analysis evaluates and discloses the potential environmental consequences on fire and fuels that may result with the adoption of a revised land management plan. The analysis examines, in detail, the five different alternatives for revising the 1988 Lake Tahoe Basin Management Unit Land and Resource Management Plan as amended (1988 Forest Plan). There is considerable overlap between fire and fuels programs and vegetation management programs. This analysis focuses on the effects fuels treatments have on fire behavior in the wildland-urban interface, the ability of the alternatives to return fire to the ecosystems, and wildland fire management throughout the LTBMU.

Organization of Fire and Fuels Section

Methodology

Describes the process used for the two sets of analyses conducted:

1. The wildfire risk analysis attempts to identify areas with elevated hazards, areas with elevated ecological risk, as well as areas with higher probability of events, such as ignitions, occurring.
2. The second analysis examines operational opportunities and constraints to the fire and fuels program meeting needs identified in the risk analysis above.

Assumptions

These include assumptions used in the analyses, as well as general assumptions applicable to the alternatives.

Indicators

A description of the indicators used to compare the effects between alternatives.

Overview of the Affected Environment

A brief description of the current situation including environmental conditions, and the results of the analyses listed above.

Environmental Consequences

Explanation of the expected relative impacts of implementing each of the alternatives in terms of the results of the analyses.

Analytical Conclusions

The final conclusions weighing the differences and benefits of the various alternatives, the ability or constraints associated with the alternatives and their relative contribution to achieving desired conditions.

This Fire and Fuels section provides summarized analyses results only. For more detailed information, see the full Fire and Fuels Report in the project record.

Methodology

1. **Wildfire Risk Analysis**

Analysis questions:

- Where have ignitions occurred historically?
- Where are the potential problem areas for fire behavior?
- Where are the fire return interval departures the greatest?
- What has been the recent fire activity?

Analysis methods:

Ignition Risk--Ignition risk was assessed in two ways:

- Recorded ignition point data (1973-2010) were used to produce a density surface partitioned into five risk classes ranging from very low to very high ignition risk.

- The ignition point data were then separated by fire management unit (FMU) to produce an ignition risk by FMU map. The ignition risk by FMU data were displayed in charts by general cause (human vs. natural), and by frequency and proportion (see Fire and Fuels Specialist Report).

Current Wildfire Potential --FLAMMAP (Version 3) was used to predict fire behavior characteristics such as flame length and fire type (e.g., crown fire, surface fire). FLAMMAP uses GIS-based raster inputs for terrain and fuel characteristics and computes fire behavior outputs of a given landscape using standard fire behavior prediction models. For this analysis, the 2011 update California Fuels Landscape was used (http://wfdss.usgs.gov/wfdss_help/index.htm?page=WFDSSHelp_Non-LANDFIRE_CAv082710.html). Raster maps are produced showing potential fire behavior characteristics (flame length, crown fire potential, etc.) over the entire landscape. Fire behavior modeled with FLAMMAP provides a point in time (assumes fuel moisture, wind speed and wind direction are constant) fire behavior calculation for each 30 meter cell across the landscape. It does not simulate fire growth or changes in fire behavior characteristics over time (see Fire and Fuels Specialist Report).

Fire Return Interval Departure (FRID)—This polygon layer consists of information compiled about fire return intervals for major vegetation types in the Lake Tahoe Basin (LTB). Comparisons are made between pre-Euro American settlement and contemporary fire return intervals (FRIs). Current departures from the pre-Euro American settlement FRIs are calculated based on mean, median, minimum, and maximum FRI values. Fig. 3.34 displays mean FRID condition classes for the LTB.

Recent Fire History—Historical fire report data were analyzed in a variety of ways to answer the analysis questions related to recent fire activity. Data from FAMWEB (http://famtest.nwcg.gov/fam-web/) data warehouse: queries and reports—Fire Causes and Acres Burned by Year for Administrative Unit.

2. Potential to Meet Fire and Fuels Program Objectives

Analysis questions:

- What are the environmental and regulatory constraints that might affect the ability to meet program objectives?
- Where and when has lightning historically occurred?
- Based on a regression of the historical record, how often does a lightning strike cause an ignition?
- What is the potential for meeting objectives with managed wildfire by alternative?

  Note: *any modeled potential acres of managed wildfire accomplishments for any of the alternatives are not expected TARGETs. Rather they are modeled maximum acres burned under favorable conditions in which every lightning ignition from the historical record was modeled as a wildfire managed to meet resource objectives. These are BEST-CASE estimates of potential managed wildfire under ideal conditions in which all lightning ignitions that occur in approved areas are managed for resource objectives. With the amount of WUI, infrastructure, current fuel conditions, smoke management issues, and prevailing weather typical at or near periods where lightning ignitions are expected to occur, decisions to manage natural ignitions will be much less frequent and the actual accomplishments will more likely be near the lowest end of the projections.*

Analysis methods:

Historical Burn Day Analysis--To assess prescribed burning opportunities on the California side of the LTB, we analyzed data from California Air Resources Board (CARB) and the Meyers remote automated weather station (RAWS). All CARB and weather data were combined into a single database and a day-by-day comparison over the past 13 year period was analyzed to assess patterns and trends when prescribed fire prescriptive criteria coincide with days designated as permissible burn days by CARB.

Smoke management in Nevada is regulated by Nevada Division of Environmental Protection (NDEP). NDEP does not designate days as burn days or non-burn days. This analysis, as designed, was not conducted for the Nevada portion of the LTBMU (see Fire and Fuels Specialist Report).

Lightning Strikes and Ignitions Analyses--Lightning strike data for 1990 through 2010 were obtained from the Bureau of Land Management (BLM). The lightning data is provided to BLM under contract by WSI Corporation, Inc. (BLM 2011). Lightning ignition data were derived from FAMWEB. Linear regression to assess relationship between annual strikes and ignitions was conducted to provide the ability to use lightning strike frequency as a predictor for ignition frequency. Lightning strikes by month and by FMU were assessed to examine potential opportunities to manage wildfire to meet resource desired conditions and objectives.

Ability to Use Managed Wildfire to Meet Resource Desired Conditions and Objectives (Managed Wildfire)—The Fire Spread Probability (FSPro) model in the wildland fire decision support system (WFDSS) was used to model potential to meet management objectives. FSPro provides the ability to estimate the probability of wildfire spreading into an area or to a point of interest from a specific location. The advantage of using FSPro over other fire behavior models is that multiple wind-weather scenarios for historical climatology weather records are used to simulate hundreds of possible patterns. The proportion

of the total each cell is impacted by fire is then partitioned into probability categories which are used to predict potential managed wildfire opportunities. Historically, the majority of lightning caused ignitions occur in August. Therefore simulations were run using August 1 start dates. In order to cover a range of moisture conditions, two sets of simulations were run using historical climatological weather records from a low precipitation year (2007) and a high precipitation year (2011). Each simulation ran 500 different fires scenarios for seven days.

Assumptions

Modeling assumptions and limitations

- FLAMMAP uses constant weather and fuel moisture conditions representing a single moment in time. Actual weather conditions are variable and dynamic throughout the Basin. No set of weather parameters can fully account for all possible conditions that may be encountered. Therefore, a generalized set of weather conditions are used in the FLAMMAP analysis.
- FLAMMAP uses the same fire behavior calculations as many other models i.e., Rothermel's 1972 and 1991, Van Wagner's 1977, and Nelson's 2000) fire spread equations, and either the Scott or the Finney crown fire models (Finney was used here as recommended for the California Fuels Layer). Limitations of these models are inherent in FLAMMAP.
- Estimated annual acres of managed wildfire assume all lightning ignitions in approved FMUs are managed to meet resource objectives. This is based on historical lightning caused ignition frequencies divided by the years of the analysis period.
- FSPro simulations assume no suppression actions taken. However, simulated wildfire growth was restricted as stated below.
- FSPro wildfire extents are restricted as follows:
  - When multiple fires are simulated in FSPro, some fire sizes may be limited as fires grow together. These limits to fire size are assumed to mimic conditions of an active managed wildfire program where fire scars of previous wildfires limit growth of subsequent fires.
  - When calculating estimated acres of managed wildfire by alternative, FSPro spreads are cut off at approved FMU boundary. This is assuming that fires spreading from approved FMUs into unapproved FMUs will be suppressed.
- FSPro modeling was conducted using weather from a dry year (2007) and a wet year (2012). Estimates of potential maximum acres of managed wildfire are based on 2011 weather following a winter with abundant precipitation. The assumption is that decisions to manage a wildfire for resource objectives in dry years such as 2007 will be unlikely, and the decision instead will be to suppress the fire. The ignitions by lightning strikes regression analysis assigns all lightning strikes equal probability of causing an ignition.

Fire and Fuels specific assumptions

- In all five alternatives, the majority of fuels reduction treatment efforts are concentrated in the WUIs until initial WUI treatments are completed (see the Lake Tahoe Basin Multi-Jurisdictional Fuel Reduction and Wildfire Prevention Strategy – September 20, 2007—hereafter the "10 year strategy"). WUI treatments that maintain the treatment unit's effectiveness occur as needed. Note that scheduling in the 10 year strategy has outpaced accomplishments on the ground. However, the pace of WUI mechanical and hand treatments will not vary by alternative.
- Fuels treatments are assumed to effectively modify fire behavior at conditions for which they were designed.
- Prescribed fires and managed wildfires burn at intensities within or close to those expected under natural fire regime. The assumption is that if conditions or prescriptive criteria are outside of an

acceptable range (conditions conducive to high or extreme fire behavior) decisions will be to suppress wildfires or not to ignite prescribed fires.

- Weather, resource availability, smoke dispersion, and other conditions necessary for implementation of a prescribed fire or managed wildfire are extremely difficult to predict beyond the very short-term. Any projected acres of prescribed fire or managed wildfire are based on the assumption that conditions are sufficient for safe and effective implementation.
- Pile burning is included as reducing FRID. Although it can be argued that pile burning does not provide the same level of ecological benefits as understory burning, pile burning does put fire back into the system and often, fire is allowed to creep between piles, providing similar effects as underburning in some areas. More importantly, pile burning is often a necessary precursor to understory burns.
- Currently, as an alternative to prescribed pile burning, biomass utilization accounts for approximately 100 acres per year. If future opportunities for biomass utilization increase, then the proposed pile burning will decrease proportionally.

Forest structure restoration establishing new age classes in the form of small openings is expected to reduce fire behavior initially. However, these treatments are meant to create early seral conditions, which, in a few years, may increase fire behavior depending on the level of tree recruitment and shrub growth and in-fill.

Indicators

1. Fire behavior.
2. Fire return interval departure (FRID).

(see Safford et al. 2011 for detailed description of FRID).

Indicator descriptions

1. **Fire behavior** modification is a primary objective of fuels treatments. During the planning and design phase of a site specific fuels treatment project, each treatment unit has desired outcomes and objectives to which the unit is designed, i.e., desired post-treatment fire type (surface fire) or flame length. These objectives are specific to each unit based on location, fuel type, terrain features, etc. For instance, in order to achieve a surface fire type under a given set of weather conditions, a different thinning prescription would be needed for flat ground than for a steep slope in order to meet the surface fire objective. For this analysis, when any alternative proposes fuels reduction on one of the treatments listed below, the proposed acres of treatment are all assumed to meet the minimum criteria for which it was designed (see assumptions above). Some non-WUI treatments may not be designed with fire behavior modification as a primary objective but those included here are expected to have similar effects to a fuels treatment (see Forest Vegetation section for these treatment descriptions). Forest vegetation treatments that modify fire behavior are:

    - Thinning and fuels reduction in the WUI
    - Forest structure restoration—non-WUI treatments establishing new age classes in the form of small openings.
    - Forest type conversion— non-WUI treatments converting fir to Jeffrey pine or mixed conifer
    - Forest stand resilience—thinning outside the WUI

2. **FRID** is an important concern for the forest restoration and fuels reduction strategy of the forest plan revision alternatives. The reference fire regimes of the major forest types in the LTB include attributes such as burn patterns, severity, rotation, and fire return interval. The observed departures of current conditions from these reference conditions provide a guide to direct management objectives.

Although we can attempt to predict what the severity or burn pattern might be should a particular portion of the landscape burn in a wildfire, we cannot predict with any certainty what the outcome will be. Prior to an actual fire, the only departure from an historic fire regime attribute in which we can place a reasonable degree of confidence is in FRID. Although a single wildfire event or prescribed fire may not contribute greatly to reducing this indicator in areas that have missed multiple fire cycles, it does set the stage for implementation of a regular program of using fire for fuels treatment maintenance and ecological restoration. Multiple fire cycles will be required to get to conditions that will more closely produce historical fire effects. Further, even when FRID is within historical conditions, that does not necessarily mean that a wildfire will burn with the same range of historical effects. Climate regimes today are different than pre-settlement regimes that were established by the historical conditions.

For this analysis we use FRID as an indicator by which we can measure success in restoring fire’s role back into the ecosystem. The tools we will use to reduce FRID are prescribed fire and managed wildfire. Both of these tools depend upon many conditions outside of our control (see assumptions above). Each alternative’s proposed prescribed fire acres are derived from past accomplishments and adjusted to be consistent with an alternative’s strategy for meeting desired conditions. Average acres burned using managed wildfire is estimated using FSPro to produce probability analysis for each alternative. Although the estimates are based on a high degree of uncertainty, the acres are included as potential reductions in FRID to measure the relative effectiveness of the alternative’s potential for affecting this indicator.

Regardless of the effects or ignition source, all wildfires and prescribed fires contribute to reducing FRID (The exception is the case where fire is occurring more frequently than indicated by the presettlement fire regime e.g., some shrub systems in southern California). Wildfires which are not managed for resource or multiple objectives are suppressed. Annual acres burned in the LTB by suppressed wildfires are highly variable, ranging from less than ten to greater than 3,000 acres. Recent studies on climate change and the potential to affect wildfire suggest larger and more intense wildfire in the future (Flannigan et al. 2000, Lenihan et al. 2003, McKenzie et al. 2004, Stephens et al. 2007, National Research Council 2011, also see the Climate Report in Appendix D). However, when considering suppressed wildfire contributions to reducing FRID, we project annual acres burned at the current 10 year moving average of 455 acres per year. Although the alternatives’ different strategies are expected to affect vegetation and fuels in different ways and to varying degrees, we project this number of acres and the associated effects equally for all alternatives, and therefore do not include it in the analysis of this indicator.

3.4.10.2. Overview of the Affected Environment

The LTBMU Comprehensive Evaluation Report (LTBMU 2006) (Part of the Analysis of the Management Situation) assessed the current state of management direction for fire and fuels management and identified the need to address the following:

- Direction in the 1988 Forest Plan called for suppression of all wildfires and did not provide the opportunity to manage wildfire to meet resource objectives (Note: The Sierra Nevada Forest Plan Amendment (SNFPA 2004) allows wildfires in wilderness areas to be managed to meet resource objectives). The Desolation Wilderness Forest Plan Amendment (November 1998) approved wildfire management to meet resource objectives in the Desolation Wilderness.
- Fire and fuels management needs to have more integration with vegetation and habitat management, and fire ecology.

- Focus should be on historic fire regimes, and forest vegetation composition and structure.
- New science and modeling data need to be included in forest plan revision, especially concerning the importance of restoration of natural disturbance regimes and their effects on forest structure, composition, and function.
- The number of human caused ignitions needs to be decreased, especially since these usually occur in close proximity to human communities. With projected warming and increasing fuels loads associated with climate change, potential for catastrophic wildfire affecting communities and natural resource will continue to increase.
- Updating guidance for smoke management. Although the current plan provides guidelines and mitigations for reducing smoke emissions and impacts, some of the options for slash disposal now conflict with scientific knowledge and current management practices. The revised Forest Plan needs to consider potential smoke emissions from these sources (LTBMU 2006, p.32)
- The public expressed a variety of opinions regarding the management of the amount of smoke in the basin resulting from prescribed burns used to improve forest health and safety. In most cases, those who understood the goals of prescribed burning generally supported the need to continue these burns, however there was overwhelming support to use alternatives to burning where possible (especially pile burns).

Summary of past actions

Prior to European settlement, fires were ignited by lightning or members of the Washoe Tribe. It is estimated that between 2,000 and 8,000 acres on average burned each year, although there was very high interannual variability. Fifty percent or more of the acres burned were at the lower elevations in the montane zone (Manley et al. 2000). Because frequent fires in the montane zones reduced surface and ladder fuels, fire intensities were low and there was relatively little mortality of mature trees (Manley et.al. 2000, Skinner and Chang 1996).

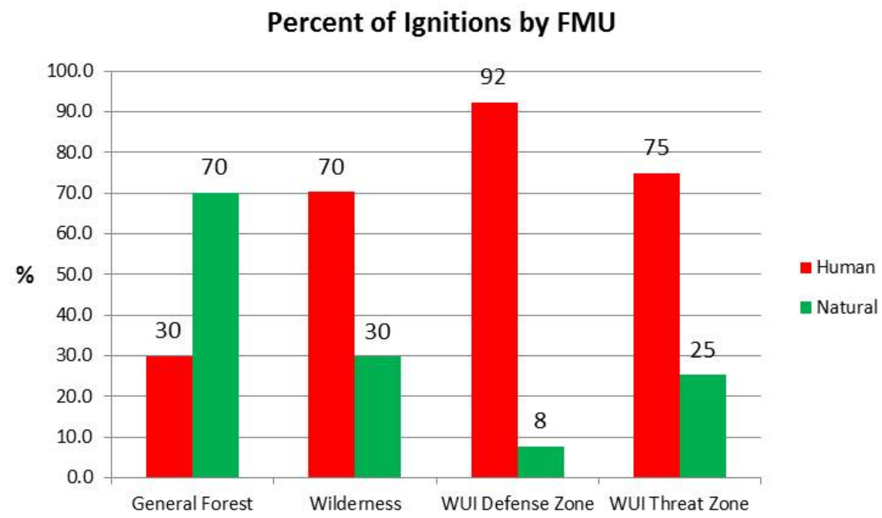
Over the last century LTB ecosystems have been altered through a combination of drought, fire suppression and past timber harvesting (Stephens et al. 2004, Taylor 2004, Nagel and Taylor 2005). This has resulted in heavy accumulations of dead and down woody fuels, altered fuel arrangements and changes in vegetative structure and composition. As a result, the fire regime attributes have departed substantially from historic patterns.

As Europeans settled in the LTB, several factors contributed to changes in the fire regime and fuel hazards. The seasonal fires set by the Washoe Tribe were eliminated as Native Americans left the basin. During the Comstock Era (1875- 1895) large scale clear cutting removed most of the old growth forests in the Basin (Lindstrom et al. 2000). By1900, most of the Basin's forests were dominated by seedlings and saplings (trees with a DBH of less than 12"). In addition to current fuel conditions and the effects of past actions, increasing temperatures and changing precipitation patterns exacerbate the problem. Western fire seasons are beginning earlier and lasting longer than in the past (Westerling et al. 2006, Miller et al. 2008, North et al. 2009 GTR 220). Extreme fire weather has become more frequent and forest fires are predicted to continue to grow larger and more severe making them more difficult to suppress (Flannigan et al. 2000, McKenzie et al. 2004, Stephens et al. 2007, National Research Council 2011).

Recognition of the role natural disturbance regimes play in shaping ecosystem condition leads to the need to provide a fire and fuels program strategy that re-establishes natural disturbance processes while providing for community safety. In many cases, existing heavy fuel loads preclude the use of fire until other management techniques are first used to reduce heavy fuel loading in order to facilitate safe use of fire.

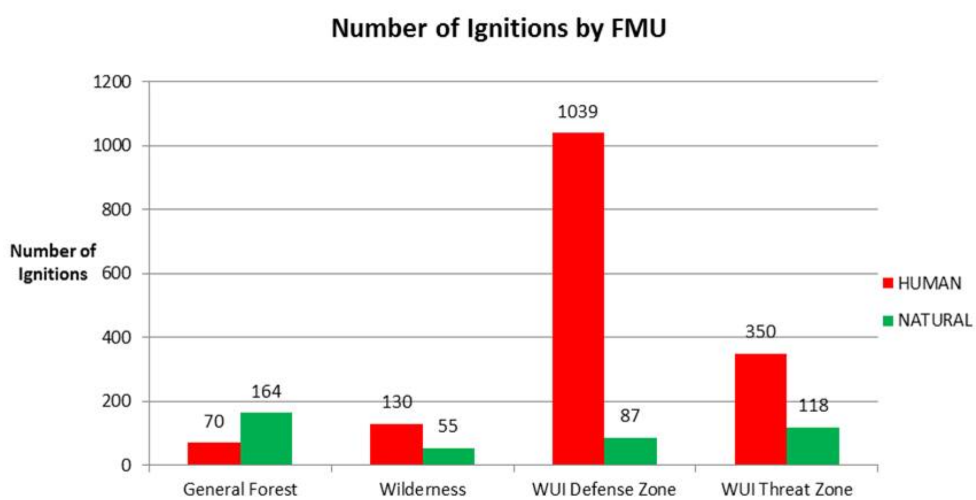
Where have ignitions occurred historically?

Figures 3-26 and 3-27 show the distribution of ignitions heavily skewed towards the WUI. More natural ignitions than human ignitions occur in the General Forest FMU. The opposite is true in the other FMUs. To summarize: 12% of all types of ignitions occur in the General Forest, 9% in Wilderness, 56% in the WUI Defense Zone, and 23% in the WUI Threat Zone.



Note: the WUI FMU is broken down into its components; threat and defense zones.

Figure 3 26. Percent of ignitions throughout the Lake Tahoe Basin by fire management unit (FMU) and cause (Human vs. Natural) 1973-2010.



Note: the WUI FMU is broken down into its components; threat and defense zones.

Figure 3 27. Number of ignitions throughout the Lake Tahoe Basin by fire management unit (FMU) and cause (Human vs. Natural) 1973-2010.

Where are the potential problem areas for fire behavior?

Flammap was used to display areas where fire behavior under high fire danger conditions (90th percentile weather) is expected to vary across the landscape (Figure 3-28). The 90th percentile weather is calculated from the historical climatology and therefore does not account for projected future warming. Areas in orange and red are a major concern since these areas may experience extreme fire behavior (crown fire) threatening values at risk. East side shows less extreme fire behavior (less red) than other areas, largely due to more open stands as is typical of less productive sites. See Assumptions section for a discussion of limitations of the Flammap model.

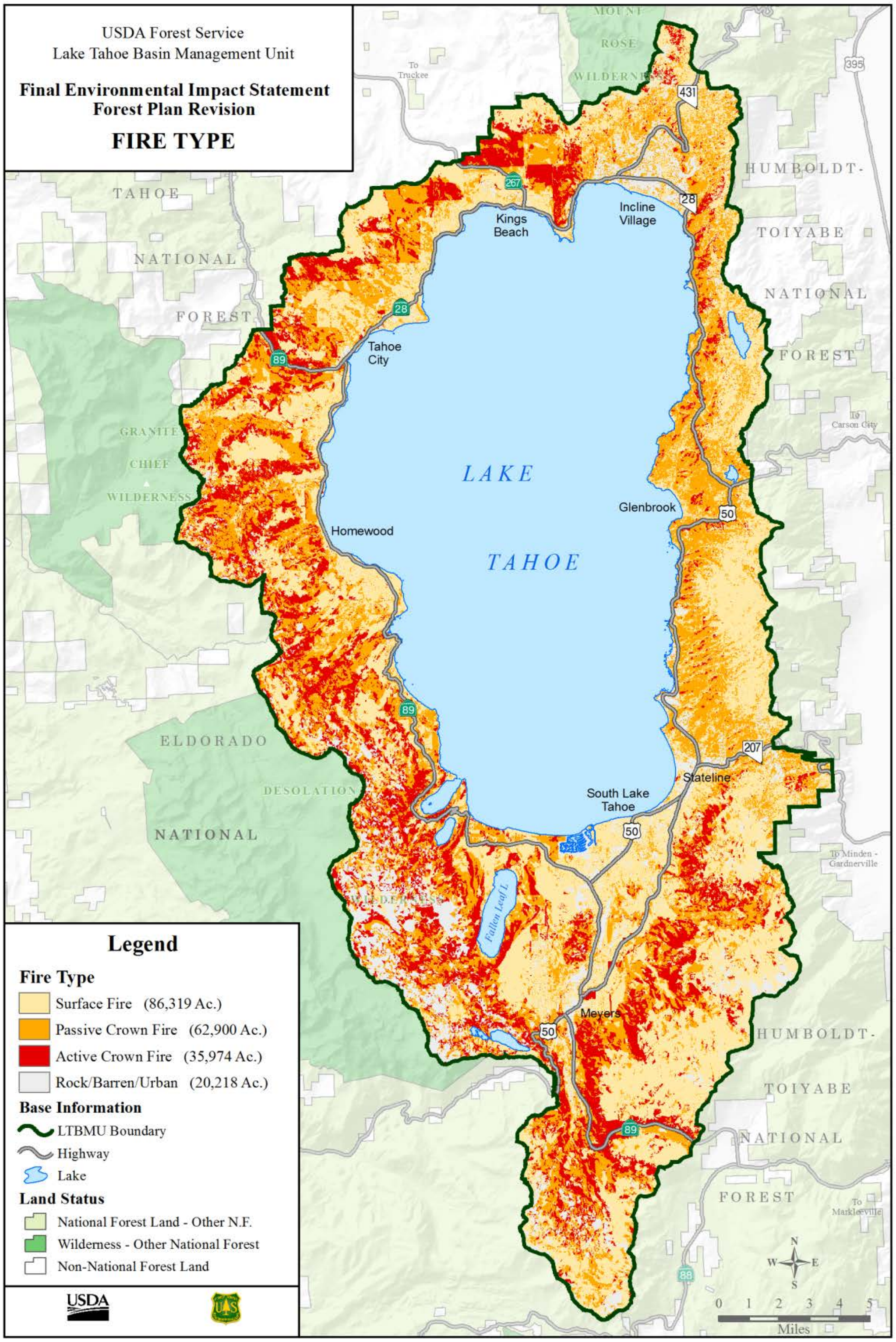


Figure 3 28. Fire type map based on FLAMMAP output (see "Current wildfire potential" above)

Where are the fire return interval departures the greatest?

Historic mean fire return intervals (FRI) in the LTB ranged from over 400 years in the subalpine zone to about 10 years in the lower montane zone (Elliott-Fisk et.al 1996, Manley et.al. 2000, Barbour et.al. 2002, Taylor 2004, Nagel and Taylor, 2005, Beatty and Taylor 2009, Safford and Schmidt 2007). About 50% of the landscape supported vegetation with FRIs less than 22 years. Areas with long historic mean FRIs will typically be within the historic range (condition class I) since the period of fire exclusions has not yet interfered with multiple fire cycles. Therefore areas colored green on map 3-34 depict mostly types such as subalpine where historic FRIs are long (e.g., 85 years or greater).

Today large wildfires (greater than 100 acres) are uncommon in the Basin and current (1910-2012) FRIs are extremely long (Figure 3-29). Ninety eight percent of the land area in the LTB has not had a fire since 1910, and greater than 90% of the land is characterized as moderately or severely departed (FRI condition classes II and III) from pre-Euro-American settlement FRIs (Safford and Schmidt 2007, Safford et al. 2011). Additionally, wildfire severity proportions during recent wildfires have not been consistent with natural fire regimes. For example, greater than 50% of the Angora fire burned at high severity compared to 5-15% expected under presettlement fire regimes in the forest types burned (Safford et al. 2009, Carlson 2009).

Forests with fire regimes within or near their natural range of variation (NRV) for FRI (condition class I) generally will have lower fuel loading than forests where fire has been excluded for multiple cycles. The lower fuel loading also promotes fire effects more similar to NRV for other fire regime attributes such as severity. Reference fuel conditions for the LTB can be estimated by using quantified fuel loads from reference ecosystems such as unlogged, and until recently, non-fire suppressed Jeffrey pine and mixed conifer forests of the Sierra San Pedro Martir (SPM) mountains in Baja, Mexico (Stephens 2004) or through, fire scar dendrochronological studies, modeling. or extrapolative techniques (Taylor et al. 2013). Stephens (2004) measured average surface fuel loading in SPM at 6.4 tons per acre (range: 0-65 tons per acre). Taylor et al. (2013) measured contemporary fuel loading and estimate reference fuel loading for Jeffrey pine, mixed conifer, red fir, and lodgepole pine at a variety of sites on the east and west shores of the LTB (Tables 3-30 and 3-31). These are useful references for comparing current fuel loads with what is expected of presettlement LTB ecosystems that had intact natural fire regimes. However, when designing projects for community protection or restoration, post treatment fire behavior, taking topography, weather, as well as fuel loading, into account should determine project design.

Table 3 30. Mean (range) surface fuel characteristics estimated for reference (Ref.) and contemporary (Con.) forests in the Lake Tahoe Basin, USA

Note: Using the fire and fuels extension of the forest vegetation simulation (FFE-FVS), photo series, planar intercept transects and table values (Tables) from van Wagtendonk & Moore (2010).

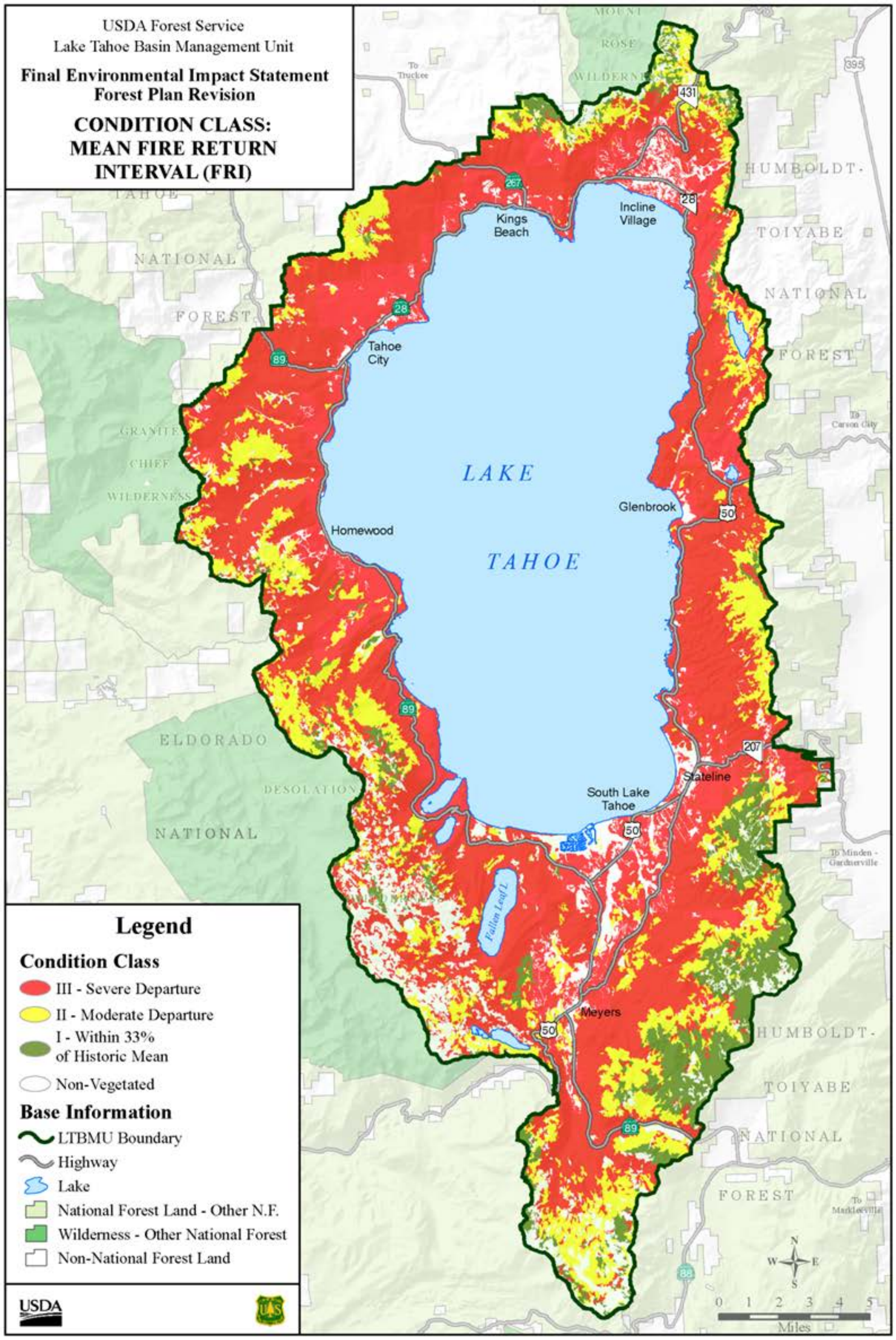
Forest type and method	1-hr mg·ha-1		10-hr mg·ha-1		100-hr mg·ha-1		Total 1-, 10-, 100-hr	
Jeffrey pine	**Ref.**	**Con.**	**Ref.**	**Con.**	**Ref.**	**Con.**	**Ref.**	**Con.**
(n = 11) FFE-FVS	1.4 (1.1–1.7)	2.0 (1.7–2.1)	1.9 (1.4–2.5)	2.2 (1.9–2.3)	2.8 (1.7–4.1)	3.3 (2.7–4.6)	6.1 (4.4–8.2)b	7.5 (6.2–8.8)b
Photo series	0.2 (0.2–0.2)	0.4 (0.0–0.4)	2.5 (1.6–3.4)	1.3 (1.1–2.2)	1.4 (0.9–1.8)	2.5 (1.8–4.5)	4.2 (2.7–5.4)	4.2 (3.6–6.7)
Tables	0.6 (0.1–1.4)		3.3 (2.1–5.8)		2.0 (0.9–4.0)		6.0 (3.2–10.3)	
Mixed conifer								
(n = 12) FFE-FVS	0.8 (0.3–1.4)	1.6 (1.4–1.8)	1.3 (0.6–2.1)	1.7 (1.5–2.0)	2.4 (1.0–3.6)	5.1 (3.1–6.8)	4.4 (1.9–6.8)c	8.5 (6.5–10.1)c
Photo series	0.5 (0.2–1.6)	1.6 (1.0–2.2)	2.0 (0.9–4.5)	4.6 (2.9–5.8)	3.1 (0.9–8.1)	6.6 (5.3–10.0)	5.7 (2.7–13.0)c	12.9 (9.2–17.8)c
Planar intercept		0.9 (0.3–1.5)		5.2 (1.3–8.9)		6.1 (2.5–14.5)		12.2 (5.8–24.7)
Tables	1.6 (0.5–3.0)		4.0 (1.2–8.2)		3.2 (1.0–6.5)		8.3 (3.4–17.8)	
Red fir								
(n = 6) FFE-FVS	0.6 (0.5–0.6)	2.0 (1.6–2.2)	1.0 (0.8–1.1)	2.4 (1.9–2.8)	2.2 (1.9–2.6)	4.6 (3.1–6.1)	3.7 (3.2–4.3)c	8.9 (6.9–11.0)c
Photo series	1.6 (0.9–2.0)	1.7 (0.7–2.4)	6.0 (4.0–6.9)	5.5 (0.9–7.1)	5.3 (2.5–6.7)	5.2 (0.4–8.1)	12.9 (7.4–15.7)	12.3 (2.0–17.5)
Tables	3.4 (2.0–3.9)		3.7 (2.2–4.5)		1.6 (1.0–1.8)		8.6 (5.3–10.1)	
Lodgepole pine								
(n = 3) FFE-FVS	5.4 (3.4–6.5)	2.2 (1.8–2.5)	7.1 (4.8–8.3)	2.4 (2.0–2.7)	11.4 (8.8–14.0)	3.4 (2.4–4.4)	23.9 (16.9–28.6)a	8.0 (6.2–9.3)a
Photo series	0.4 (0.2–0.7)	0.4 (0.2–0.4)	0.9 (0.9–0.9)	3.0 (0.9-4.0)	0.4 (0.4–0.4)	2.9 (1.6–3.6)	1.7 (1.6–2.0)	6.3 (2.7–8.1)
Tables	2.5 (1.5–3.2)		2.3 (1.0–3.0)		1.1 (0.4–1.4)		5.8 (2.9–7.6)	

For the Average Total 1-, 10-, 100-hr columns, values in the same row with the same letter are significantly different (Kruskal–Wallis H test aP < 0.05, bP < 0.01, cP < 0.001).

Table 3 31. Mean (range) canopy fuel characteristics for reference and contemporary forests in the Lake Tahoe Basin. Table recreated from Taylor et al. 2013

Forest type	Canopy bulk density (kg/m3)	Canopy base height (m)	Stand height (m)
Jeffrey pine			
Reference	0.02 (0.01-0.03)[c]	8.2 (6.4-11.9)[c]	30.1 (24.7-36.9)
Contemporary	0.07 (0.04-0.10)[c]	0.6 (0.3-0.9)[c]	31.9 (28.0-36.6)
Mixed conifer			
Reference	0.04 (0.01-0.06)[b]	4.9 (3.7-6.4)[b]	30.6 (19.8-35.7)
Contemporary	0.09 (0.03-0.18)[b]	0.5 (0.3-1.2)[b]	31.8 23.2-39.6
Red fir			
Reference	0.05 (0.04-0.07)[a]	6.6 (6.1-7.6)[c]	34.5 (31.1-36.3)[c]
Contemporary	0.09 (0.04-0.12)[a]	0.9 (0.9-0.9)[c]	28.4 (25.9-32.3)[c]
Lodgepole pine			
Reference	0.04 (0.03-0.06)	7.3 (5.5-9.8)[b]	31.9 (28.7-33.5)
Contemporary	0.08 (0.03-0.11)	0.8 (0.6-0.9)[b]	27.8 (26.8-29.0)

Values for reference and contemporary forests with the same letter were significantly different (Kruskal–Wallis H test, aP < 0.05, bP < 0.01, cP < 0.001).



Note: This condition class (CC) measure is derived using the departures from mean point fire return interval (FRI) data. To summarize: CC-I = within +/- 33% of historic mean. CC-II = moderately departed—between 33% and 67% departure. CC-III = >67% departure. cite FRID.

Figure 3 29. Condition Class based on mean FRID (CC[FRI])

What has been the recent fire activity?

The number of acres burned by wildfires in the LTB has increased in each decade since 1973 including a ten-fold increase during the last decade (Figure 3-29). Although the majority of fires are small, three recent fires during the last decade grew larger than fires of the past few decades —the Gondola and Showers Fires (673 and 294 acres, respectively) in 2002 and the Angora fire (3,100 acres) in 2007. The Angora Fire, which destroyed or damaged more than 240 buildings, was the largest fire ever recorded in the LTB. Weather conditions on the initial burning period of each of these fires recorded from Lake Tahoe Airport are listed in the table below (Table 3-32). It should be noted that these recorded weather conditions in Table 3-32 are below the 90th percentile conditions to which the Basin designs its fuel treatments. Windy conditions were the dominant factors influencing fire growth. Even with highly effective suppression resources, the crown fire activity and sizes of these fires provide additional evidence that fuel hazards in the Basin have increased substantially and will continue to increase in the years ahead (Lake Tahoe Basin Multi-Jurisdictional Fuel Reduction and Wildfire Prevention Strategy –10 year strategy, September 20, 2007).

Table 3 32. Weather recorded on days when large fire occurred in Lake Tahoe Basin

Site	Date	Max Temp (^{o}F)	Min RH (%)	Avg. Afternoon 20ft Wind (mph)
Gondola	3 July, 2002	77	18	9-13 with gust to 22
Showers	19 August, 2002	76	11	10-16 with gusts to 26
Angora	24 June, 2007	68	11	9-13 with gusts to 28
90th percentile		85	5	25 (10 minute average)

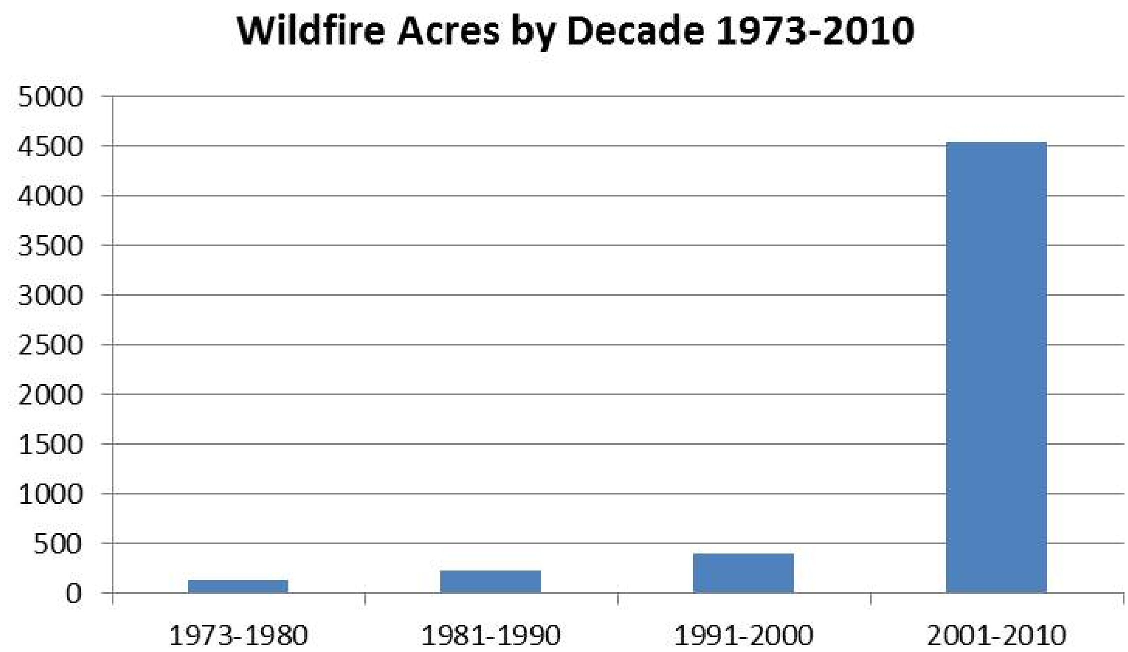
Data from National Weather Service; Lake Tahoe Airport (LTVL). Ninetieth percentile calculated from Meyers RAWS' historical dataset May through October.

Human caused ignitions are the predominant source of wildfire ignitions in recent decades (Table 3-33, Figures 3-30 and 3-31). On average, human caused ignitions occur nearly four times as often as natural ignitions since 1980 (Table 3-33, Figure 3-31). Over the same time period human caused ignitions accounted over 99% of acres burned (Figure 3-32). Further, as of 2010, lightning ignitions have greatly declined since 2003; with 2006 having the most with 9 lightning ignitions (Table 3-33, Figures 3-31 and 3-32). Lastly, the number of acres burned is related more to climatic factors such as drought, and to weather conditions near the time of ignition, than to the number of ignitions.

Table 3 33. Wildfire activity from 1980 through 2010; number of ignitions and acres burned by cause (human versus natural) over the last three decades.

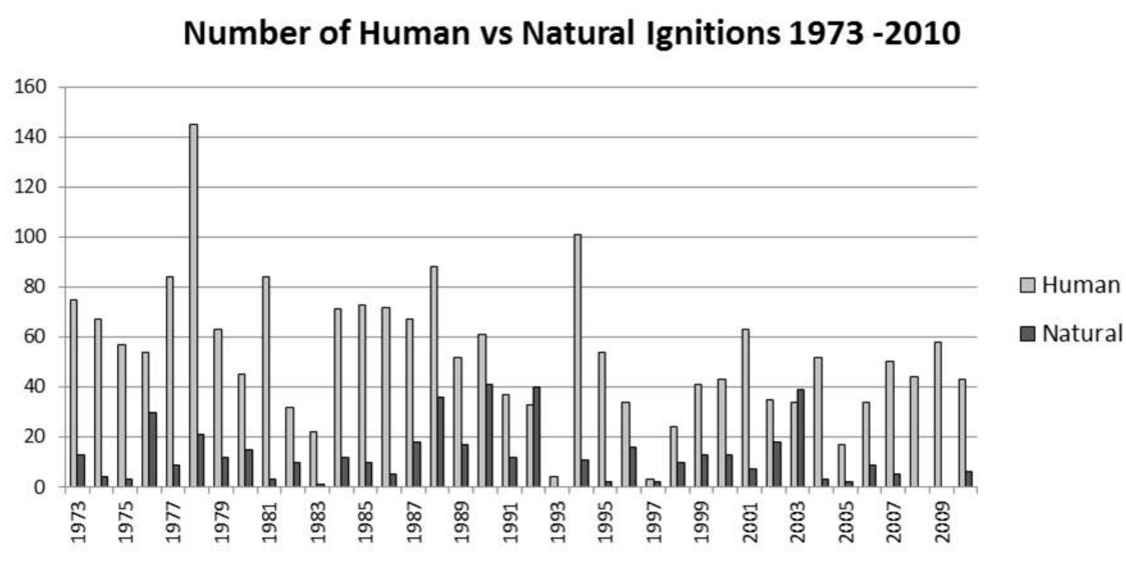
	Human Cause		Natural Cause		Grand Total	
Year	**Number**	**Acres**	**Number**	**Acres**	**Number**	**Acres**
1980	45	9	15	2	60	12
1981	84	17	3	0	87	17
1982	32	7	10	1	42	8
1983	22	3	1	2	23	5
1984	71	139	12	2	83	140
1985	73	19	10	5	83	24
1986	72	12	5	1	77	13
1987	67	10	18	27	85	38
1988	88	14	36	8	124	22
1989	52	8	17	2	69	9
1990	61	8	41	6	102	14
1991	37	6	12	2	49	7
1992	33	5	40	5	73	11
1993	4	0	0	0	4	0
1994	101	53	11	1	112	54
1995	54	152	2	0	56	153
1996	34	168	16	3	50	171
1997	3	0	2	0	5	1
1998	24	8	10	2	34	11
1999	41	10	13	2	54	12
2000	43	7	13	2	56	8
2001	63	31	7	2	70	34
2002	35	1041	18	2	53	1043
2003	34	278	39	6	73	283
2004	52	6	3	1	55	6
2005	17	2	2	0	19	2
2006	34	36	9	2	43	38
2007	50	3127	5	1	55	3128
2008	44	5	0	0	44	5
2009	58	8	0	0	58	8
2010	43	5	6	3	49	8
Total	1471	5194	376	89	1847	5283
Average	47	168	13	3	60	170

Data from FAMWEB (http://famtest.nwcg.gov/fam-web/) data warehouse: queries and reports—Fire Causes and Acres Burned by Year. These data pertain to National Forest System Lands in the Lake Tahoe Basin.



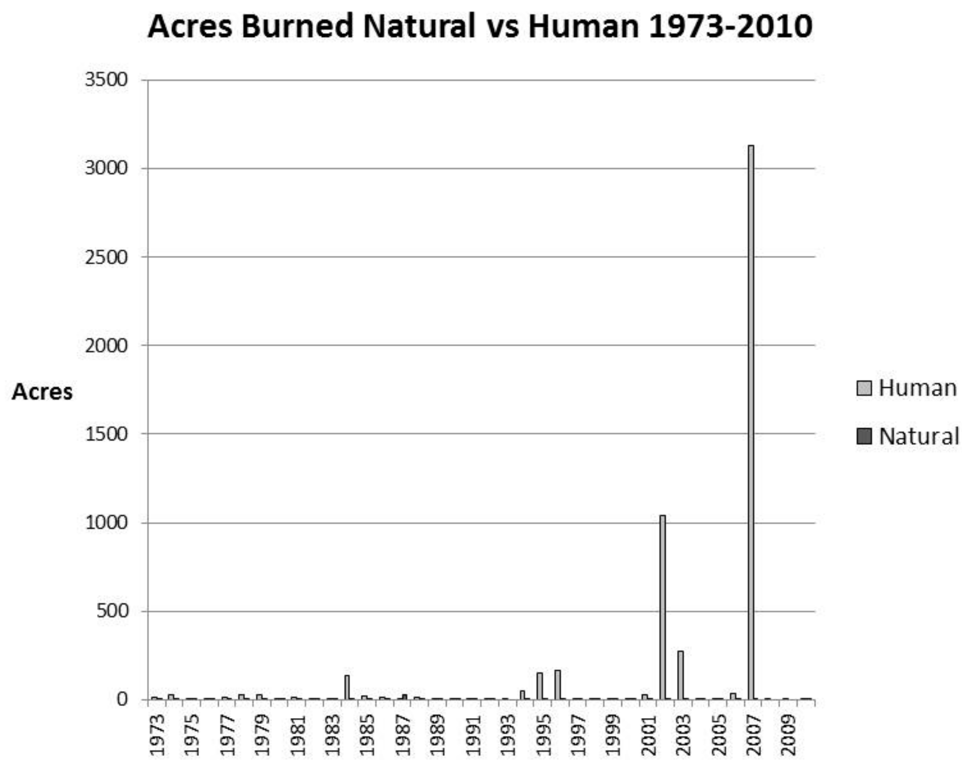
Data from FAMWEB (http://famtest.nwcg.gov/fam-web/) data warehouse: queries and reports—Fire Causes and Acres Burned by Year.

Figure 3 30. Wildfire acres burned in the Lake Tahoe Basin by decade (1973-2010)



Data from FAMWEB (http://famtest.nwcg.gov/fam-web/) data warehouse: queries and reports.

Figure 3 31. Number of human and natural ignitions 1973-2010



Data from FAMWEB (http://famtest.nwcg.gov/fam-web/) data warehouse: queries and reports.

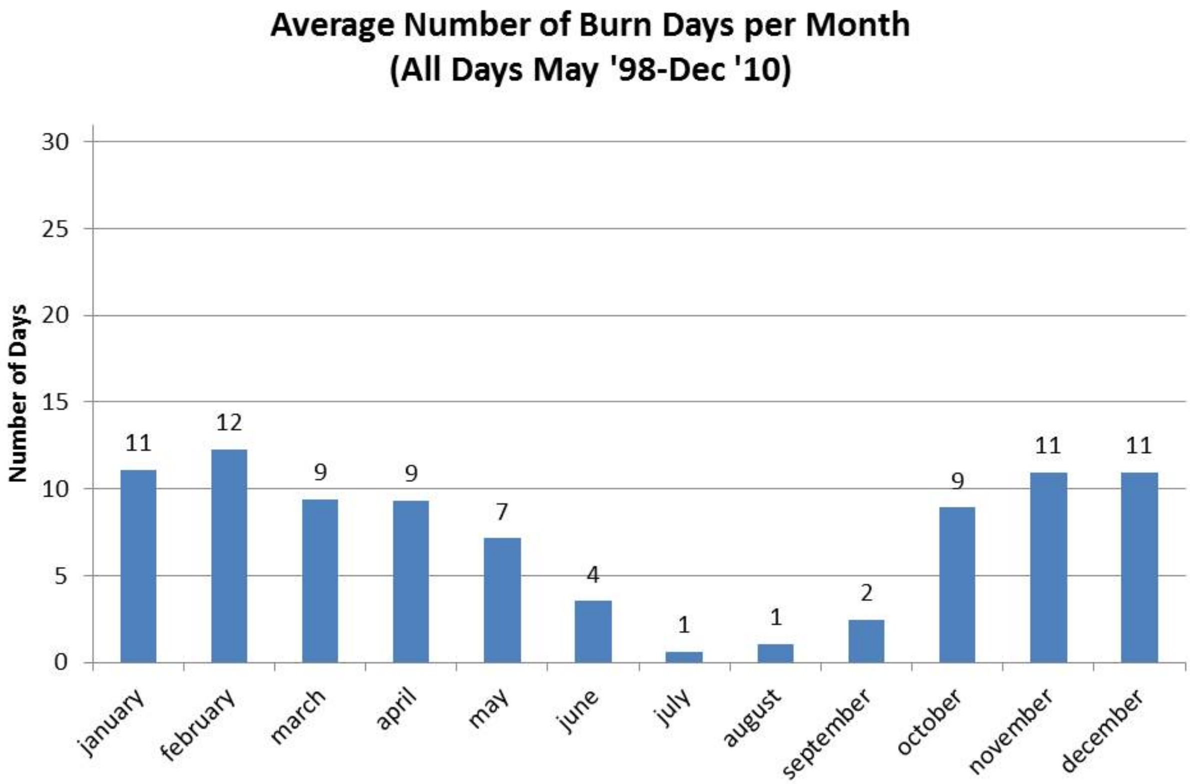
Figure 3 32. Fire Causes and Acres Burned by Year

What are the environmental and regulatory constraints that might affect the ability to meet program objectives?

The LTBMU conducted an historical analysis combining days that met burn plan prescriptive criteria coincident with days designated by the California Air Resources Board (CARB) as permissible burn days (atmospheric conditions meeting smoke dispersion criteria). These data are very important for assessing the Unit's ability to implement prescribed fires. They can also be used to predict the availability of periods where conditions will be conducive to using managed wildfire.

Seasonality of available burn days is an obvious pattern when looking at the monthly means, with the summer months having the lowest number. Note the inverse relationship between average burn days (Figure 3-33) and average monthly lightning strikes (Figure 3-34); a relationship important for planning for managed wildfire opportunities.

Historical Burn Day Analysis

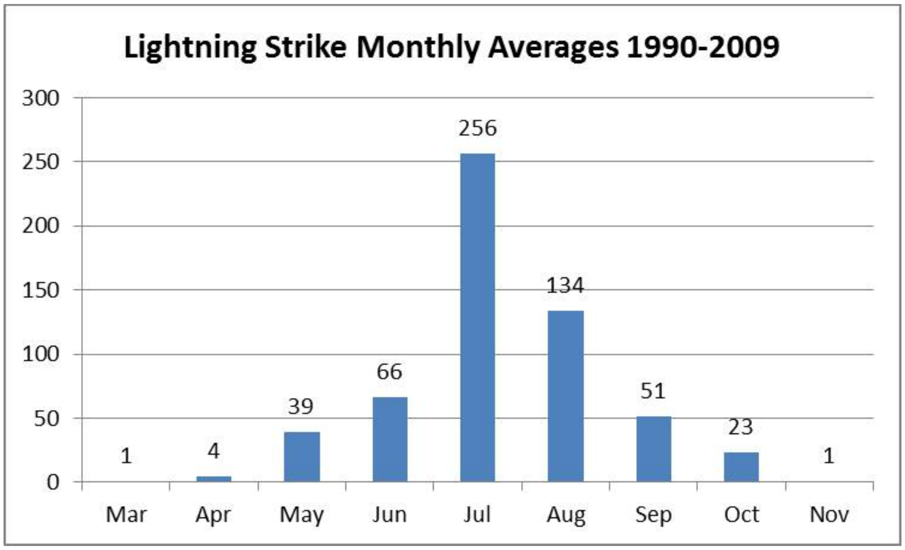


Data from CARB and Meyers RAWS, May 1, 1998 through Dec 31, 2010.

Figure 3 33. Monthly average number of days that meet permissible burn day and burn plan prescription criteria

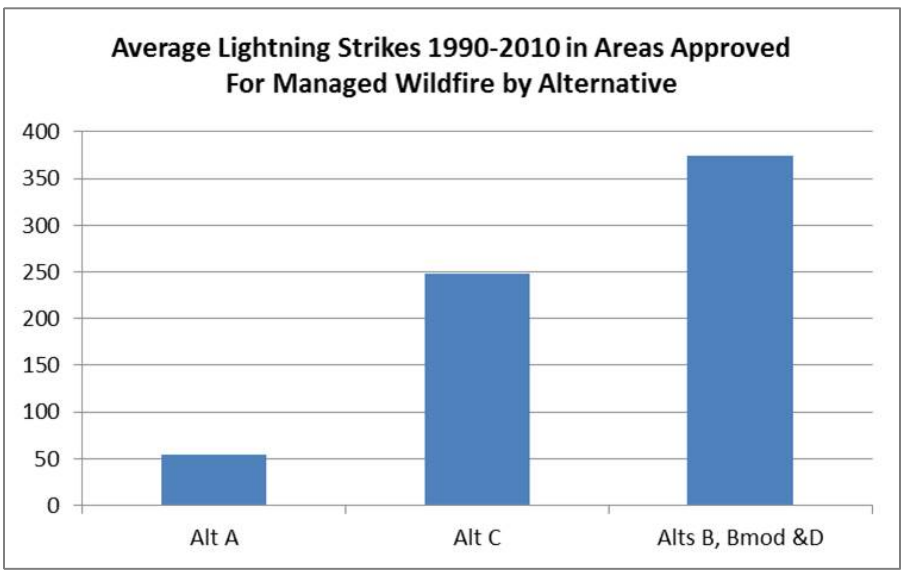
Where and when does lightning occur?

Historic Lightning Occurrence – Over the past couple decades, lightning strikes in the LTB have been mostly concentrated between June and September, and have been extremely rare between November and March (Figure 3-34). Areas approved for managed wildfire in Alternative A averaged 54 lightning strikes per year. Alternative C averaged 249 annually and Alternatives B, E and D averaged 375 strikes annually (Figure 3-35) (Lightning strike data for 1990 through 2010 were obtained from the Bureau of Land Management (BLM) (The lightning data is provided to BLM under contract by WSI Corporation, Inc.).



Proprietary lightning data acquired from Bureau of Land Management (Lightning strike data for 1990 through 2010 were obtained from the Bureau of Land Management (BLM) (The lightning data is provided to BLM under contract by WSI Corporation, Inc.).

Figure 3 34. Average lightning strike occurrence in the Lake Tahoe Basin recorded by month from 1990 through 2009



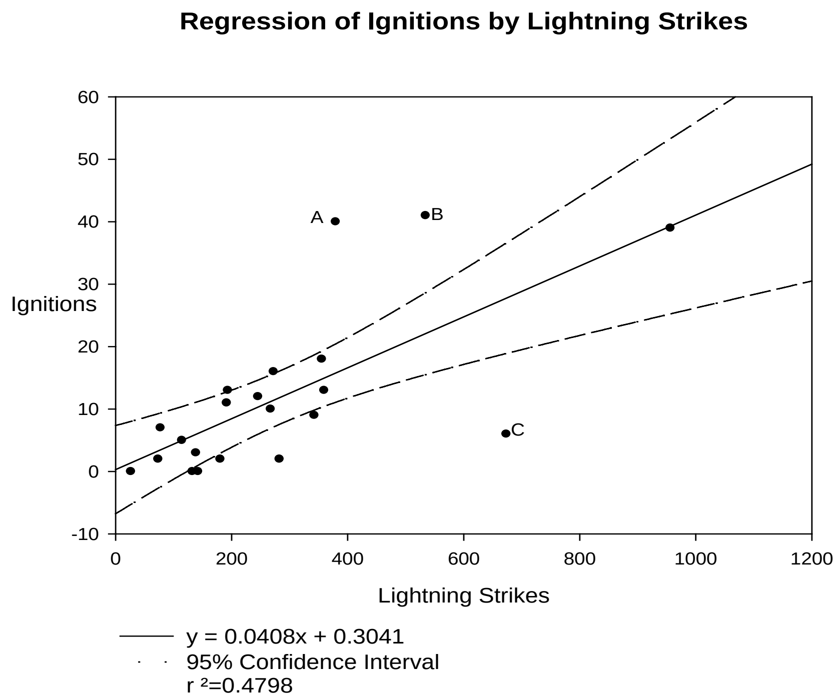
(Lightning strike data for 1990 through 2010 were obtained from the Bureau of Land Management (BLM) (The lightning data is provided to BLM under contract by WSI Corporation, Inc.).

Figure 3 35. Average number of lightning strikes occurring from 1990 through 2010 in areas approved for managed wildfire by alternative

How often does lightning cause ignitions?

Based on the regression (Figure 3-36), the lightning frequencies stated above predict an average of three ignitions annually in approved fire management units (FMUs) for Alternative A, ten for Alternative C, and 15 for Alternatives B, E and D (Table 3-34).

Note: *Not all lightning strikes have equal probability of causing an ignition. Lightning fires are started by strikes to ground that have a component called a continuing current. All positive discharges have a continuing current, and about 20% of negative discharges have one. Ignition depends on the duration of the current and the kind of fuel the lightning hits (Latham and Schlieter 1989). This regression accounts individual strikes as equally likely to cause an ignition.*



Ignition data from FAMWEB (http://famtest.nwcg.gov/fam-web/) data warehouse: queries and reports—Fire Causes and Acres Burned by Year. Proprietary lightning data acquired from Bureau of Land Management. Note the 3 outliers labeled A, B and C. Points A and B correspond to 1990 and 1992, years with annual precipitation recorded at 49% and 56% of average respectively. Point C is data from 2010, a year with 168% of average annual precipitation (precipitation data from NOAA (http://www.cnrfc.noaa.gov/rainfall_data.php) and California Dept. of Water Resources (http://cdec.water.ca.gov)). R-squared value increases to 0.8092 when outliers excluded.

Figure 3 36. Linear regression of lightning ignitions by lightning strikes from 1990 through 2010

Average numbers of reported lightning caused ignitions in the approved FMUs for each alternative are also shown in Table 3-35.

Table 3 34. Average annual lightning strike occurrence by area approved for managed wildfire by alternative, and estimated ignitions calculated from regression equation

	Average Annual	Estimated Ignitions	Reported Ignitions (avg.)
Alternative A	54	3	1
Alternative C	249	10	6
Alternatives B, D, & E	375	15	8

(See Figure 3-36) Average reported ignitions from FAMWEB (http://famtest.nwcg.gov/fam-web/) data warehouse: queries and reports—Fire Causes and Acres Burned by Year.

What is the potential for meeting objectives with managed wildfire by alternative?

The ability to restore fire to a degree necessary to achieve desired conditions will depend on many things, including patterns and trends in lightning strike occurrence, weather and atmospheric conditions, as well as management constraints such as resource availability and suppression preparedness level. In order to assess each alternative's potential to utilize fire to meet program objectives, we analyzed historic lightning occurrence from 1990-2009 (Figures 3-34, 3-35 and 3-36), reported lightning caused ignitions (Table 3-34), and California Air Resources Board (CARB) permissible burn days that coincided with days in burn plan prescription from 1998-2010 (Figure 3-33).

Utilizing historic lightning ignition point data, the LTBMU conducted an analysis to project potential for managed wildfire to restore fire as an ecosystem process. These data were used as ignition points from which to produce simulated wildfire spread probability maps using the Fire Spread Probability (FSPro) model. FSPro is a spatial-probabilistic model that produces fire spread partitioned into polygons based on the proportion of times each cell in the polygon was burned by the numerous fires in the simulation. The analysis was based on hundreds of fires grown from each historical ignition point modeled under hundreds of possible weather scenarios.

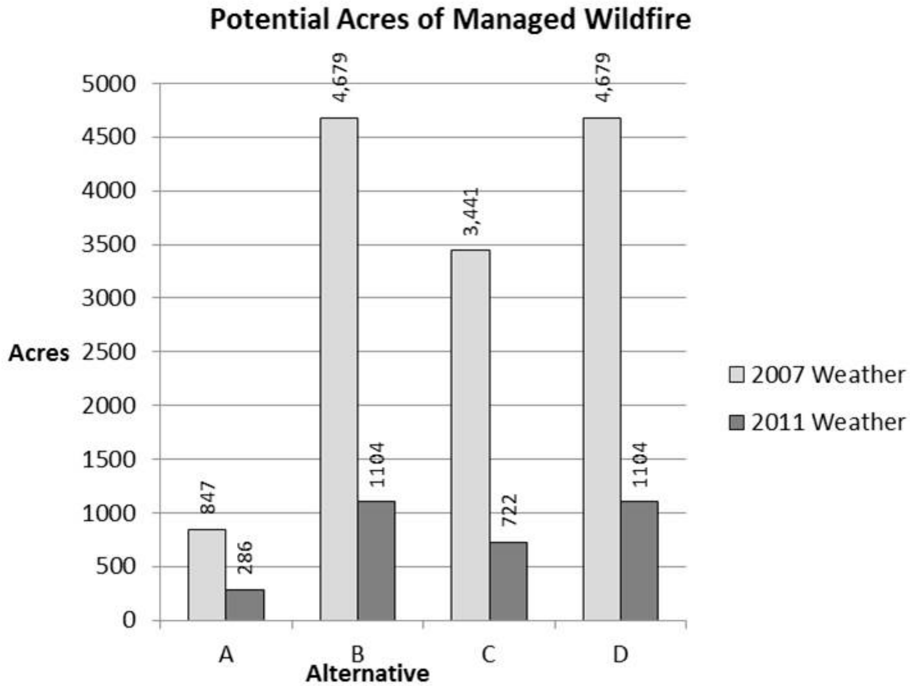
In order to produce a range of climatological conditions under which managed wildfire growth was estimated, a dry year (2007) and a wet year (2011) were used as model inputs.

The analysis uses every reported lightning ignition for the past 30 years as a point source ignition for the FSPro runs. Each of these ignitions is grown simultaneously for 7 days, with 500 repetitions. The chosen start date (Aug. 1, 2007, or Aug. 1, 2011) provides preconditioning of the fuels associated with the weather prior to ignition. Individual random weather scenarios from the historic record are then used as fire weather influencing fire progression. Then the acreage tally is divided by 30 to get the projected annual estimate.

Projected days available for prescribed fire are analyzed by quantifying the number of days that met air quality and prescribed fire weather criteria. Although these may not be directly linked to future managed wildfire decisions, they do show relative trends of when conditions can be expected to be most favorable. Note the inverse relationship between average lightning strikes by month (Figure 3-34) and available burn days (Figure 3-33).

Note that modeled fires allowed to grow into the defense zone and urban core (prior to clipping polygons) spread into greater than 90% more acres when using 2007 weather than 2011 weather.

To increase confidence, only pixels that experienced fire spread 60% or more were counted towards estimated acres.



Based on lightning ignitions over a 30 year period (1981-2010) and expected acres summed across 60 through 100 percent FSPro spread probabilities. Analysis covered two disparate years in terms of rainfall: a dry year (2007) and a wet year (2011).

Figure 3 37. Potential acres of managed wildfire produced using the Fire Spread Probability (FSPro) model.

Note: These are projected MAXIMUM acres. 2007 represents conditions in which decisions to manage wildfires for multiple objectives are highly unlikely. Even acres projected for 2011 are projected as a best-case scenario. Given the complexity of the LTB, actual managed wildfire acres is expected to account for fewer acres than shown here.

Summary of the Affected Environment

- The Comprehensive Evaluation Report (USDA Forest Service LTBMU 2006) determined the need for the fire and fuels resource to:
    - Reconsider more opportunities to implement managed wildfire
    - More thoroughly integrate fire and fuels management with other resource programs
    - Focus more on historic fire regimes as well as vegetation structural diversity and ecological function
    - Utilize science and modeling products available since the last plan update
    - Reduce the number of human ignitions
    - Consider alternatives to pile burning
- Risk to human communities and ecological resources:
    - Ignition risk by FMU—nearly 80% of all ignitions occur in the WUI, 56% in the Defense Zone and 23% in the Threat Zone.
    - Greater than 90% of the Basin is moderately or severely departed from reference fire return interval (FRI).
    - Under 90^{th} percentile weather conditions, fire behavior modeling produced fire type outputs in the following proportions—46% surface, 34% passive crown, 19% active crown
    - Additionally, wildfire severity proportions during recent wildfires have not been consistent with natural fire regimes, specifically, low severity has been under-represented and high severity over-represented.
    - Gondola Fire—July 3, 2002, 673 acres
    - Showers Fire—2002, 294 acres
    - Angora Fire—2007, 3,100 acres, over 250 homes destroyed, the largest fire ever recorded in the LTB.
    - Of all acres burned since 1980, 85% burned in the last decade (2002-2011)
- Fire and fuels management programs:
    - Burn plan prescription criteria and air quality restrictions limit the number of days available to meet prescribed burning objectives.
    - In recent years lightning caused ignitions have declined. If the trend continues, opportunities for managed wildfire will be minimal. Lightning frequency is probably cyclical.
    - Wet years such as 2011 may provide opportunities to utilize managed wildfire to meet various resource desired conditions and objectives

- Dry years, such as 2007 may be much more difficult to manage wildfires and thus suppression of most or all wildfires will be the likely decision.
- There has been a slight negative trend in human caused ignitions over the past three decades.
- Current trends in climate change are expected to increase fuel production as well as increase fire activity that may affect LTBMU's fire and fuels programs to unknown degrees.

3.4.10.3. Environmental Consequences

All five alternatives are consistent with Federal wildland fire management policy. LTBMU wildland fire management promotes the goal of managing fire to meet safety, protection, and natural resource management goals. Initial action on human-caused wildfire will continue to suppress the fire at the lowest cost with the fewest negative consequences with respect to firefighter and public safety.

The following activities are expected to affect the indicators:

- Indicator 1—Fire behavior will be affected primarily by WUI thinning and fuels reduction, but also by activities outside the WUI that restore forest structure, forest type conversion, and resilience.
- Indicator 2— FRID is affected only by prescribed fire and managed wildfire activities (suppressed wildfires not counted here since we project equal effects in all the alternatives).

Indicator 1 Consequences – Fire Behavior

This indicator is affected by numerous activities. Here we analyze and summarize the expected effects WUI fuels treatments and various non-WUI forest restoration treatments have on wildland fire behavior. Because all five alternatives follow the 10 year fuels reduction strategy, they are equal in the number of acres of WUI thinning and fuels reduction, although Alternative C thins to a lower density and Alternative D relies more on hand thinning and less on mechanical thinning than the other alternatives. Acres and types of treatments outside the WUI differ by alternative.

Reduction of fuel loading and modification of fuel arrangement are effective in modifying fire behavior, thereby reducing risk to communities, infrastructure and natural resources (North et al. 2009, Safford et al. 2009, Stephens et al. 2009, Ager et al. 2010, Moghaddas et al. 2010). Fire behavior modification is the primary objective in WUI fuels reduction projects. Each WUI treatment will be designed to meet a minimum fire behavior threshold under prescribed weather and fuel moisture conditions (90^{th} percentile). Even though all alternatives' fuels treatments will meet minimum criteria, those alternatives with fewer constraints may exceed those criteria and will be more effective under extreme conditions. WUI treatments will have similar effects at minimum criteria for all the alternatives. All the alternatives propose 2,000 acres per year of WUI fuels treatments. Alternatives A and D include more stringent thinning and diameter limit constraints. Alternative D relies more heavily on hand thinning than the other alternatives. Fuels treatments in Alternative C are designed to meet objectives with fewer entries and provide for greater longevity of treatment effectiveness.

By altering fuel loading and arrangement, forest restoration activities outside of the WUI also contribute to modification of fire behavior even though that might not be the primary objective. Alternatives A, B, and E propose equal numbers of acres, but more stringent diameter limits and thinning constraints provide less flexibility and decrease the ability of Alternative A to meet or exceed fire behavior objectives. Alternative C proposes treating twice the acres outside the WUI over Alternatives A, B, and E, and has

fewer constraints than Alternative A. In Alternative D, the WUI Threat Zone converts to non-WUI and a 12 inch diameter limit outside the WUI Defense Zone goes into effect once initial WUI fuel treatments are completed (approximately 10 years). In addition to the 12 inch diameter limit in Alternative D, mechanical treatments are minimized and the alternative relies heavily on hand thinning and prescribed fire to meet objectives. The uncertainty of having conditions suitable for using fire to meet objectives reduces the flexibility to meet objectives when fire is not available to managers.

WUI thinning and fuels reduction

All five alternatives are very similar with respect to modification of fire behavior in the WUI zones until initial WUI treatments are complete (~10 years). Alternative D relies slightly more on hand treatments over mechanical treatments in the WUI, but total acres remains the same among all alternatives. Greater differences among alternatives would emerge once the initial WUI treatments are complete and the Threat Zone converts to non-WUI and the 12 inch diameter limit outside the defense zone takes effect in Alternative D.

Forest structure restoration (Non-WUI)

Alternatives A, B, D, and E propose the same number of acres. Alternative C proposes twice the number of acres of this activity. Alternative D does not include manual type conversion but relies completely on hand thinning and prescribed fire to meet forest structure restoration objectives.

Forest type conversion (Non-WUI)

Alternatives A, B, D, and E propose 50 acres per year, while Alternative C proposes 100 acres per year. Alternative D relies on hand treatment and prescribed fire.

Forest stand resilience (Non-WUI)

Alternatives A and B and E propose 500 acres per year (7,500 ac over the life of the plan). Alternative C doubles the number of acres (15,000 ac over the life of the plan). Alternative D proposes only 300 acres per year (4,500 ac over the life of the plan) of stand resiliency treatments, and relies on hand treatments and fire.

Table 3 35. Acre contributions to effects on Indicator 1 (Modification of Fire Behavior) by the various vegetation and fuels treatments

Activity	Alternative A		Alternative B		Alternative C		Alternative D		Alternative E	
	Annual	Plan Life	Annual	Plan Life	Annual	Plan Life	Annual	Plan Life	Annual	Plan Life
WUI thinning & fuel reduction	2,000	30,000	2,000	30,000	2,000	30,000	2,000	30,000	2,000	30,000
Structure restoration	100	1,500	100	1,500	200	3,000	100	1,500	100	1,500
Type conversion	50	750	50	750	100	1,500	50	750	50	750
Forest stand resiliency	500	7,500	500	7,500	1,000	15,000	300	4,500	500	7,500
Total	2,650	39,750	2,650	39,750	3,300	49,500	2,450	36,750	2,650	39,750

These are estimates of average annual accomplishments and those expected over the life of the Plan (15 years).

Indicator 2 Consequences – FRID

All five alternatives use prescribed fire as the primary tool for reducing FRID. Managed wildfire may also contribute. Therefore we include an estimated best-case scenario for potential maximum annual acres of managed wildfire. The proposed prescribed fire and the estimated managed wildfire acres are summed to provide total potential acres of FRID reduction (Table 3-36). Alternative D is estimated to reduce FRID on the most acres at 54,811 acres over the next 15 years. That is about 10,000 acre more than Alternatives B, E and C, and about 20,000 acres more than Alternative A.

Wildland fire is a natural process that, among other things, reduces fuel loads, supports a superior forest gene pool, promotes development of all structural stages, and increases resilience to disturbances and to climate change (Collins et al. 2009, Miller et al. 2012, North et al. 2012, Collins and Skinner 2013). According to FRID over 90% of the Basin is characterized as moderately or severely departed from historic fire return interval. It is estimated that wildfires burned an average annual acreage of between 2,000 and 8,000 acres in pre-settlement times (Manley et al. 2000); 1,600 to 6,400 of those estimated acres occurred in the montane and upper montane zones. These are the vegetation zones in which most of the LTBMU's management activities are located, much of which occurs in the WUI.

Alternatives A, B, and E each propose 1,800 acre of prescribed burning per year in the WUI. If this is accomplished, 27,000 acres will be treated over the life of the plan. This equates to 45% of the WUI that will have some fire on the ground. Alternatives C and D each propose 2,100 acre of prescribed burning per year in the WUI. If this is accomplished, 31,500 acres will be treated over the life of the plan. This equates to 52% of the WUI that will have fire on the ground. Prescribed burning outside of the WUI is proposed to begin once initial WUI treatments are complete. Alternatives A, B, and E propose 100 acres per year. Alternative C proposes 200 acres per year, and Alternative D 450 acres per year.

Alternative D does less pre-treating and relies much more on hand treatment to prepare units for prescribed fire. Those units outside the WUI are further subject to the 12 inch diameter limit. Denser post-treatment stands may narrow the prescription window for use of fire. But, there may be fire behavior trade-offs as a denser stand may have lower insolation, reduced wind speeds and decreased undergrowth regeneration than more open stands. Stands thinned to a lower minimum density provide greater treatment longevity over stands with higher residual densities. Alternative C provides the greatest treatment longevity. Alternative D will rely on fire to meet treatment objectives. More high intensity fire and tree mortality should occur during prescribed burning with Alternative D. This is consistent with this strategy and is expected to help restore structure and composition. Proximity to communities may limit use of higher intensity prescribed fires as public acceptance of intense fire activity and torching trees is limited.

Assuming that the proposed acres in each alternative are accomplished, substantial FRID reductions in the WUI will be realized over the life of the plan. Substantial reductions in FRID usually will not occur with a single fire treatment, but getting these initial burns accomplished is critical to restoration efforts since second entry prescribed burns are more likely to resemble natural fire regimes.

Projecting any amount of prescribed burning or managed wildfire acres requires assuming that conditions will be suitable, objectives can be met, resources are available to complete the projects, smoke impacts can be mitigated, and the burn can be implemented within acceptable risk. These are huge assumptions based on a high degree of uncertainty. The LTBMU conducted an historical analysis of burn opportunities over a 13 year period (see Figure 3.33), and based on the analysis, conditions suitable for prescribed burning are not abundant. During the late summer, early fall months, when most presettlement burning occurred, smoke dispersion and weather conditions coincide only about one third of the time. Further, two to four consecutive day periods meeting these criteria occur very infrequently (average less than twice per year in each of these three months) and longer consecutive day periods are even less frequent. Based on these constraints and all the inherent uncertainties, projecting acres using prescribed fire to reduce FRID

is a difficult exercise. Keeping up with fuel accumulation, restoring fire to the ecosystems, and meeting the goals and objectives of any of the alternatives will require us to be prepared to take advantage of burn opportunities as they arise. Alternatives that provide conditions most favorable for safe implementation of prescribed fire will have the most potential for success. Alternatives A, B, and E propose the least number of acres of prescribed fire. Alternative D proposes the most, but imposes the greatest constraints on activities that may be needed to prepare treatment units for prescribed fire. This lack of flexibility reduces the probability of success for this alternative. Because Alternative C imposes fewer constraints on preparatory treatments, it provides the most flexibility and probability of success.

Utilizing natural ignitions for meeting resource desired conditions and objectives is essential for restoration (Collins and Stephens 2007, Collins et al. 2008, North et al. 2009) but also effective for fuels reductions (Miller 2003). The importance of fire in restoring forest structure and composition as well as reestablishing a dynamic equilibrium with changing climate and ignition conditions should not be underemphasized (North et al. 2009). The LTBMU realizes the value of using fire to meet these objectives. As with any application of fire, making decisions to allow naturally ignited fires to meet resource objectives is subject to a variety of constraints based on weather criteria, fuel conditions, resource availability, smoke dispersal conditions, and safety concerns. Projecting desired acres into the future based on these assumptions and inherent uncertainty is extremely difficult.

For the LTBMU, decisions for utilizing fire are even more difficult for fire managers and line officers because of the proximity to communities and the high-value resources throughout the unit. Conditions under which a decision to go ahead with a naturally ignited wildfire and manage it to meet resource objectives will undoubtedly be those conditions that will support low fire activity and thus result in small fires (conditions such as those in 2011 rather than 2007). While Alternatives B, E and D propose more acres available than C, the extra acres consist of WUI Threat Zone acres. Although urban areas were restricted in the FSPro simulations consistent with respective alternatives, it should be noted that when using 2007 climatology, the model burned greater than ten times more acres in the defense zone and urban areas than those simulations using 2011 climatology. These are areas that are least likely to provide decision makers with the level of comfort to make the decision to allow a fire to be managed for resource objectives. Likelihood of affirmative managed wildfire decisions decrease with proximity to values at risk, but may increase when in proximity to treated areas.

In order to make a decision to manage a wildfire to meet resource objectives, the ignition must be natural (lightning) caused. Since 2004 there have been a total of 25 lightning caused ignitions reported in the Basin (see lightning occurrence and natural ignitions in Affected Environment section of this report). If this frequency trend continues, our ability to meet resources objectives using managed wildfire will be very limited. If lightning ignitions continue at the current frequency or trend downward, the importance of utilizing this tool to meet resource objectives will be virtually non-existent. Should this reduced frequency of lightning caused ignition over the last few years be part of a cyclic pattern, or perhaps due to stochastic processes, opportunities to manage natural ignitions to meet resource objectives may increase.

Prescribed burning

All five alternatives use prescribed fire as the primary tool for reducing FRID. Alternatives A, B and E propose reductions on 1,900 acres per year or 28,500 acres over the life of the plan. Alternatives C and D propose 2,300 and 2,550 acres per year respectively, or 34,500 and 38,250 acres respectively over the life of the plan.

Managed wildfire

Current direction provides for this only in the LTBMU portion of the Desolation Wilderness (21,998 acres). Alternative C provides the option in all areas except the WUI (83,534 acres) and Alternatives B, E, and D propose the highest number of acres available (130,740). This includes all areas except the WUI

Defense Zone. Figure 3-37 shows modeled upper estimates for managed wildfire acres under 2007 and 2011 weather scenarios. Modeled FSPro wildfire spread into defense zone and urban core areas occurred greater than 90% more frequently when using 2007 weather. Since a year such as 2007 is unlikely to receive an affirmative decision to manage a wildfire to meet resource objectives, estimated acres using the 2011 weather only are reported in Table 3-36.

Note: *any modeled potential acres of managed wildfire accomplishments for any of the alternatives are not TARGETs. Rather they are modeled maximum possible? acres burned under favorable conditions in which every lightning ignition from the historical record was modeled as a wildfire managed to meet resource objectives. With the amount of WUI, infrastructure, current fuel conditions, smoke management issues, and prevailing weather typical at or near periods where lightning ignitions are expected to occur, accomplishments will more likely be near the lower end of the projections.*

Table 3 36. Acre contributions to effects on indicator 2 (Reduction in fire return interval departure) by prescribed fire and managed wildfire

Activity	Alternative A		Alternative B		Alternative C		Alternative D		Alternative E	
	Annual	Plan Life	Annual	Plan Life	Annual	Plan Life	Annual	Plan Life	Annual	Plan Life
Prescribed Fire	1,900	28,500	1,900	28,500	2,300	34,500	2,550	38,250	1,900	28,500
Managed Wildfire	286	4,287	1,104	16,561	722	10,830	1,104	16,561	1,104	16,561
Total	2,186	32,787	3,004	45,061	3,022	45,330	3,654	54,811	3,004	45,061

These are estimates of average annual accomplishments and those expected over the life of the Plan (15 years). Managed wildfire acres here reflect only those acres modeled using 2011 weather.

These are considered maximum acres with minimums estimated annual acres equal to zero.

Climate Change

Over the last 100 years, mean annual temperature in the Lake Tahoe Basin has increased by 2^{o} F. Days with temperatures below freezing are decreasing. Average annual precipitation during the last 100 years is increasing, but inter-annual variability is also increasing. While average annual precipitation is increasing, the amount falling as snow is decreasing, as well as average winter snow pack. Further, spring thaw is occurring 5-30 days earlier than several decades ago (see Appendix D– LTBMU Climate Change Trend Assessment).

These observed trends are expected to affect fire and fuels in a variety of ways. Increasing the growing season for fuels may affect the rate at which fuels accumulate under current conditions. Excess water during wet years can support higher rates of fuel production, while dry years are more conducive to large fire growth. Extended summer drought may increase tree mortality and contribute to more of these accumulating fuels providing more available fuels that contribute to increasing fire size and severity. This can be seen in recent trends in wildfire characteristics throughout the Sierra Nevada region over the past 2-3 decades, where wildfire frequency, size, total area burned and severity have all been observed to increase. Climatic changes discussed above are considered primary causal factors for these increases (Westerling et al. 2006; Miller et al. 2009).

If these projected changes occur the fire and fuels program may be affected in a variety of ways. It might make prescribed fire and managed wildfire implementation more difficult if the fire season is extended. Alternatively, if more of the winter months experience rain rather than snow, burn opportunities could expand. Most likely, the projected high inter-annual variability will create years with abundant burn opportunities alternating with years with very few burn windows. Climate change impacts to the program will be very similar across all the alternatives.

3.4.10.4. Analytical Conclusions

Fire behavior

Alternative C will provide the most acres of modified fire behavior with 3,300 acres per year or 49,500 acres over the life of the plan. That is 35% greater than Alternative D and 25% greater than Alternatives B and E. Alternatives B, C, and E share the greatest flexibility to meet or exceed fire behavior criteria. Alternative C provides the greatest treatment longevity.

Conclusion: Alternative C provides the greatest benefit in terms of fire behavior.

FRID

Given all the uncertainties and assumptions listed in the consequences section, the following conclusions have been derived:

While Alternatives C and D estimate more acres in FRID reduction, Alternatives B and E will provide the greatest probability of success in reducing FRID. Alternative D estimates more potential acres of FRID reduction, but should conditions suitable for the safe and effective use of fire not occur, the ability to meet objectives will be compromised since other treatment options are restricted.

Alternative C proposes more pretreated acres, which is an advantage for meeting resource objectives, but includes less area allowable for manage wildfire. Alternative A by far provides the least opportunities for reducing FRID.

Conclusion: Alternatives B and E provide the greatest probability of success in reducing FRID.

Climate Change

The effect of the fire and fuels program on mitigating the effect of climate change may vary by alternative and will be mostly dependent on the amount of area treated, post-treatment stand density, and the amount of prescribed burning proposed and managed wildfire allowed by alternative. For the amount of area treated and post-treatment stand density, Alternative C creates the most resilience to climate change, followed equally by Alternatives A, B, and E. Alternative D creates the least resilience to climate change. When considering use of prescribed fire and managed wildfire, the differences between alternatives depend greatly on where the amount of burning falls in the range of proposed prescribed fire and acres of estimated managed wildfire. The alternatives differ at the upper range of burning, but all have the same lower range of zero. So if climatic conditions are such that prescribed fire or managed wildfire accomplishments trend towards the lower range, differences between alternatives will be minimal. If optimal burning conditions are realized, Alternative D will have the most beneficial effect followed by Alternative C, then B and E, and finally A. However, as stated in relation to the indicators above, reliance on conditions outside the Unit’s control elevates the risk of the strategy and reduces probability of success. Strategies that allow the most flexibility to meet uncertain future conditions have a higher likelihood of success.

Conclusion: Alternative C provides the most treatment acres and flexibility to increase resilience to projected climate change.

Other activities that may affect fire fuels indicators

- Acres of PACs restored by 2025—A=0, B, C, E=3,900, D=0. PACs are human constructs delineated to include spotted owl or goshawk nest stands and encompass the best available 300 acres of habitat consisting of two or more tree canopy layers, large trees (> 24“ dbh) and high canopy cover (> 60%). These conditions are very susceptible to stand replacing fire. Depending on where and how these restoration projects were implemented, they could have minor effects on localized fire behavior and, if prescribed fire or managed wildfire are used, FRID. However, activities used to meet these restoration targets are not described by alternative and therefore, effects on fire and fuels indicators cannot be evaluated.
- Developed recreation expansion (overnight units, parking, permit expansion, ski run expansion)—A=0-10% increase, B=0-5% increase, C=0-15% increase, D=0-15% decrease, E same as B but overnight accommodations may increase up to 10%. Were activities associated with recreation expansion to occur, some alteration of vegetative cover would likely be required. Any new structures would require defensible space as stated in Forest Vegetation DC7. However, most these activities would be much localized and are not expected to have significant impacts on the any of these indicators or on fire and fuels management in general. Significant exceptions would be new or widened ski runs which would be effective as fuels breaks. However, without project specific details, this is difficult to evaluate except to say that these activities are most likely to occur in Alternative C and descend in likelihood according to the percentages above.
- Miles of Roads—A=199, B, E=204, C=221, D=207. Alternative C may provide an advantage over the other alternatives since it proposes between 14 and 22 miles of more road access. Depending on where future fuels treatments are located, these roads may provide important access to vehicle and equipment needed for implementation. However, without site specific treatment location information, it is not possible to precisely quantify the effects additional roads will have on the fire and fuels indicators.
- Acres of Backcountry Management Emphasis Areas and Wilderness—the alternatives propose varying amounts of backcountry and wilderness areas. This is based on recommending current Backcountry Management Emphasis as Wilderness, or in additional Backcountry Management Emphasis areas such as in Alternative E. Therefore any increase in Wilderness is accompanied by an equal decrease in Backcountry Management Emphasis. Alternative A keeps current acreages.

Alternative E adds about 3,600 acres of new Backcountry Management Area between Ward and Blackwood Canyons called Stanford Rock backcountry area that excludes WUI. Alternative C recommends the Dardanelles Roadless Area as recommended Wilderness area. Alternative D recommends the Dardanelles and the Freel Roadless Areas, as well as adds the Stanford Rock backcountry area which overlapped part of the WUI. Impacts of these recommendations on fuels indicators or programs will be minimal since we do not conduct significant fuels management in roadless or wilderness areas. The exception is where backcountry overlaps with WUI. In these cases, community protection is still the number one priority. Where treatments in backcountry are required for community protection, treatment methods may be modified to be consistent with Backcountry Management Emphasis suitable uses. But fire behavior objectives will still be met. Since Stanford Rock backcountry area does not overlap any of the WUI, impacts to fire and fuels management will be minimal. Wildland fire management might be affected if more wilderness areas are added since there are constraints to what suppression tactics can be employed inside wilderness areas. However, none of the alternatives are expected to have significant impacts on fire and fuels management due to changes in Wilderness or backcountry areas.

How the Alternatives Maintain or Achieve the Desired Conditions

Rather than addressing each individual vegetation and fire-fuels related desired condition, the desired conditions are grouped according to similar themes.

Modification of fire behavior and reducing risk to communities

Throughout implementation of the 10 year strategy for the WUI, all five alternatives would progress towards community risk and fire behavior modification desired conditions in similar fashion and at a similar rate. Minor exceptions would be those alternatives with more thinning constraints (diameter and canopy cover retention limits) or those relying more on hand treatments than mechanical. Alternative B, C, and E have exceptions to the 30 inch diameter limit. However, these exceptions are expected to be used very sparingly and therefore, will not have great impact. Alternative D uses hand thinning more than the other alternatives and is subject to conversion of WUI threat Zone to non-WUI as well as a 12 inch diameter limit outside the defense zone. However, these will not go into effect until the 10 year strategy is complete. Alternative A and D may reduce fire behavior slightly less and Alternative D provides less treatment longevity than the others. Alternatives A, B, and E will be similar in effects because they both treat the same number of acres. However, since Alternatives B and E have fewer constraints, their effects on fire behavior and treatment longevity will be greater than Alternative A. Alternative C treats the most acres with the fewest constraints and therefore, provides the most longevity and modification of fire behavior. Alternative D’s heavy reliance on fire to achieve desired conditions and to meet objectives includes a great deal of uncertainty. If conditions are mostly suitable for using fire, then Alternative D may meet desired conditions and objectives as well or better than the other alternatives. Should conditions be unfavorable for application of fire, then Alternative D will reduce fire behavior the least and have the least treatment longevity due to the heavier reliance on hand versus mechanical treatments.

Once initial treatments of the 10 year strategy are complete, some changes will occur in the alternatives. The most significant changes will be vegetation management increased emphasis on ecological restoration outside the WUI and Alternative D’s Threat Zone converting to non-WUI management. The restoration treatments outside the WUI will be less important in terms of community risk than WUI treatments, but are still important in reducing fire behavior because wildland fires originating outside the WUI can still threaten WUI and natural resources. Alternatives B and E are slightly better than Alternative A in their ability to meet fire behavior and community risk reduction desired conditions outside the WUI. Alternative C is the most effective at meeting these desired conditions. The reasons are the same as those stated in the paragraph above. The most significant difference outside the WUI occurs in Alternative D, because Threat Zone is converted to non-WUI along with associated thinning

constraints and heavy reliance on hand treatments and prescribed burning to meet restoration objectives. So evaluating the effectiveness of Alternative D at meeting fire behavior modification desired conditions outside of the WUI Defense Zone depend on successful use of fire. If conditions do not permit enough use of fire, then thinning constraints would make this Alternative the least effective. If conditions permit sufficient use of fire to thin forest to appropriate levels, Alternative D can be as effective as any other alternative. However, any alternative that limits choices and reduces flexibility for meeting desired conditions should be viewed with caution.

Conclusion: Alternative C would make the most progress towards risk reduction and fire behavior desired conditions.

Restoring and maintaining ecological processes and disturbance regimes, restoration of historic forest structure, composition.

Alternatives A, B, and E treat the same number of acres for meeting these ecological restoration desired conditions. Alternatives B and E provide fewer constraints and more flexibility and would make better progress towards these desired conditions. Alternative C doubles acreage and would progress towards the desired conditions much faster than Alternatives A, B, or E. Alternative D relies primarily on hand treatment and use of fire to meet ecological restoration desired conditions. Restoration of natural processes such as fire is the preferred method of meeting desired conditions. Such a strategy, theoretically, would reestablish dynamic equilibrium with reigning climates and provide the most resilient and sustainable conditions. Alternatives B, D and E project the greatest number of managed wildfire acres, followed by Alternatives C, and then A. If conditions are optimal for using fire, then Alternative D will have as high a probability of success as Alternatives B and E. However, excluding other available tools and technologies that can be used as surrogates to natural disturbance processes will reduce this alternative's ability to meet desired conditions when conditions safe for implementation of fire use are not available.

Conclusions: Alternatives B and E best provide the ability to restore ecological process desired conditions.

Resilience

Several desired conditions discuss increasing the forest's resilience to fire, drought, insects, and pathogens. Additionally, most predictions suggest a warmer and potentially drier future for the Lake Tahoe Basin (see the Climate Report in Appendix C) Creating resilience to these stressors is an important part of each of the action alternatives. The desired conditions for forest vegetation are based both on contemporary reference conditions (unlogged forest with minimal fire suppression) and historical pre-settlement conditions (since these conditions evolved over centuries under prevailing disturbance regimes). Strategies with the best chance for success seek to reestablish fundamental ecosystem processes (fire, hydrology, propagule dispersal, etc.) wherever possible, so that LTB ecosystems can more readily achieve dynamic equilibrium with changing climates. All alternatives seek to utilize natural processes, such as wildfire, or surrogates, such as prescribed fire and thinning, to create more resilient conditions. Alternatives A, B, and E propose equal efforts in terms of acres treated. Once again, Alternatives B and E have fewer constraints and more flexibility and would have better ability to create resilience. Alternative C doubles the acreage of Alternatives A, B, and E and includes fewer constraints than Alternative A, providing more resilience than Alternatives A, B, or E. The common theme with Alternative D is that relying too heavily on one set of tools (i.e., underburning and managed wildfire), however appropriate those tools may be, could end up tying the hands of managers should the appropriate conditions for using those tools not materialize.

Conclusion: Since Alternative C thins the most acres with the fewest constraints, it provides the most flexibility and highest likelihood of success for meeting resilience related desired conditions.

Overall conclusions: Alternative C provides the best strategy for modifying fire behavior, reducing risk, and achieving forest vegetation and fire-fuels related desired conditions. Alternatives B and E reduce FRID and restore ecosystem processes the most due to more area allowed for managed wildfire than Alternative C. However, while Alternatives B and E do not propose as many acres of treatments as C, they are not precluded from treating more acres if capacity is present and ecological conditions suggest more treatments are appropriate. Finally, this report concludes that Alternative B or E provide the best strategy for success in meeting fire and fuels program goals.

3.4.11. Forest Vegetation

The goal for forest vegetation in the forest plan is to restore forest structure and composition to conditions that are more resilient to future changes in climate and disturbance regimes. The first step will be to target historic, pre-Euro American settlement conditions where possible, with eventual modifications as more is learned about the influences of a changing climate. Goals include Jeffrey pine and white fir forests that have fewer and (on average) larger trees, more structural variability, and a more clumped (or random) spatial distribution than current forests (Taylor, 2006).

As defined here, forest restoration includes:

1) Creating early seral openings within the mid-seral stage to restore temporal and physical distribution of structure by major forest type;

2) Converting overabundant white fir types to more resilient pine or mixed conifer types to restore relative abundance of major forest types; and

3) Reducing stand densities and understory fuels periodically over the life of the stand to resilient levels that allow for continued stand development following drought, fire and bark beetle attacks.

The forest in the Lake Tahoe Basin is subdivided into smaller, relatively homogenous units, called stands. This makes management of the larger landscape much easier because it can be approached one stand at a time (Hunter, 1990). An important point to remember is that these units of area (e.g., stand, forest, landscape) are not static and change a great deal through time. Disturbance, whether a random event or something that occurs slowly over time, will influence the competitive advantages of trees and other associated species within – and across – each major forest type.

3.4.11.1. Introduction

Analysis of how well each alternative progresses towards, achieves or maintains the forest vegetation desired conditions is based primarily on the scale and intensity of forest restoration treatments along with periodic incidence of modeled wildfire and bark beetle-caused mortality. A suite of prescriptions were developed using the SPECTRUM model, a computer-based analytical tool for building natural resource management models where parameters are formulated to capture the effects of disturbance and succession (Henderson, 2008, USDA, 2008) to accomplish forest restoration goals. Since the timeframe to achieve the desire conditions extends beyond the life of this plan, this analysis is focused on trends towards which each alternative makes in achieving the restoration goals. Given the estimated annual treatment acres in Table 2-1, combined with a lack of site specificity, the modeled runs reflect a generalized view of possible outcomes. The acres in Table 2-1 of the forest plan are based on objectives and strategies to meet DCs. The model uses these to inform the prescriptions for each alternative.

A team of vegetation, fire, and biology specialists in the USFS Regional Office and on the LTBMU developed a list of prescriptions, constraints for treatments, and goals for modeling forest vegetation over time for each alternative. Using Forest Inventory & Analysis data, GIS resource layers, and the treatment amounts in the forest plan, model runs were projected out to assess differences in achieving the desired conditions between alternative specific goals. The goal for each alternative analyzed differed by the intent of that alternative. These are as follows:

Alternative A - maximize the amount of late seral closed canopy forest.

Alternatives B, C, & E – maximize restoration of forest structure and composition, with alternative C reflecting more progress over time.

Alternative D – maximize growth of large trees (>30 inches diameter) mostly through the use of hand treatments and prescribed fire.

The principal question addressed in the analysis is whether the trends move towards the reference conditions and achieve the goal for the alternative.

Methodology

The Spectrum model was the primary model used by analysts to predict future outcomes of planned treatments identified to achieve forest restoration goals. Using GIS and application of basic prescriptions (combined with acres from Table 2-1), outputs were generated from 2003 forest inventory data (FIA, 2003) to illustrate reduction in departure from historic conditions by alternative.

Established data sets were used for analysis within the model. There were three sources of established data sets used including: 1) current forest vegetation inventory information (Christensen et al., 2008) from the 2003 Forest Inventory & Analysis program of the US Forest Service-PNW along with corresponding IKONOS satellite imagery, 2) historic forest structure and composition information from modern studies of historic or reference conditions and fire frequency by multiple researchers as well as the Wieslander inventory for the US Forest Service in the 1930s, and 3) locally and Regionally defined prescriptions for treatment using professional judgment as related to the objectives.

Geographic Information System is the primary tool for spatially quantifying various types of information, e.g., slope percent, soil types, suitable road access, etc. that influence treatment methods and constraints (e.g., cultural sites, riparian areas) that require special treatment measures. Major forest types were highlighted in the GIS generated map with stratification made on the basis of structural class, density, and location within the land suitability framework. However, specific treatment sites were not identified.

Outputs of the modeling are approximations of future outcomes to aid in evaluating consequences of actions. Although the timeframe for implementation of the revised forest plan is 15-20 years, to understand the implications of restoration outcomes a half century or more is needed to determine whether the actions taken today will have the desired effect beyond the life of the plan.

Limitations inherent in the information, analytical tools, and modeling include:

- Currently used prescriptions are generalized for practical modeling purposes. These general prescriptions satisfy the majority of cases in which a silviculturist would prescribe treatment to meet the forest restoration desired conditions. Although there are some constraints built into the model for certain wildlife habitats, e.g., Protected Activity Centers for Spotted Owls and Northern Goshawks, wildlife specific prescriptions were not included.

- The Revised Forest Plan contains more specific standards and guidelines for consideration in project planning than is feasible to model here.

- Model strength or accuracy is generally greater the shorter the modeled duration or period. The predictive growth model is thought to be reliable up to 50 years out. After that it drops in reliability.

- There are slight differences in classification of forest types between current FIA inventory (classified into CWHR types) and representations of modeled historic forest types in the historic reference condition mapping. Historic forest types are classed as percentages of the landscape within a structural seral stage while the current inventory of forest types represents the actual seral stage acreage within each (HUC 6) watershed.

- The model includes periodic disturbance from wildfire and bark beetles based on historic occurrences. Disturbance frequencies and severities may not be the same in the future, but is all we have to go by. Drought was not specifically modeled. These are in addition to the planned/prescribed treatments and occur every 2 periods in the model
- There is a first decade adjustment for treatments and fires (e.g., Angora Fire of 2007) that occurred between the time of the inventory (2003) and the running of the model (2011). For this analysis and since this period of 10 years has past, the first decade has been dropped from analysis.
- Group selection openings were modeled for an average sized opening of 2.5 acres. This means that there are no openings of other sizes between 1 and 10 acres.
- The forest plan seeks to retain trees greater than 30 inches in diameter, although there are exceptions on a case-by-case basis that would allow trees greater than 30 inches in diameter to be removed (this is the case for alternatives B, C, and E), therefore, no trees greater than 30 inches were removed by the SPECTRUM model.

Indicators

The key indicators selected for evaluating progress and accomplishment of forest restoration goals resulted from a collaborative approach comprising technical experts from agencies, universities, and private sector consulting. These indicators best represent conditions at each stage of stand development as well as overall conditions at the landscape scale (also see Table 3-38).

1. **Forest Structure –** This indicator is both a physical and temporal distribution of stand development stages (hereafter called "seral stages") that have been classified as Early, Mid Closed, Mid Open, Late Open, and Late Closed seral stages. (See Table 3-37 for explanation of seral stage sizes and opening percentages).
2. **Forest Type –** This indicator describes composition of the dominant tree species that make up a stand, sometimes represented by a single species or as a mixture. Conversion of a forest type from one to another relates to abundance desired at the basin-wide scale that was present pre-settlement. Forest Types include Jeffrey pine, white fir-mixed conifer, and red fir (see Figure 3-38). These are derived from California Wildlife Habitat Relationships (CWHR) vegetation types.
3. **Forest Stand Resiliency –** This indicator refers to the ability of a forest stand to withstand disturbance at each seral stage (See Definition below). In a resilient stand, trees are capable of capturing sufficient resources (water, sunlight) to resist (see Definition below) drought, fire and bark beetles. This indicator can be measured directly as a result of actual mortality or predicted through the use of modeling. In addition to being an indicator, density levels for each forest type over a range of site conditions can be used to predict mortality.

Table 3 37. Seral stages by canopy and tree sizes

Seral Stage	Canopy	Tree Size
Early	Open	0-4.9”
Mid	Closed	5-23.9”
Mid	Open	5-23.9”
Late	Open	≥24”
Late	Closed	≥24”

Note: “Open” and “closed” are relative measures for the canopy layer of a stand. For this analysis, a stand is considered open if the canopy closure is less than 40 percent for Jeffrey pine and less than 50 percent for red fir and white fir/mixed conifer.

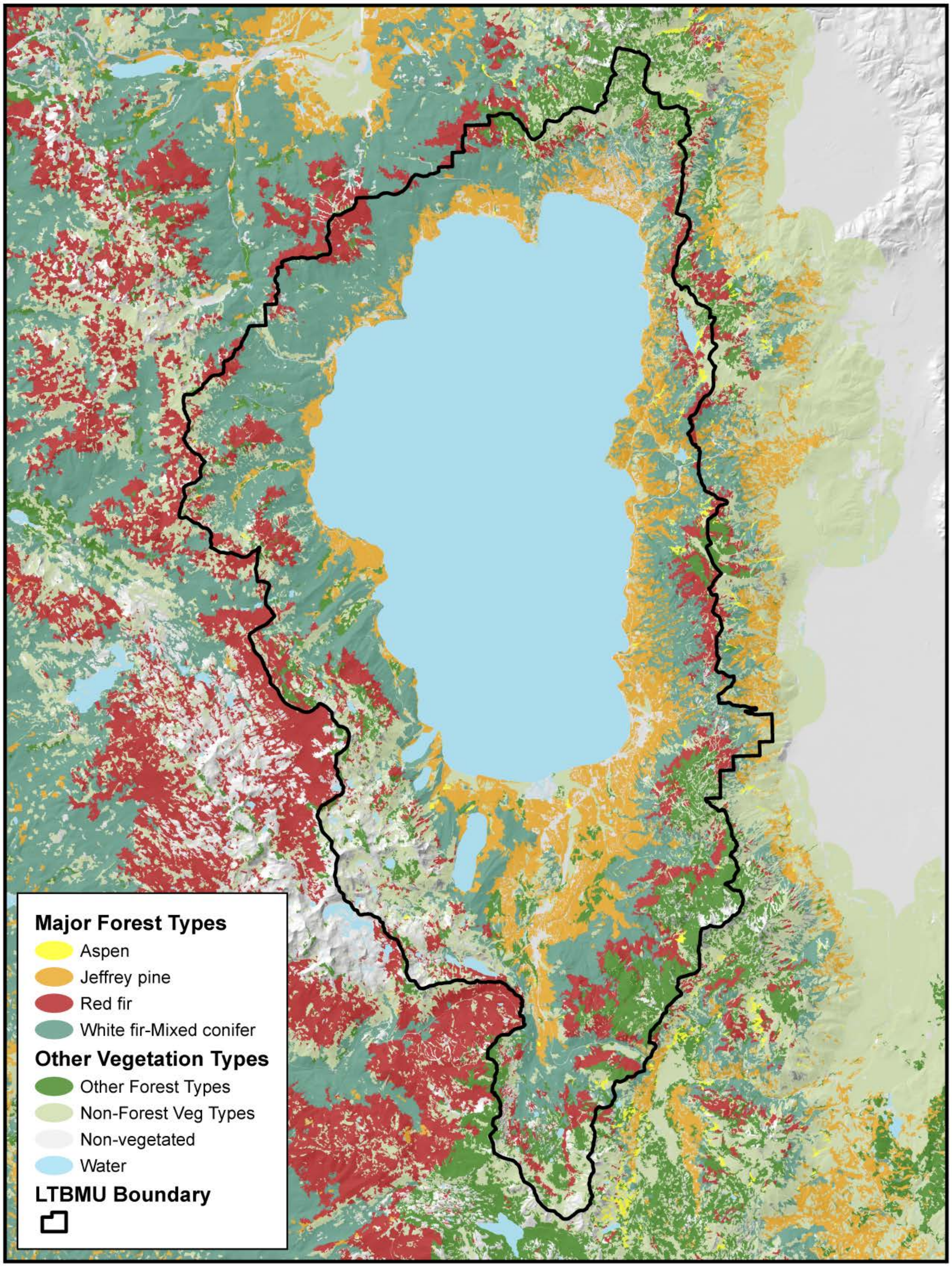


Figure 3 38. Major Forest California Wildlife Habitat Relationships (CWHR) vegetation types

Assumptions

In the analysis for this resource, the following assumptions have been made

- The models used (SPECTRUM, FOFEM) are correct.
- After treatments, forest stands regenerate back to original forest type unless purposefully converted. That is, unless directed to do so the model does not convert from one forest type to another.
- The current conditions in table 3-38 are accurate. The starting point for outputs from the SPECTRUM model is the second decade. Starting with the second decade allows for more consistent inter-decadal change over time, i.e., trend.
- The SPECTRUM model is deterministic (linear modeling) limited to the inputs provided by analysts, which means that one outcome is provided based on hundreds of data runs.
- The aim is to restore forest structure and forest composition beyond the life of the Revised Forest Plan (20 years). In reviewing the outputs from the model regarding departures from reference conditions, it would appear that this assumption is on the order of 100 years or more to achieve restoration for some forest types.
- First Order Fire Effects Model (FOFEM) was used to generate wildfire event information at the 90th percentile weather, which were then generalized into periodic events (every 20 years) in SPECTRUM.
- We allow the SPECTRUM model to create small openings (2.5 acres) in the WUI, because they are good for fire behavior modification as well as structural modification.
- Forest type conversion (WF/MC to JP) is allowed for white fir/mixed conifer stands that were previously identified as Jeffrey pine in the Weislander inventory of 1935. Type conversion and group selection is avoided in both Late Open and Late Closed Seral Stages.
- Subalpine vegetation is considered to be within the desired condition and not analyzed as a separate forest type in the model.
- Meadow and aspen restoration are not analyzed in the model, because SPECTRUM models conifer growth that has occurred in these vegetation types and conifers would be removed completely or nearly completely from these types.
- All four alternatives follow the collaboratively developed Lake Tahoe Basin Multi-Jurisdictional Fuel Reduction and Wildfire Prevention Strategy (2007). Exceptions will occur in the second decade when the WUI Threat Zone is scheduled to be eliminated in Alternative D. Additionally, diameter limits may exclude creation of early seral patches which may otherwise occur inside of the WUI. Alternatives will vary in the application of prescribed fire.

3.4.11.2. Overview of the Affected Environment

The forest types surrounding Lake Tahoe range along elevation gradients, beginning with those found in the montane zone at lake level (6,250 feet), continuing through an upper montane zone (7,200-8,500 feet) and up to the sub-alpine zone along the mountain peaks and ridges (above 8,500 feet). The major forest types that comprise the greater extent of the lower elevations include the Jeffrey pine and white fir-mixed conifer while the upper montane includes red fir. Together, these three forest types comprise the majority of forested lands around Lake Tahoe.

Montane and upper montane forests were dramatically changed in the late 1800s by logging to support silver mining in Nevada, and since the early 1900s from exclusion of fire to protect people and property at the Lake. Prior to the changes wrought on the forest in the 1800s, the Washoe Tribe was a regular visitor to the Basin and made use of fire as a tool for maintaining open forest and abundant forage for game. Fire plays a pivotal role in shaping and maintaining the structure, composition, and function of mixed-conifer and yellow pine ecosystems and was once very common in most of the Sierra Nevada (North et al. 2009). Heavy logging and long-term fire suppression have severely altered Lake Tahoe Basin forests from their "natural" state.

Today there are few examples that can be used as proxies for ecosystem-based management that approximate a forested ecosystem with its inherent disturbance regimes. The coniferous forests of the Peninsular Ranges of northern Baja California are close analogues to the Lake Tahoe Basin, having similar climate, geology, and dominant species. Because large areas of these northern Mexican forests were not logged, and because fire suppression has only been in effect for the last few decades, their composition and structure provide an important reference for the much altered forests of the Lake Tahoe Basin.

Considerable research on suitable reference conditions exists for the Lake Tahoe Basin. Some of this involves historical reconstructions of pre-settlement fire regimes and major forest type seral stage frequency distributions (Taylor 2004, Beaty and Taylor 2007). Modeling efforts have produced additional historical reference condition information (Safford and Schmidt 2007). Another important information resource is contemporary analogue forest systems in northwestern Mexico, which have been little logged and not managed under long-term fire suppression (Stephens and Fulé 2005).

Multilayered and very dense canopies, often associated with Pacific Northwest old-growth forests, are not the best model for Sierran mixed-conifer and especially not for pine forests because when adjacent trees are multilayered, the continuity of vertical fuels can provide a ladder for surface fire into the overstory canopy. Almost all historical sources suggest that, on average, yellow pine and mixed conifer forests were much more open and heterogeneous in structure than current forests. Horizontal heterogeneity, however, used to be relatively common in Sierran mixed-conifer forests (North et al. 2009). All of the Sierran reconstruction studies suggest mixed-conifer forests, under an active fire regime, had a naturally clumped distribution containing a variety of size and age classes (North et al. 2009).

There has been no deliberate restoration of early seral stages or structural heterogeneity across vegetation types in the Basin through management activities over the life of the current forest plan. The primary factors affecting the forest conditions remain the Comstock era logging that removed most of the Jeffrey pine forest in the late 19^{th} century and the exclusion of fire for more than 100 years. Over the past decade two wildfires occurred in 2002, the Gondola Fire (700 acres) and the Showers Fire (300 acres) and two in 2007, the Angora Fire (3,000 acres) and the Washoe Fire (20 acres). Although these fires converted some late and mid seral stages to early seral vegetation, they do not represent restoration. Except for the sub alpine zone, the historic fire regime or fire return interval has not occurred in these areas.

Forest vegetation treatments have occurred for fuel reduction, including understory removal with minimum thinning of the canopy. In wildfire-prone forests, tree-based carbon stocks are best protected

by fuel treatments that produced a low-density stand structure dominated by large, fire resistant pines (Hurteau & North, 2009). The recent climate has been favorable for growth and has created an increased potential for large-scale and intense levels of mortality due to bark beetles. Treatments have also occurred to reduce density and improve resiliency of the residual stand to bark beetle caused mortality. A suite of mechanical or hand treatments followed by prescribed fire have resulted in lower densities that have not had additional bark beetle caused mortality (Stark, et al, 2013). The dominant mid-seral stage condition present today that resulted from Comstock era logging persists in the montane and upper montane areas around the Lake, and is progressing toward late seral forest. However, this trend is not sustainable as there are few acres of early seral stages to progress into the mid seral stages. See the table below for general status and trend of each indicator.

In North America, management has often sought to recreate patterns characteristic of historical (pre-degradation) reference conditions, and historical information helped provided a blueprint for the desired outcome. In the future, the management emphasis in many ecosystems will shift from one of historical fidelity to one of ecological integrity, resilience, and delivery of services (Millar et al. 2007, Stephenson et al. 2010, Cole et al. 2010b). In this changed management environment, the role of historical ecology becomes one of informing a management response to global change rather than resisting global change. Historical ecology can, among other things, identify important broad-scale and long-term processes that influence local ecological outcomes under different climate conditions or disturbance regimes; provide clues to mechanisms underlying ecosystem dynamics and resilience (i.e., why have some systems persisted through climatic changes in the past?); guide the development and validation of predictive models; suggest appropriate future trajectories, and inform us if current conditions are anomalous and worthy of management intervention (Tausch et al. 1993, Landres et al. 1999, Millar and Woolfenden 1999, Swetnam et al. 1999, Cole et al. 2010a). In the end, historical ecology represents our clearest window into ecological patterns and processes that occur at temporal scales beyond the scope of human observation.

Any projection of future conditions is by definition uncertain. Although calibrated models of climate change agree on a range of plausible future mean temperatures, temperature extremes are impossible to predict with any certainty, and the extremes are often the primary drivers of ecological responses to climate (Easterling et al. 2000). Precipitation predictions vary widely, and for many places models projecting increased precipitation are countered by other models predicting decreased precipitation. As many authors have noted, uncertainties in future projections of climate change and its impacts are almost certainly higher than uncertainties in the spatial and temporal accuracy of historical ecological data (Willis and Burks 2006, IPCC 2007, Keane et al. 2009, Lawler et al. 2010). Thus, the argument has been made that because our understanding of historical ecosystems is usually much greater than that for most novel or emerging ecosystems, setting short-term targets based on known, historical ecosystems may minimize the risk of making things worse (Jackson and Hobbs 2009). The key is to understand that projected trajectories for many places will lead beyond the historical range of variability in climate – measured over thousands of years – in the next century. HRV-based management targets are thus better seen as “way-points” rather than “end-points.”

The Proposed LTBMU Forest Plan uses research on historical pre-settlement conditions to help set forest management and restoration on the right path toward generating sustainable conditions under future changed climates, understanding that future climatic conditions will not mimic past climatic conditions. For example, there is general agreement that fire frequencies and burned area are increasing strongly across the western US, and fire severity has been rising in the Sierra Nevada as well (Westerling et al. 2006, Miller et al. 2009). Future projections suggest similar but accelerating trends throughout the next century (Lenihan et al. 2003, McKenzie et al. 2004). Forest conditions described for the Lake Tahoe Basin before Euroamerican settlement were strongly shaped by fire. Historical ecological data on fire-adapted forests provide a highly useful template for designing future forest conditions (structures,

compositions, processes, etc.) that are more likely to be resilient to warming climates and intensifying wildfire activity.

A perspective that recognizes the pervasiveness of human impacts on ecosystems also recognizes the importance of using contemporary ecosystems as reference systems whenever possible. We use historical information principally to understand ecological events and processes that we cannot observe firsthand, but directional changes in the baseline state (climate, air, water, soil, etc.) mean that historical conditions may be imperfect surrogates for future desired conditions. To compensate – where available – properly functioning contemporary reference ecosystems should form part of the package of information that underlies restoration and resource management. Jeffrey pine-dominated forest types in the Lake Tahoe Basin have experienced 100+ years of heavy logging, grazing, and fire exclusion (Sugihara et al. 2006). High elevation conifer forests in northern Baja California, Mexico are the southern extension of the semiarid Alta California yellow pine forests – they grow on similar soils, experience a similar climate, and support the same dominant trees and shrubs. Both Alta and Baja California yellow pine forests are experiencing directional climate change, but large areas in Baja were not logged, and fire exclusion has only recently come into vogue (Stephens and Fulé 2005). Historical data substantiate the long-term ecological similarity of the systems and have uncovered important climate-fire linkages that help to explain ecosystem patterns and processes along the latitudinal gradient that joins the California forests (Stephens et al. 2003, Skinner et al. 2008). Researchers and management agencies have recognized the potential of using the Mexican sites as contemporary reference systems for the American sites, and many studies have documented ecological patterns and processes within the former for management use in the latter (see, e.g., Minnich et al. 1995, Stephens and Fulé 2005). We use forest structure and fire severity data from the Baja California mountains to develop some of our desired conditions in the LTBMU Forest Plan.

In summary, while future changes in climate are likely to be outside of the historical range of conditions, the historical range of variation in ecosystem components and processes can provide information on, among other things, ecosystem dynamics, status of current ecosystem conditions, and insight into potential future ecosystem behaviors. Pre-Euro-American settlement conditions may provide information relevant to past and future ecosystem resilience or vulnerability. These pre-settlement conditions, in combination with information from contemporary reference systems in the mountains of Baja California, have provided information for the desired conditions developed for the alternatives analyzed in this document. Achieving approximate pre-settlement conditions as an initial baseline goal will include restoring key ecological processes that are currently absent or compromised, and better prepare those stands for the challenges that warmer, drier climates will bring. Thus, indicators used in this analysis are based on current departures from these reference conditions.

Table 3 38. Current Status and Trend of Indicators without treatment and forest restoration goals in the Lake Tahoe Basin.

Indicator	Existing Condition	Trend (Without Treatment)	Goal
Forest Structure	Predominance of Mid-Seral stage	Preponderance of Mid-seral trending to Late-seral without enough Early-seral to grow into the Mid-seral stages	Seral Stage distributions more similar to pre-settlement, leading to higher landscape heterogeneity.
Forest Type	Overabundant White Fir & under represented Jeffrey Pine. Lodgepole pine encroaching into red fir and riparian vegetation (aspen, streams, meadows).	White fir continues to dominate where pine had dominated prior to Comstock era logging. Riparian converting to lodgepole.	Relative abundance of dominant species more similar to pre-settlement abundances.
Forest Stand Resiliency	High stand densities resulting in high risk of bark beetle and fire mortality.	Continued increase in density and higher susceptibility to bark beetles and fire	Forest stands are thinned to levels that can sustain disturbance without a high amount of mortality.

Annual mortality of trees is mapped by the US Forest Service's Forest Health Protection unit and quantified by causal agents (see Table 3-39). The bark beetle caused mortality has occurred in many of the late seral stands throughout the basin, which largely overlap spotted owl and goshawk PACs/HRCAs (see map, Figure 3-39). There is a higher vulnerability in late seral stands to bark beetles due to past limitations to treatment options, including (but not limited to) diameter limits on tree cutting and avoidance to protect areas for habitat. Older trees in dense stands are often in competition with younger, more vigorously growing trees. Mortality of large-diameter (>39.4 inches (>100 cm) DBH) white fir, red fir, incense cedar, and sugar pine trees can be significantly high (Smith et al, 2005) following periods of drought as occurred with the fir engraver outbreak of the mid-1980s and the Jeffrey pine beetle outbreak of the 1990s. In the Lake Tahoe Basin, the Jeffrey pine beetle outbreak of the 1990s reduced the greatest amount of canopy cover in areas with higher density (Egan et al, 2012). In order to increase the resiliency of late seral stands from fire and bark beetles some level of treatment will be necessary. Specific standards and guidelines are provided in the Revised Forest Plan for this purpose, but are beyond the capability of the SPECTRUM model to capture. Therefore, despite the increasing levels of mortality occurring in late seral stands, no treatments are modeled in this seral stage.

In addition, the health of forests in the Tahoe Basin depends on a greater amount of space for trees to grow than forests with similar forest types on the west slope due to: 1) geography – being situated mostly on the east side, which is characterized by less precipitation to support dense stand conditions; and 2) topography – being mostly mountainous terrain consisting of steep slopes where soils do not retain water or nutrients for trees to tap into as compared to flatter terrain. As a result, where the slope is flatter and on the west shore, which receives more precipitation (e.g., Blackwood Canyon), denser Jeffrey pine canopy conditions exist. However, where the slope is steeper, conditions do not support the same densities.

Table 3 39. Annual Aerial Tree Mortality Survey for the years 2000 to 2011. (USFS State & Private Forestry, Forest Health Protection)

Acres with mortality and damage by causal agent and year													
Causal Agent	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**Totals**
Unspecified or mixed bark	15	1	0	17	6,03	73	6,09	77	78	3,37	11	21	16,93
Jeffrey pine beetle	99	5	21	2	41	10	17	65	15	21	18	14	2,36
Mountain pine beetle	34	28	0	30	22	69	1,72	2,28	1,98	96	69	77	9,17
Red turpentine beetle	0	0	0	0	0	0	0	0	0	40	0	0	40
Ips engraver beetles	0	0	0	0	0	0	0	5	1	0	4	0	10
Fir engraver	19	61	57	21	4,64	4,14	1,88	10	16	1,41	5,60	2,51	21,34
Unknown**	80	0	0	0	0	0	56	0	24	73	39	39	31
Totals	55	34	78	41	11,11	4,39	9,92	3,82	2,41	6,07	6,64	3,68	50,17
Number of estimated dead trees by causal agent and year													
Causal Agent	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**Totals**
Unspecified or mixed bark	29	1	0	1,14	6,81	78	18,02	56	10	13,71	11	50	41,09
Jeffrey pine beetle	31	7	73	4	67	95	35	97	41	24	35	15	5,17
Mountain pine beetle	1,35	46	0	12	45	12	3,36	12,56	7,84	2,93	2,51	86	32,19
Red turpentine beetle	0	0	0	0	0	0	0	0	0	1,75	0	0	1,75
Ips engraver beetles	0	0	0	0	0	0	0	10	19	0	20	0	49
Fir engraver	32	70	1,18	41	6,75	5,03	3,73	58	12	3,85	12,09	3,86	37,85
Unknown**	0	0	0	0	0	0	15	0	10	0	0	23	25
Totals	1,72	1,17	1,91	1,69	14,28	6,18	25,50	14,16	8,51	22,49	15,09	5,61	118,37

*Unspecified or mixed bark beetles typically denotes mortality affecting true fir and one or more species of pine.

**Unknown agents in the Tahoe Basin were attributed as either "aspen decline, aspen mortality or aspen defoliation," with the exception of 57 acres of fir defoliation in 200

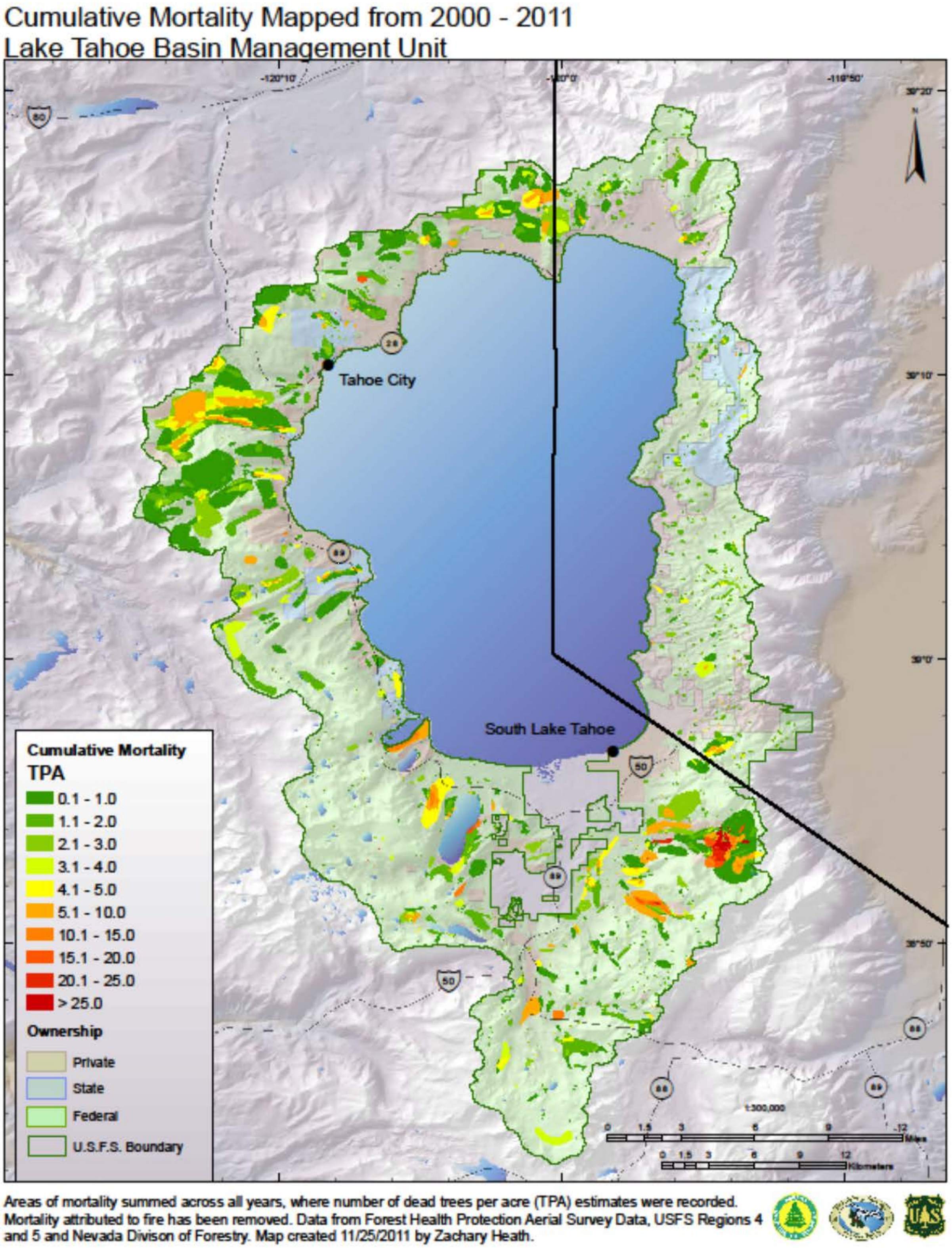


Figure 3 39. Cumulative Mortality, trees per acre (TPA) across the LTBMU, 2000-2011

Periodic disturbances, such as fire, drought, bark beetle outbreaks, flooding, wind, and other human caused disturbances, have occurred historically and more recently have been suppressed or mitigated to the extent possible. Stephens et al. (2009) found when fires were preceded by drought that spatial heterogeneity was a key feature in forest resiliency. In a warming climate, disturbance events could become more dramatic and prolonged, resulting in management actions that might need to be taken after an event. Moving current forest conditions towards the pre-settlement conditions is part of an overall approach that will also include adaptive strategies based on what can be learned from climate change to refine the prescriptions needed to achieve desired conditions (Table 3-40).

As of 2010, the proportions of the major forest types analyzed as currently within the historic ranges by seral stage only existed for white fir/mixed conifer. All of the other forest types were tremendously outside the historic ranges. In particular, Jeffrey pine and mixed conifer deviate the most from the reference, and red fir is shifting in composition to lodgepole pine (Taylor et al, 2013). The current proportions within the early seral stage are mostly under-represented and the mid and late seral stages over-represented. However, as the model grows the forest out beyond 20 years, much of the mid seral stages reach a mean diameter that puts them into the late seral stage. This pushes most of the forest in the Lake Tahoe Basin to a precarious situation in which there is little early seral forest to replace the mid seral. The imbalance of structural classes indicates the need for forest management to begin creating additional early seral from a portion of the mid seral stage before it grows into late seral.

The ability of the forest to self-maintain all seral stages only exists within the potential for periodic mortality-inducing disturbance events, e.g., bark beetle outbreaks and fire. To the extent that these can be controlled, management treatments will be necessary to restore forest conditions that are more resilient to these disturbances, drought and other climate-related changes. This is an objective in the current plan and will be even more important to achieve if the forests of Lake Tahoe are to become healthy (see the Glossary for a definition of Forest Health, Resilience and Resistance) and sustained for future generations.

Reference conditions for the major forest types in the Lake Tahoe Basin

Pre-settlement or Historic Reference Condition modeling for major Lake Tahoe Basin forest types were developed from non-linear forest stand dynamics (state and transition) modeling, using disturbance regimes from pre-Euro-American settlement period. Climate inputs were applied from 20th century information. The values derived cannot be reliably applied to landscape units less than about 10,000 acres in area (Safford and Schmidt 2007).

The reference percentages of area for the forest types analyzed come from the 1935 Vegetation Type Map (Wieslander) and the 2003 Lake Tahoe Basin Existing Vegetation Map, Version 4.1, updated for the 2007 Angora Fire. (Tables 3-40 and 3-41)

The diameter ranges for seral stages represented in the reference table below are: 0 to 4.9 for early, 5.0 to 23.9 for mid, and 24 and larger for late seral stages.

For white fir, and the red fir types, an “open” canopy has less than 50 percent closure while a closed canopy has closure greater than 50 percent; for Jeffrey pine, the open-closed cutoff is 40%. For detailed seral stage definitions, see Safford and Schmidt 2007.

Vegetation data to be updated as new information becomes available.

Table 3 40. Landscape Scale Desired Conditions for Major Forest Vegetation Types (desired average percent of vegetation type)

Vegetation Description	Approx. Percent of Area 1935	Approx. Percent of Area 2003	Early-Seral	Mid-Seral, Closed Canopy	Mid-Seral, Open Canopy	Late-Seral, Open Canopy	Late-Seral, Closed Canopy
White fir mixed conifer	10	21	10-20	5-15	10-15	30-40	20-30
Jeffrey pine	37	19	5-15	5-10	25-30	45-50	5-10
Red fir	15	18	10-20	20-30	5-15	15-25	25-35

Notes:

- 1935 percent of area from Forest Service 1935 Vegetation Type Map (Wieslander);
- 2003 percent of area from Lake Tahoe Basin Existing Vegetation Map, Version 4.1, updated for the 2007 Angora Fire.
- Desired Average Percent of Vegetation Type is derived from Historic Reference Condition modeling for major LTB forest types, developed from non-linear forest stand dynamics (state and transition) modeling, using disturbance regimes from pre-Euro-American settlement period. Climate inputs from 20th century. Values cannot be reliably applied to landscape units less than about 10,000 acres in area (Safford and Schmidt 2007).
- Early, mid, and late seral stages represent stand quadratic mean diameters of 0-5”, 5-25”, and >25” dbh respectively.
- For white fir, and the red fir types, an “open” canopy has less than 50 percent closure while a closed canopy has closure greater than 50 percent; for Jeffrey pine, the open-closed cutoff is 40%. For detailed seral stage definitions, see Historic Reference Condition Mapping, Safford and Schmidt 2007.

Table 3 41. Desired Conditions for Tree and Snag Density, Coarse Woody Debris (CWD) Loading for the Major Forest Types by Stand Development Stage (Seral Stage)

Forest Type	Stocking (stems)				Basal area (feet²/acre)				Snags (>15" dbh/acre)				Coarse Woody Debris (tons/acre)			
	Early	Mid	Late	Old	Early	Mid	Late	Old	Early	Mid	Late	Old	Early	Mid	Late	Old
White Fir/ Mixed Conifer	300	100	80	25	40	150	200	350	0	3	6	25	0	2	10	150
Jeffrey pine	200	70	60	15	30	80	100	250	0	1	3	15	0	1	6	100
Red Fir	300	100	80	25	50	250	350	700	2	4	7	25	0	10	20	150

Tables 3-42 and 3-43 were developed using the 2003 USFS Forest Inventory & Analysis (FIA) inventory data classified into California Wildlife Habitat Relationship (CWHR) classes. The more than 100 FIA plots in the Lake Tahoe Basin provide the basis for each classification used in this analysis. The CWHR classes are further classified into stand development stages or seral stage classes for purposes of analysis of forest structure in the model. Both levels of classification are represented here for resource inferences, e.g., wildlife habitat, uses CWHR and the vegetation and fire & fuels resources use the seral stages.

The current conditions have been adjusted for changes since the time of the last inventory (2003), including wildfire (Angora 2007) and treatments recorded in the Forest ACtivities Tracking system (FACTS) under the current forest plan. These conditions are used as the starting point for all graphs.

Table 3 42. Current Forest Conditions by California Wildlife Habitat Relationship Class and Seral Stage based on Forest Inventory

CWHR Classes	Seral Stage Classes	White Fir/ Mixed Conifer				Jeffrey Pine				Red Fir			
		CWHR Acres	%	Seral Acres	%	CWHR Acres	%	Seral Acres	%	CWHR Acres	%	Seral Acres	%
H-1X SEEDLINGS	Early	1,667	4			1,478	9			1,553	7		
H-2X SAPLINGS		0	0	1,667	4	0	0	1,478	9	0	0	1,553	7
H-3M POLES MOD	Mid-Closed	1,031	2			322	2			0	0		
H-3D POLES DENSE		0	0			0	0			0	0		
H-4M SM SAW MOD		6,561	14			1,676	10			2,235	10		
H-4D SM SAW DENSE		5,856	13	13,448	29	1,651	10	3,649	22	0	0	2,235	10
H-3S POLES SPARSE	Mid-Open	0	0			0	0			0	0		
H-3P POLES POOR		0	0			108	1			10	0		
H-4S SM SAW SPARSE		744	2			1252	8			242	1		
H-4P SM SAW POOR		4,312	9	5,056	11	1,890	11	3,250	20	3,106	14	3,358	15
H-5S LG SAW SPARSE	Late-Open	4,987	11			2,484	15			3,018	14		
H-5P LG SAW POOR		7,431	16	12,418	27	1,679	10	4,163	25	848	4	3,866	17
H-5M LG SAW MOD	Late-Closed	10,337	22			2,991	18			7,903	36		
H-5D LG SAW DENSE		0	0			171	1			0	0		
H-6 MULTI-STORIED		3,197	7	13,534	29	926	6	4,088	25	3,265	15	11,168	50
Totals		46,123	100	46,123	100	16,628	100	16,628	100	22,180	100	22,180	100

Explanatory Notes: The following two tables are provided to describe the CWHR categories referred to in Table 3-40.

CWHR Tree Size Class Descriptions

CWHR Size	Description	Diameter at Breast Height (DBH)
1	Seedling	Less Than 1 inch
2	Sapling	1 to 6 inches
3	Pole	6 to 11 inches
4	Small Tree	11 to 24 inches
5	Medium/Large	Tree Greater Than 24 inches
6	Multi Layered	Size 5 Over Size 4 Or 3; Total Tree Crown Closure Greater Than 60%

CWHR Tree Canopy Closure Classes

Tree Canopy	Description (% Canopy Closure)
S	10 to 24%
P	25 to 39%
M	40 to 59%
D	60 to 100%

Table 3 43. Current Stocking (Trees/Acre) by Size Class (DBH) for an average acre in the Major Forest Types

Stocking (Trees/Acre) by Size Class (DBH)	White Fir/ Mixed Conifer	Jeffrey Pine	Red Fir
Less than 1 inch	161	352	164
1 to 6 inches	110	92	25
6 to 11 inches	82	43	102
11 to 24 inches	46	61	38
Greater than 24 inches	17	14	7

Explanatory Note: The Stocking Table above represents a basin-wide average per acre for the major forest types. These averages are taken from a variety of research and forest inventory data summaries. Although a stand by stand stocking table would be more accurate, doing so would go well beyond the scope of this analysis.

3.4.11.3. Environmental Consequences

Sustainability of the forest vegetation surrounding Lake Tahoe can be affected to differing levels by each alternative. Restoring and managing for forest health, increasing wildlife and plant habitat heterogeneity, and resiliency to drought, bark beetle outbreaks and wildfire are the primary objectives in the forest plan. Much of the forest structure that is targeted for treatment falls within the mid-seral stage, which is trending towards the late-seral stage. In the coming two decades, most of this will move towards the late seral stages, leaving very little early-seral stage in the mix to replace it over time. Reductions in stand densities and moving some of the mid-seral stage stands to the early seral stage will be imperative to the sustainability of the forest overall.

Associated with the goal of managing for inherent sustainability of the forest are the fire and fuels, wildlife, botany, recreation, scenic, and watershed goals. These associated values can be viewed along with those of forest vegetation from an ecological or social point of view. Many social values have direct effects on whether the goals for ecological functions can be restored, maintained, or enhanced through management actions. Likewise, laws, regulation, policy and public input into project-specific planning play a vital role in determining the level of flexibility to manage for forest sustainability, ecological functions, or restoration.

The following graphs illustrate the modeled output of changes to the forest structure and composition of the three major forest types over 5 decades. In none of the forest types are the desired condition achieved over the 50 year time frame though white fir does make some progress towards it in Alternative C. There is an increase in the amount of Late Seral stages overall, but very little Early Seral created and in some instances further decreases.

Although some progress is made towards reducing departures from historic conditions, there is an insufficient amount of treatments to restore forest structure over the course of 20 years of plan implementation. As achieving restoration goals are expected to take up to 100 years, the intention of this analysis is to determine whether the trends are towards reference conditions are positive. In implementing the revised forest plan, adaptive management may permit for greater flexibility for forest restoration. However, the model does not have the ability to predict such adaptive changes.

In the first 10 years of forest plan implementation, emphasis would be on completion of forest health and fuel reduction projects within the WUI and over the life of the plan restoration of forest health, structure and composition.

The effects of each alternative in achieving forest vegetation desired conditions

The following summaries and analyses reflect both overall forest trends and forest type-specific trends and departures from reference conditions for the three major forest types analyzed. Both treatments and disturbances (wildfire and bark beetle outbreaks) contribute to the changes in forest structure and net removals from the inventory.

In each alternative there are four different types of graphs used to illustrate the changes over time (5 decades), including 1) seral stage trends for each forest type, 2) percent departure from desired conditions (based on reference conditions), 3) net growth and removals relative to the forest inventory, and 4) growth in number of large trees (greater than 30 inches diameter).

<u>Questions</u>:

The principal question is whether the seral stages are moving towards the reference conditions, which would indicate a positive relationship between the alternative and restoration of forest structure.

The secondary question is whether the goals for the specific alternative are met.

<u>Goals</u>:

Alternative A is based on the current forest plan (as amended) to promote Late Seral Closed Canopy habitat for species dependent on this habitat, including California Spotted Owls and Northern Goshawks.

Alternatives B, C & E are to restore forest structure, while Alternative C allows for a higher level of acres treated per decade than in Alternatives B and E.

Alternative D is to grow larger trees using more passive methods of treatment, primarily prescribed fire.

<u>Percent changes</u> in seral stages by alternative are categorized as: No change (0-10 percent change); an Increase or Decrease that is either Slight (11-20 percent change), Moderate (21-50 percent change), or Substantial (>50 percent change).

Summary of Seral Stage changes across all forested types by alternative

When all of the major forest type information is combined, we see general trends for the majority of forestland area in basin. Table 3-44 highlights the general trends over 5 decades for proportions of five seral stage classes. It is important to note that these modeled outputs reflect effects of proposed treatments towards achieving alternative-specific goals and that change is due both from treatments and disturbances (fire, bark beetles).

Table 3 44. Summary of all forest type trend changes from current conditions over a prediction of five decades.

Seral Stage	Alt. A	Alt. B	Alt. C	Alt. D	Alt. E
Early	Moderate Decrease	Slight Decrease	No Change	Slight Decrease	Slight Decrease
Mid closed	Moderate Decrease	Moderate Decrease	Moderate Decrease	Moderate Decrease	Moderate Decrease
Mid open	Substantial Decrease	No Change	Slight Increase	Moderate Decrease	No Change
Late open	Moderate Increase	Substantial Increase	Moderate Increase	Substantial Increase	Substantial Increase
Late closed	Moderate Increase	No Change	Slight Decrease	Slight Increase	No Change

Summary of Seral Stage changes for white fir/mixed conifer by alternative

White fir is a shade-tolerant species that is found throughout the Lake Tahoe Basin. However, it has become a major component of the mixed conifer forest type and together comprises the largest forest association in the Basin. Table 3-45 highlights the general trends over 5 decades for proportions of five seral stage classes. It is important to note that these modeled outputs reflect effects of proposed treatments towards achieving alternative-specific goals and that change is due both from treatments and disturbances (fire, bark beetles, etc.).

Table 3 45. Summary of white fir/mixed conifer trend changes from current conditions over a prediction of five decades.

Seral Stage	Alt. A	Alt. B	Alt. C	Alt. D	Alt. E
Early	Substantial Decrease	Slight Decrease	Slight Decrease	Moderate Decrease	Slight Decrease
Mid closed	Substantial Decrease	Moderate Decrease	Moderate Decrease	Substantial Decrease	Moderate Decrease
Mid open	Substantial Decrease	No Change	Substantial Increase	Substantial Decrease	No Change
Late open	Moderate Increase	Moderate Increase	Slight Increase	Moderate Increase	Moderate Increase
Late closed	Moderate Increase	No Change	No Change	Moderate Increase	No Change

Summary of Seral Stage changes for Jeffrey pine by alternative

Jeffrey pine is a shade-intolerant species that is found throughout the Lake Tahoe Basin. Table 3-46 highlights the general trends over 5 decades for proportions of five seral stage classes. It is important to note that these modeled outputs reflect effects of proposed treatments towards achieving alternative-specific goals and that change is due both from treatments and disturbances (fire, bark beetles, etc.).

Table 3 46. Summary of Jeffrey pine trend changes from current conditions over a prediction of five decades.

Seral Stage	Alt. A	Alt. B	Alt. C	Alt. D	Alt. E
Early	Moderate Decrease	No Change	No Change	Slight Decrease	No Change
Mid closed	Moderate Decrease	Moderate Decrease	Moderate Decrease	Substantial Decrease	Moderate Decrease
Mid open	Moderate Decrease	Moderate Increase	Substantial Increase	Moderate Decrease	Moderate Increase
Late open	Moderate Increase	Slight Increase	Slight Increase	Moderate Increase	Slight Increase
Late closed	Substantial Increase	Moderate Increase	Moderate Increase	Substantial Increase	Moderate Increase

Summary of Seral Stage changes for red fir by alternative

Red fir is a shade-tolerant species that is found in the montane and upper montane reaches of the Lake Tahoe Basin. Table 3-47 highlights the general trends over 5 decades for proportions of five seral stage classes. It is important to note that these modeled outputs reflect effects of proposed treatments towards achieving alternative-specific goals and that change is due both from treatments and disturbances (fire, bark beetles, etc.).

Table 3 47. Summary of red fir trend changes from current conditions over a prediction of five decades.

Seral Stage	Alt. A	Alt. B	Alt. C	Alt. D	Alt. E
Early	Moderate Decrease	Moderate Decrease	Substantial Increase	Moderate Decrease	Moderate Decrease
Mid closed	No Change	Substantial Increase	No Change	Substantial Increase	Substantial Increase
Mid open	Substantial Decrease	Substantial Decrease	Moderate Decrease	Substantial Decrease	Substantial Decrease
Late open	Substantial Increase	Substantial Increase	Substantial Increase	Substantial Increase	Substantial Increase
Late closed	Slight Decrease	Moderate Decrease	Moderate Decrease	Moderate Decrease	Moderate Decrease

Net Growth & Removals

In decades when the net removals are high, this is due in large part to incidence of wildfire and not treatments. In addition, the first decade from the model outputs has been removed from the following charts as this decade is accounting for all inventory changes since the time of the last forest inventory and goes beyond a decade of disturbance and treatment.

Net Changes in the forest inventory are due to growth and removals (including disturbance from wildfire and bark beetles). The total forest inventory in the Lake Tahoe Basin is approximately 4.2 million CCF (Hundreds of Cubic Feet) or 50.2 million MBF (Thousand Board Feet) of volume. In all alternatives the total inventory growths and the net growth exceeds the net removals over time.

Total Inventory and net growth in large (≥30 inches DBH) trees.

There are no removals of trees greater than 30 inches DBH modeled. Changes in the amounts of additional trees over 5 decades vary by growth and removals of smaller trees.

Alternative A

Alternative A is the no action alternative and provides a baseline for the effects analysis. If this alternative were selected, management would continue as described in the 1988 LTBMU Land and Resource Management Plan (Forest Plan) (USDA Forest Service 1988), as amended (Including 2004 SNFPA). There are diameter and canopy closure limits imposed with the goal to perpetuate a greater abundance of large trees and dense-canopy stands over the Sierra Nevada Range. There is allowance for the creation of openings up to 7 acres in size to establish early seral habitat. Although integrated pest management is an objective, this is mostly attained through thinning under the timber management objectives.

Forest Vegetation

The current Forest Plan would retain tree diameter and stand canopy cover limits that would conflict to a greater extent over time with achieving desired forest structure and forest resiliency conditions. Although more large trees would emerge from the ranks of smaller diameter trees, the density at which they would grow would put them in a higher degree of vulnerability from fire, bark beetles, drought, and other effects of a changing climate. The unit would continue to conduct treatments within the WUI to reduce hazardous fuels over the first decade of the plan. Towards the end of the first decade and into the second decade of the plan, approximately 50 acres per year of group selection harvests with reserves (scattering of trees or groups of trees) would occur in openings from 2 to 5 acres with some as large as 7 acres.

Overall, the forest under this alternative increases both late seral open and closed while mid seral open and closed stages decline (see Figure 3-40). This change is likely due to a proportional amount of growth in the mid seral stages growing into the late seral stages. The effect of treatments may be minimal towards this change as the treatments prescribed for this alternative follow a thin from below prescription. In terms of restoring forest structure each forest type needs to be viewed relative to departure from reference conditions. However, this alternative overall appears to move more of the forestland towards late seral closed, which is the underlying goal.

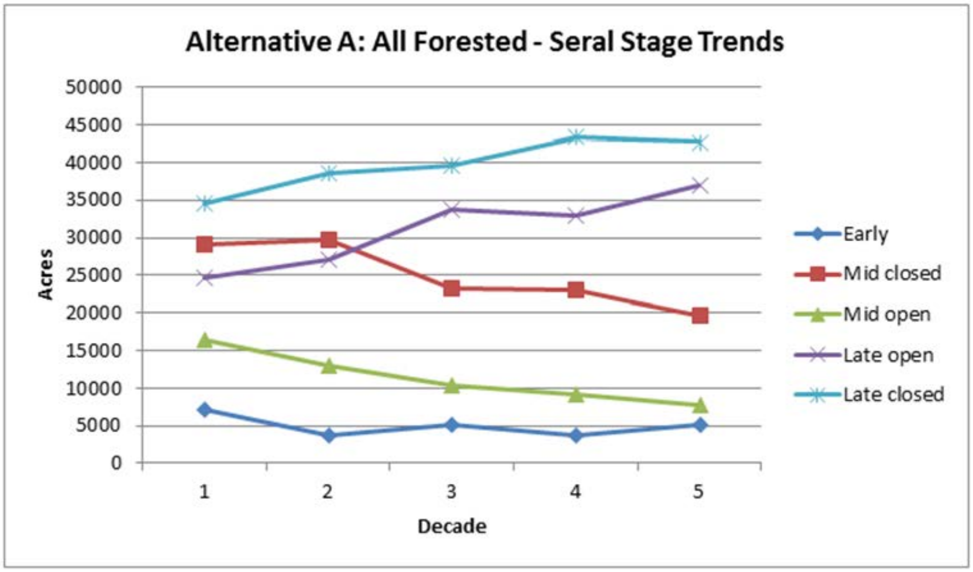


Figure 3 40. All Forested trends over time for each seral stage in Alternative A.

The white fir/mixed conifer type trends (Figures 3-41 and 3-42) mid closed and late open towards the reference conditions while the late closed and early move away. Overall, white fir/mixed conifer does trend towards having more of both late seral open and closed, thus meeting the goal for this alternative. However, meeting the desired conditions for forest structure would not be achieved over the 50 years modeled.

The decrease in total acres in the white fir/mixed conifer type from type conversion to Jeffrey pine is less than 800 acres in 50 years.

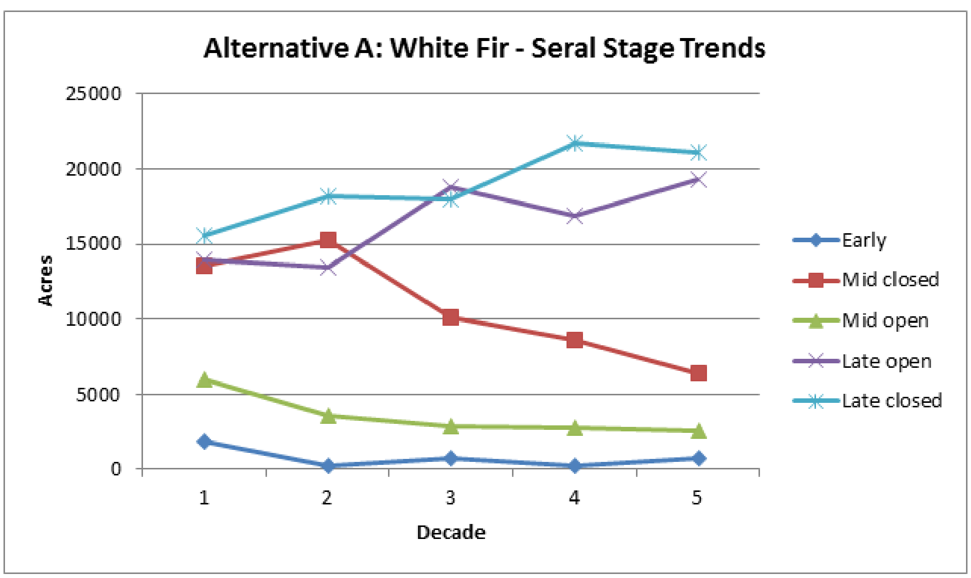


Figure 3 41. White fir-mixed conifer trends over time for each seral stage in Alternative A.

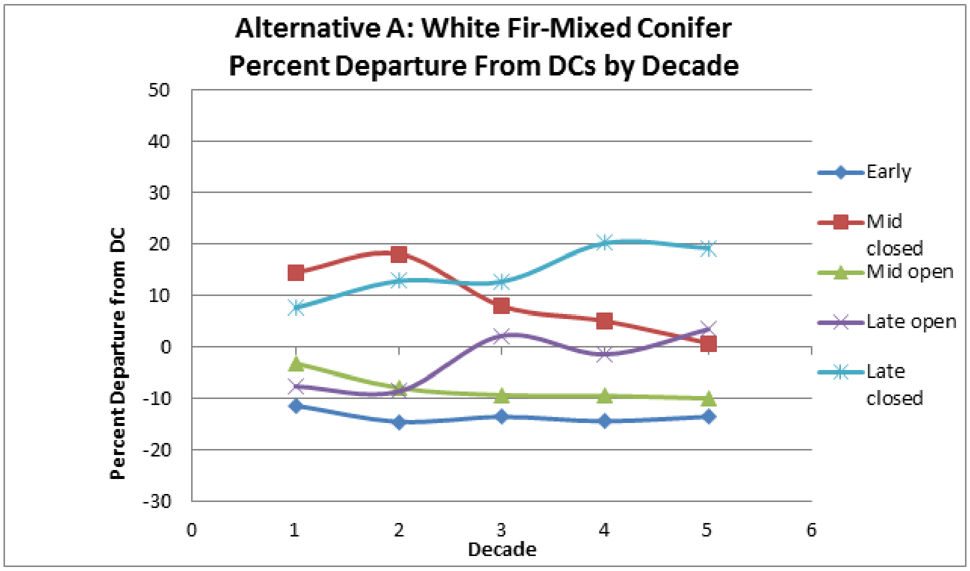


Figure 3 42. White fir-mixed conifer percent departure from desired conditions in Alternative A.

The Jeffrey pine type trends (Figures 3-43 and 3-44) mid closed and late open towards the reference conditions while the late closed and early move away. Overall, Jeffrey pine does trend towards having more of both late seral open and closed, thus meeting the goal for this alternative. However, meeting the desired conditions for forest structure would not be achieved over the 50 years modeled.

The increase in total acres in the Jeffrey type from type conversion from white fir/mixed conifer is less than 1,000 acres in 50 years.

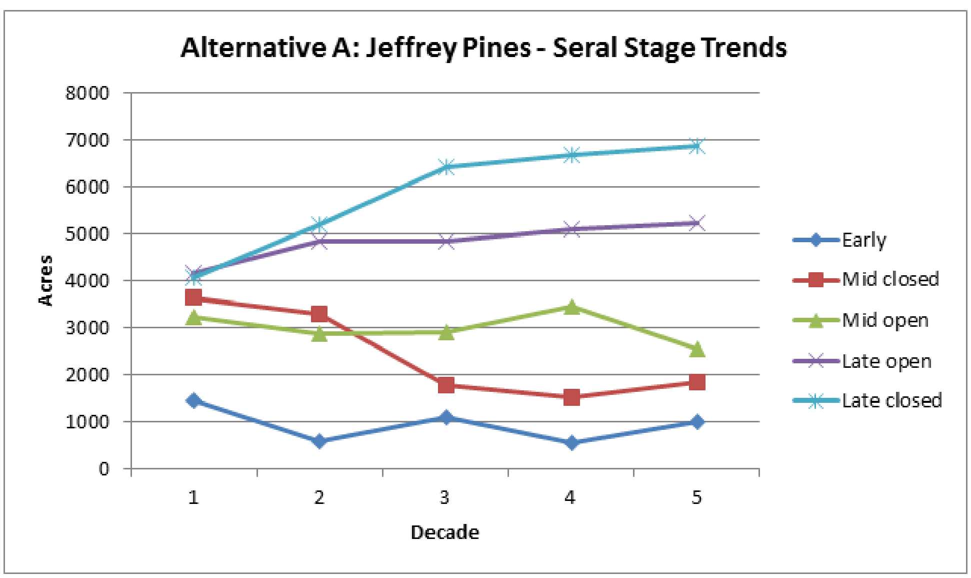


Figure 3 43. Jeffrey pine trends over time for each seral stage in Alternative A.

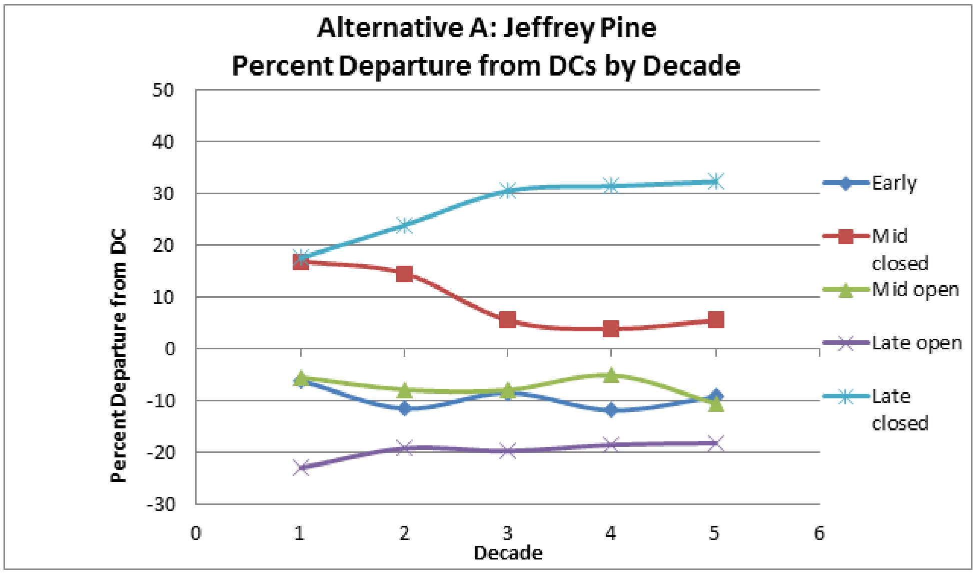


Figure 3 44. Jeffrey pine percent departure from desired conditions in Alternative A.

The red fir type trends (Figures 3-45 and 3-46)) mid open and late open and closed towards the reference conditions while the mid open and early move away. Overall, red fir trends towards having more late seral open, but less late closed, which does not meet the goal for this alternative. The desired conditions for forest structure would not be achieved over the 50 years modeled.

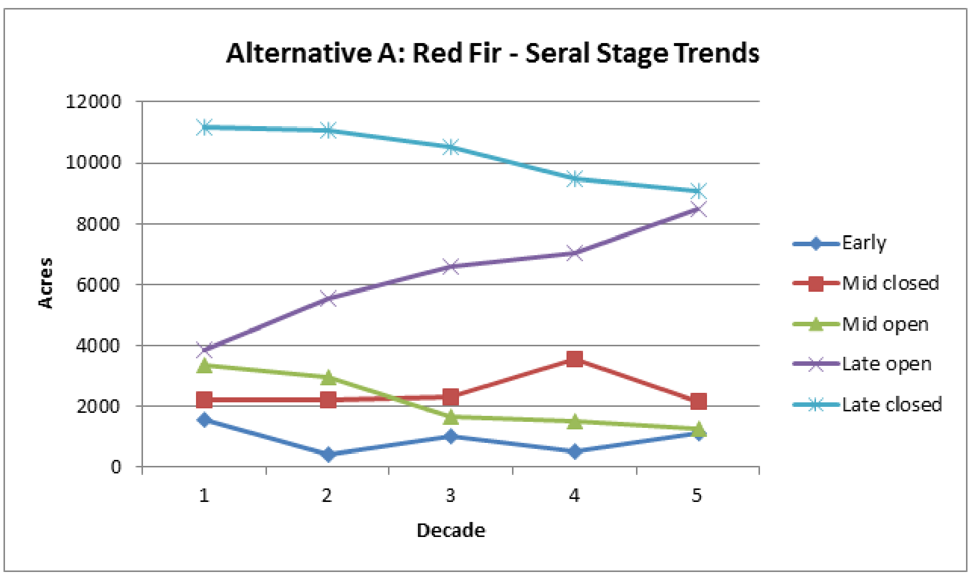


Figure 3 45. Red fir trends over time for each seral stage in Alternative A.

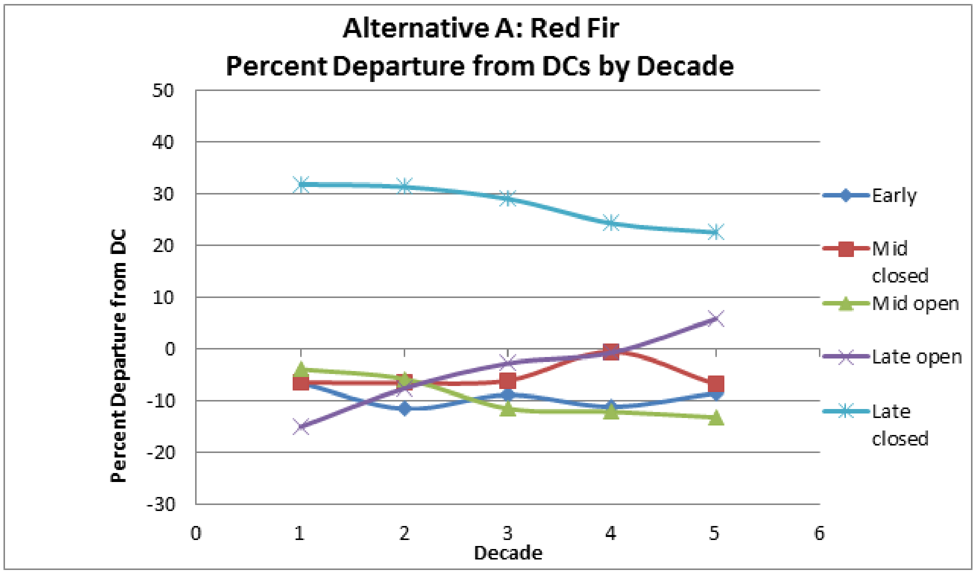


Figure 3 46. Red fir percent departure from desired conditions in Alternative A.

The forest inventory grows from 4.2 million CCF to nearly 5.0 million CCF in 50 years. Figure 3-47 indicates that net growth far exceeds net removals. Other than a modeled incidence of wildfire in the second period, treatments over time account for a very small amount of change. This means that the current forest conditions are less likely to improve relative to forest health under this alternative over time.

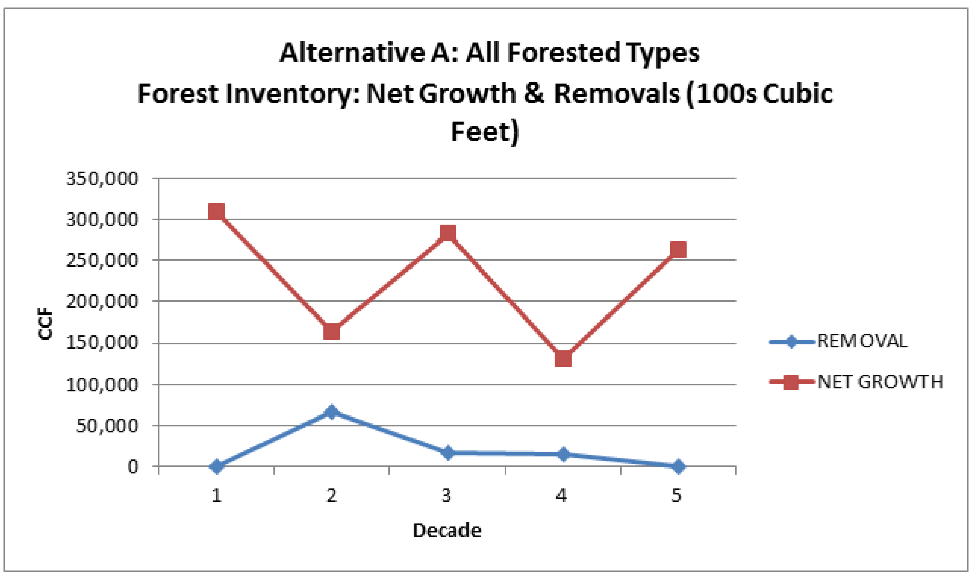


Figure 3 47. Net growth and removals (in 100s of cubic feet of volume) in Alternative A.

In Figure 3-48, the alternative does show an increase of approximately 17 percent in the amount of large trees. The graph does not show that at some point in the future, this trend would likely decrease as growing space requirements become more and more challenging to trees of this size.

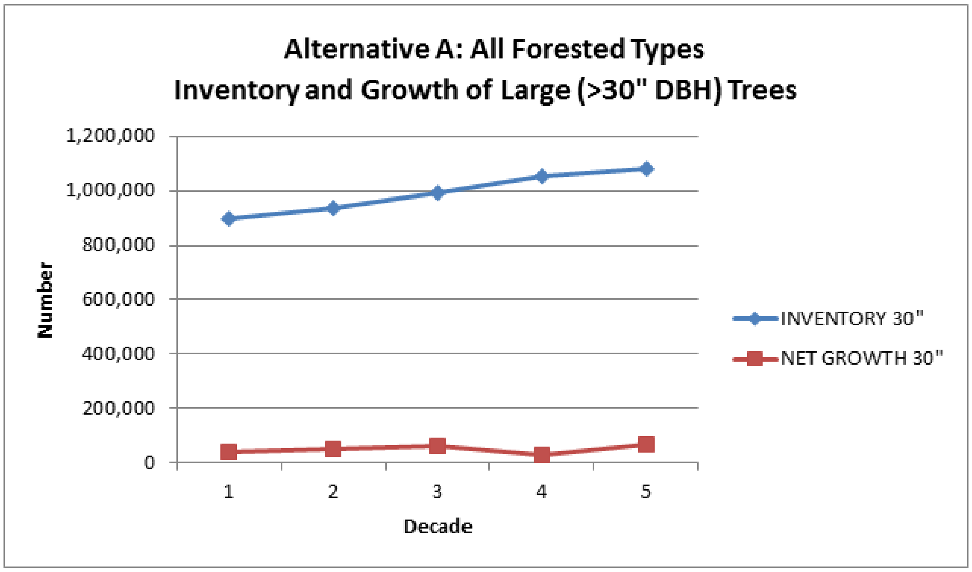


Figure 3 48. Inventory and growth of large trees greater than 30 inches in diameter in Alternative A.

In light of historical recurrences of periodic droughts, proliferation of invasive species, and the uncertain effects of climate change, the continued dominance of "closed" (dense) stands will have drastic consequences. First, drought, when combined with high densities predictably results in bark beetle outbreaks as well as the potential for stand replacing wildfire (Negron et al, 2009). Second, exotic invasive plant species (weeds) inhibit regeneration of native forest species by quickly occupying growing space following such stand replacing disturbances. Lastly, the effect of climate change could lead to an exacerbation of droughty conditions during the latter stages of the typical growing season, which could increase the level of inter-tree competition for water.

Associated Resources

Related to achieving forest vegetation goals in this plan are the following associated resource effects:

Wildlife

Forest vegetation management would primarily be conducted in conjunction with wildlife habitat objectives. However, this alternative limits the diameter to which trees can be cut to 30 inches and canopy closure in a stand to no less than 40 percent closure. As a result, vegetation management results primarily in a continued densification in forest stands, although aging of the stands means that more stands will be dominated by large trees. As trees continue to grow in size and density, these limits will inhibit managers to enhance older stands of trees and would likely result in a more rapid decline in late seral or old growth stands. This effect would be most profound in habitat for species dependent on late seral or old growth conditions, e.g., spotted owls and goshawks. Thus, the following graphs that depict an increase in the number of large and very large trees are somewhat misleading as these numbers increase without any disturbance.

Alternative B

In this alternative, forest vegetation treatments are intended to aid in the restoration of forest structure and composition. There are exceptions to the diameter and canopy closure limits. However, cutting large trees or thinning to lower densities would be implemented where the objective is to enhance the promotion of mid seral to late seral, longevity of late seral stands, or the resiliency of any stand. These

objectives involve standards and guidelines that are of a finer level of detail than can be modeled at this level. Although these objectives aim to improve overall forest health, they also target other resource improvements, e.g., wildlife habitat or scenic stability. There is allowance for the creation of openings within the mid seral stage of up to 10 acres in size to establish early seral habitat.

Overall, the forest under this alternative increases late seral open without changing late seral closed. There is a moderate decrease in mid closed while mid seral open remains unchanged (Figure 3-49). This change is likely due to a proportional amount of growth in the mid seral stages growing into the late seral stages. The effect of treatments may be minimal towards this change despite a prescription to move some mid seral to early seral through the use of group selection with reserves prescription. In terms of restoring forest structure each forest type needs to be viewed relative to departure from reference conditions. The goal for this alternative appears to make modest improvement in the restoration of forest structure. In addition more of the forestland moves toward late seral stages.

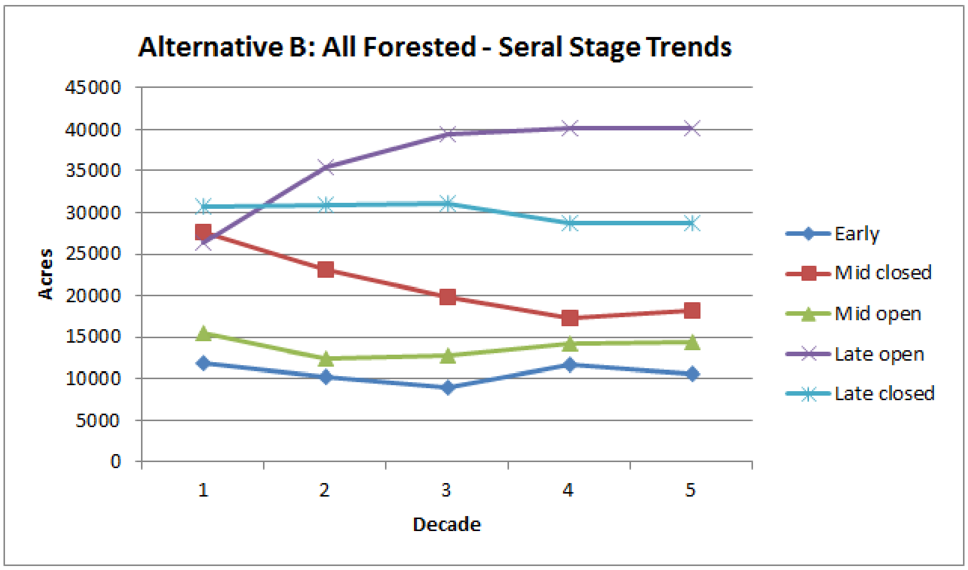


Figure 3 49. All Forested trends over time for each seral stage in Alternative B.

The white fir/mixed conifer type trends (Figures 3-50 and 3-51) nearly all seral stages towards the reference conditions despite some small changes away from the reference. Overall, white fir/mixed conifer does trend towards having more of both late seral open and closed.

The decrease in total acres in the white fir/mixed conifer type from type conversion to Jeffrey pine is less than 1,400 acres in 50 years.

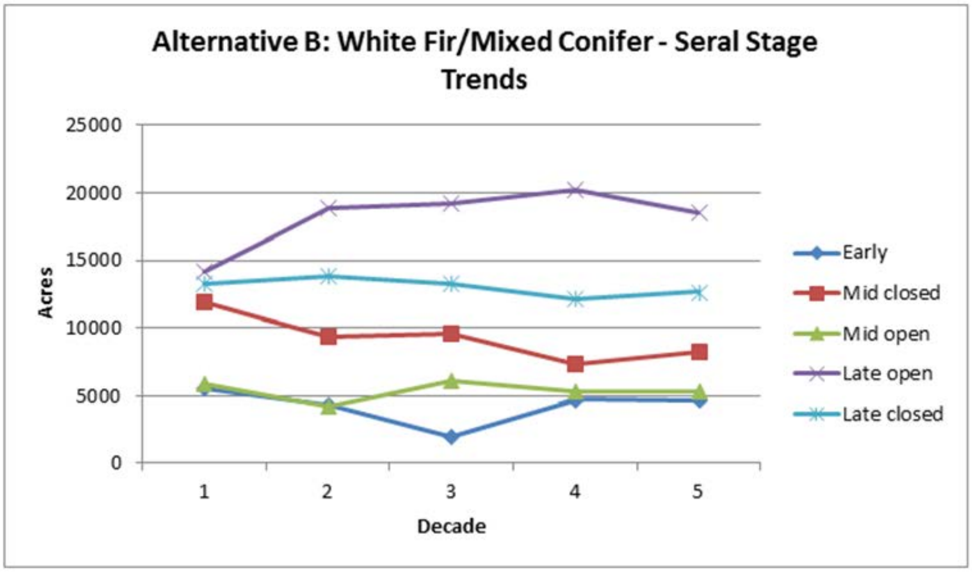


Figure 3 50. White fir-mixed conifer trends over time for each seral stage in Alternative B.

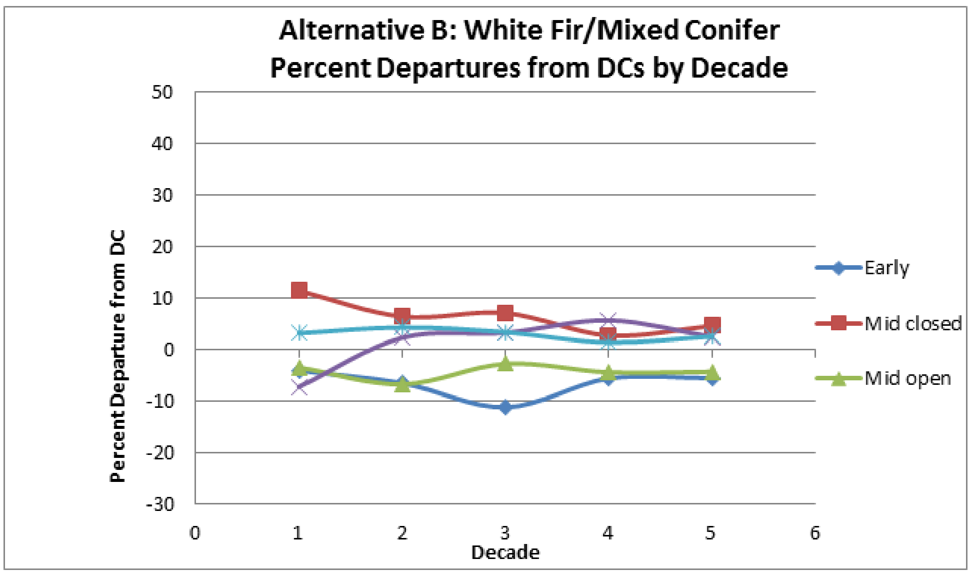


Figure 3 51. White fir-mixed conifer percent departure from desired conditions in Alternative B.

The Jeffrey pine type trends (Figures 3-52 and 3-53) nearly all seral stages towards the reference conditions though the late stages remain well outside reference conditions. Overall, Jeffrey pine does trend towards having more of both late seral open and closed. However, meeting the desired conditions for forest structure would not be achieved over the 50 years modeled.

The increase in total acres in the Jeffrey type from type conversion from white fir/mixed conifer is less than 1,400 acres in 50 years.

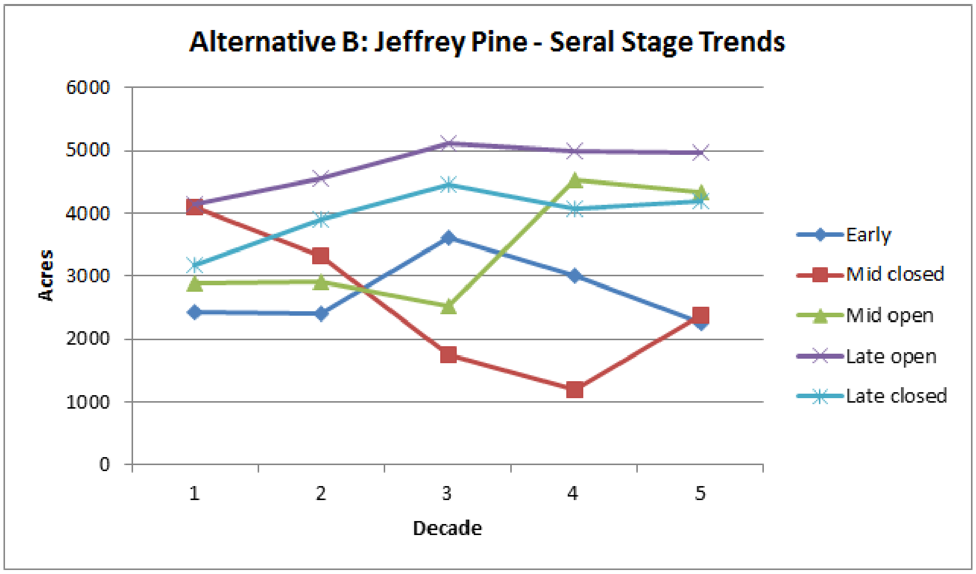


Figure 3 52. Jeffrey pine trends over time for each seral stage in Alternative B.

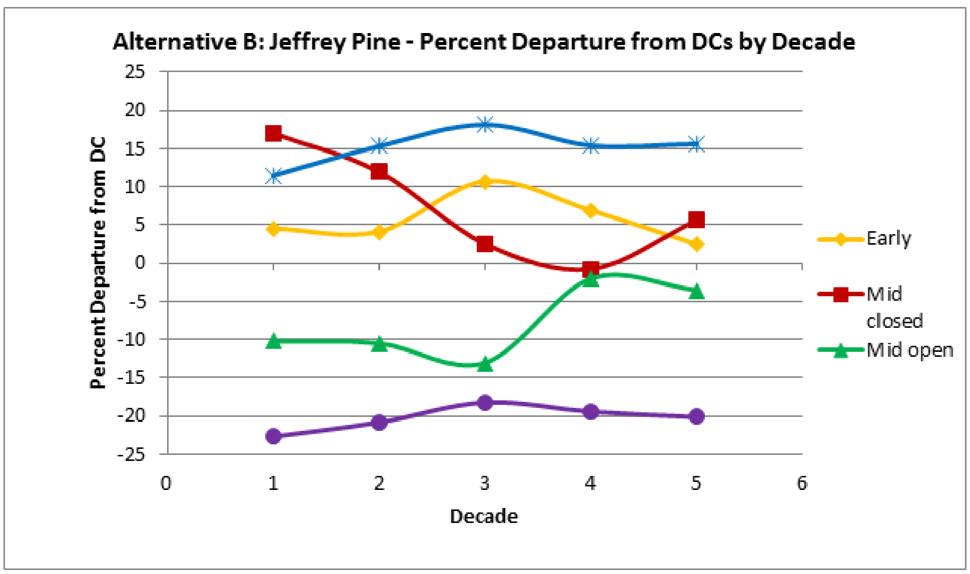


Figure 3 53. Jeffrey pine percent departure from desired conditions in Alternative B.

The red fir type trends (Figures 3-54 and 3-55) late closed towards the reference conditions while the other stages move away. Overall, red fir trends towards having more late seral open, but less late closed. This decrease in late closed appears to result from modeled disturbances and not due to the modeled treatments. The desired conditions for forest structure would not be achieved over the 50 years modeled.

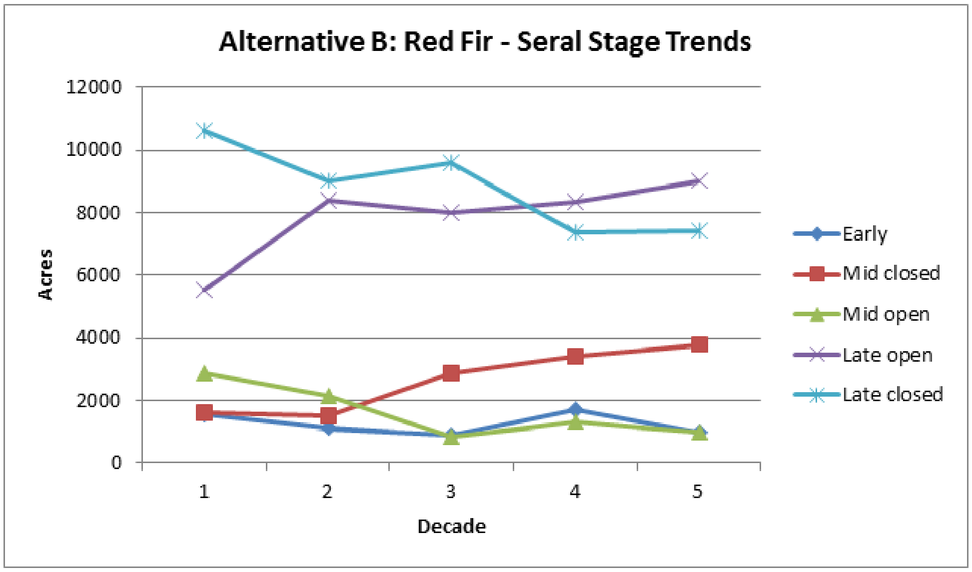


Figure 3 54. Red fir trends over time for each seral stage in Alternative B.

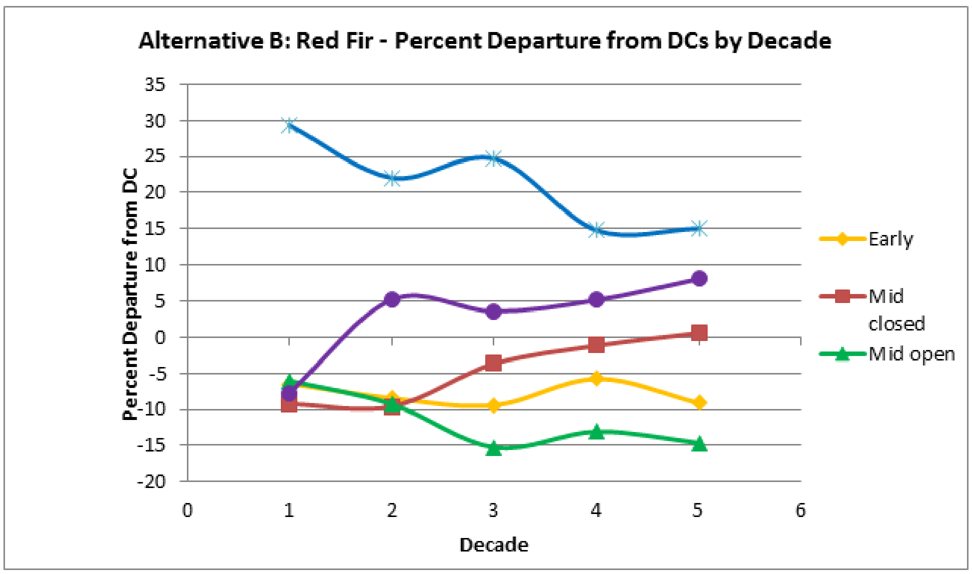


Figure 3 55. Red fir percent departure from desired conditions in Alternative B.

The forest inventory grows from 4.2 million CCF to nearly 4.3 million CCF in 50 years. Figure 3-56 indicates that net growth far exceeds net removals with the exception of the third decade in which modeled disturbance is likely why net removals exceeds the net growth. Treatments over time account for a greater amount of change than in alternative A. This means that the current forest conditions are somewhat likely to improve relative to forest health under this alternative over time.

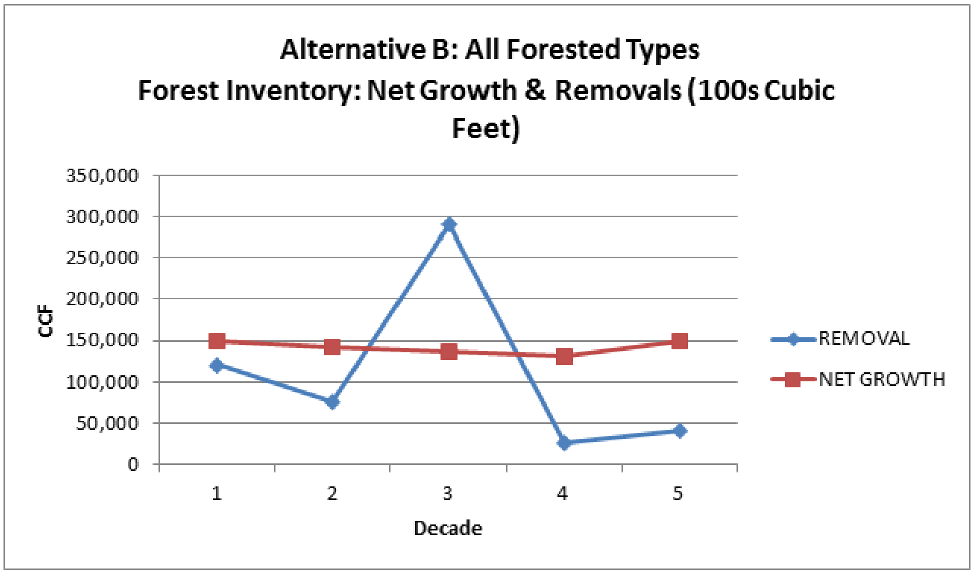


Figure 3 56. Net growth and removals (in 100s of cubic feet of volume) in Alternative B.

In Figure 3-57, the alternative does show an increase of approximately 8 percent in the amount of large trees. The graph does not show that at some point in the future, this trend would likely decrease as growing space requirements become more and more challenging to trees of this size.

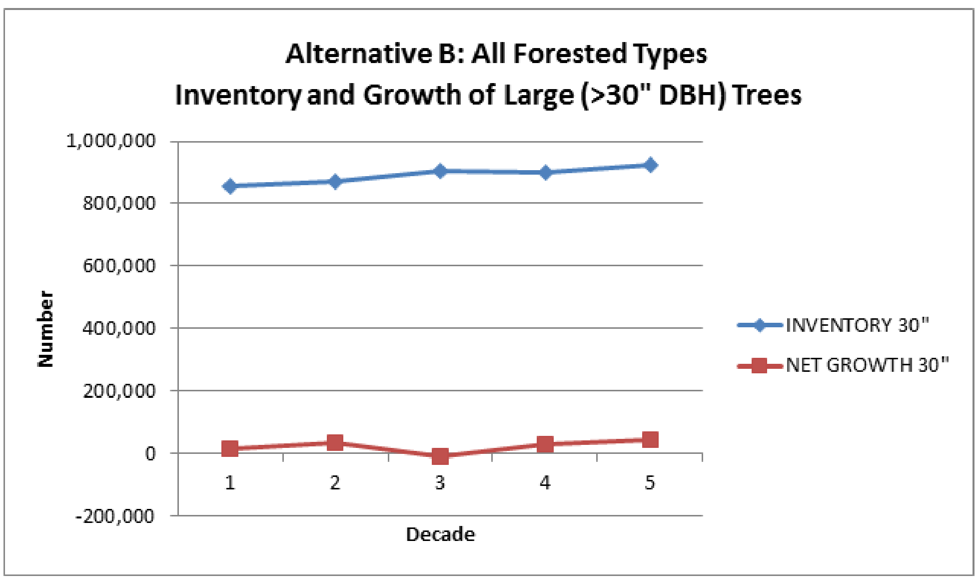


Figure 3 57. Inventory and growth of large trees greater than 30 inches in diameter in Alternative B.

Forest Vegetation

In this alternative there is a greater positive response towards the desired conditions. In particular, there is near achievement in the desired condition for white fir. In Jeffrey pine the trend towards reference conditions is positive. Early seral remains largely unchanged, but somewhat close to reference conditions. Much of the mid closed changes to mid open. While some mid seral is returned to early mid-way through the analysis, much of those gains are lost to growth into the mid seral stage. Prior thinning to enhance the mid stage would likely result in an increase in late seral open. According to the literature related to historic conditions of forest structure, the late seral stage in the Lake Tahoe Basin would have been mostly comprised of open canopy Jeffrey pine stands (Taylor, 2004).

Related to achieving forest vegetation goals in this plan are the following associated resource effects:

Wildlife

Although this alternative has the goal of restoring forest structure and composition, there is consideration of protected activity centers and home range core areas for spotted owls and Northern goshawks. Some restoration can occur in a small number of these areas, otherwise they are treated the same as in Alternative A.

Alternative C

This alternative is similar to alternative B with a greater number of treatment acres implemented per year. More acres would be treated using mechanized equipment if possible. All other factors are the same.

Overall, the forest under this alternative increases late seral open with a slight decrease in late seral closed. There is a moderate decrease in mid closed while mid seral open slightly increases (Figure 3-58). The change from mid to late is likely due to a proportional amount of growth in the mid seral stages growing into the late seral stages. The change from closed to open is likely due to thinning in the mid seral closed. The effect of treatments may be having a more noticeable effect in the mid seral stages, though there is virtually no change in early seral. In terms of restoring forest structure each forest type needs to be viewed relative to departure from reference conditions. The goal for this alternative appears to make modest improvement in the restoration of forest structure. In addition more of the forestland moves toward late seral stages.

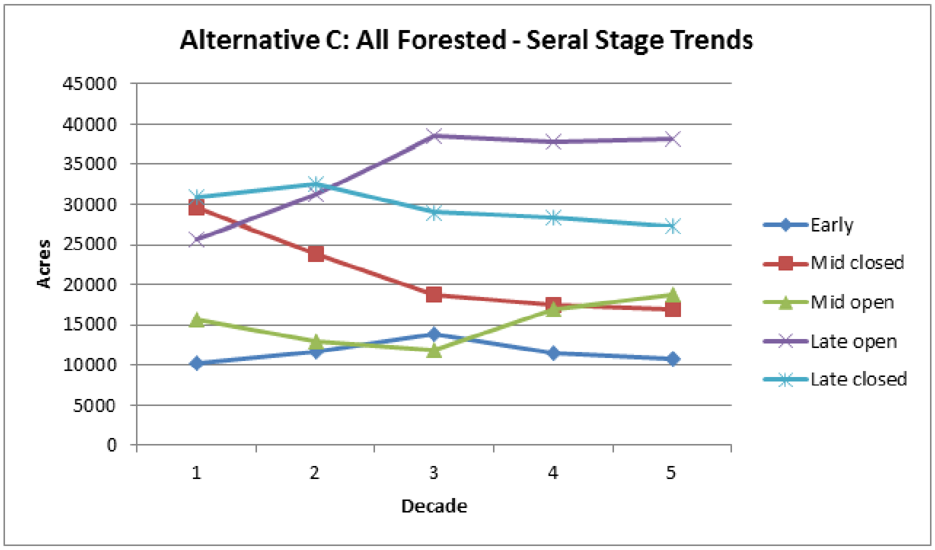


Figure 3 58. All Forested trends over time for each seral stage in Alternative C.

The white fir/mixed conifer type trends (Figures 3-59 and 3-60) nearly all seral stages towards the reference conditions by the third decade and then by the fifth decade are nearly achieved except for early seral, which is trending away. Overall, white fir/mixed conifer does trend towards having more of late seral open.

The decrease in total acres in the white fir/mixed conifer type from type conversion to Jeffrey pine is less than 1,500 acres in 50 years.

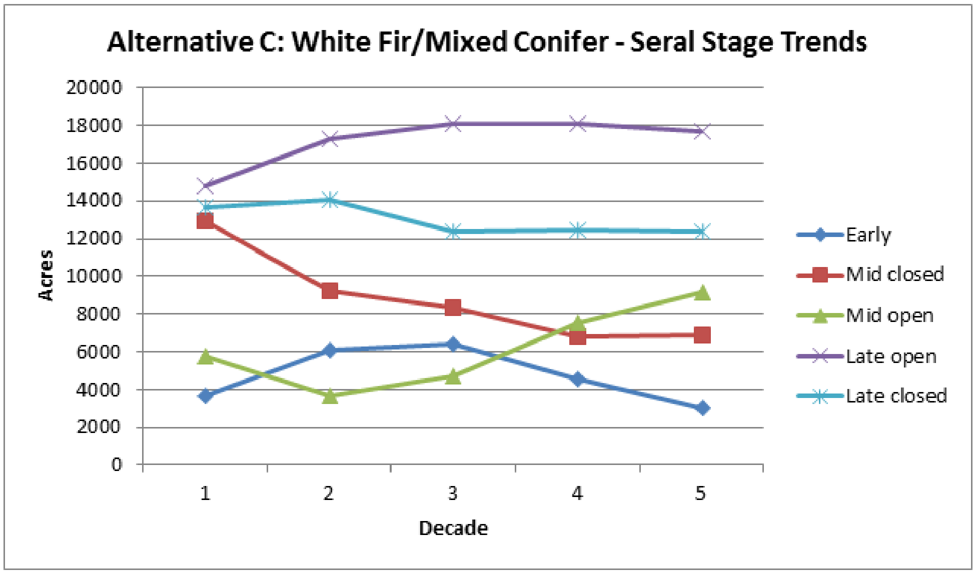


Figure 3 59. White fir-mixed conifer trends over time for each seral stage in Alternative C.

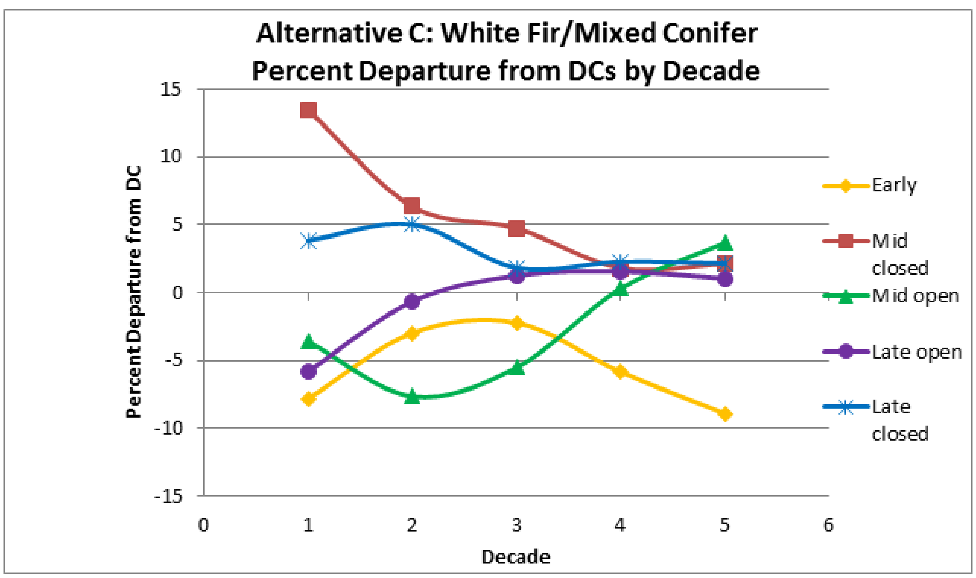


Figure 3 60. White fir-mixed conifer percent departure from desired conditions in Alternative C.

The Jeffrey pine type trends (Figures 3-61 and 3-62) nearly all seral stages towards the reference conditions except for the late closed stage, which move away from the reference. Overall, Jeffrey pine

does trend towards having more of both late seral open and closed. However, meeting the desired conditions for forest structure would not be achieved over the 50 years modeled.

The increase in total acres in the Jeffrey type from type conversion from white fir/mixed conifer is less than 1,700 acres in 50 years.

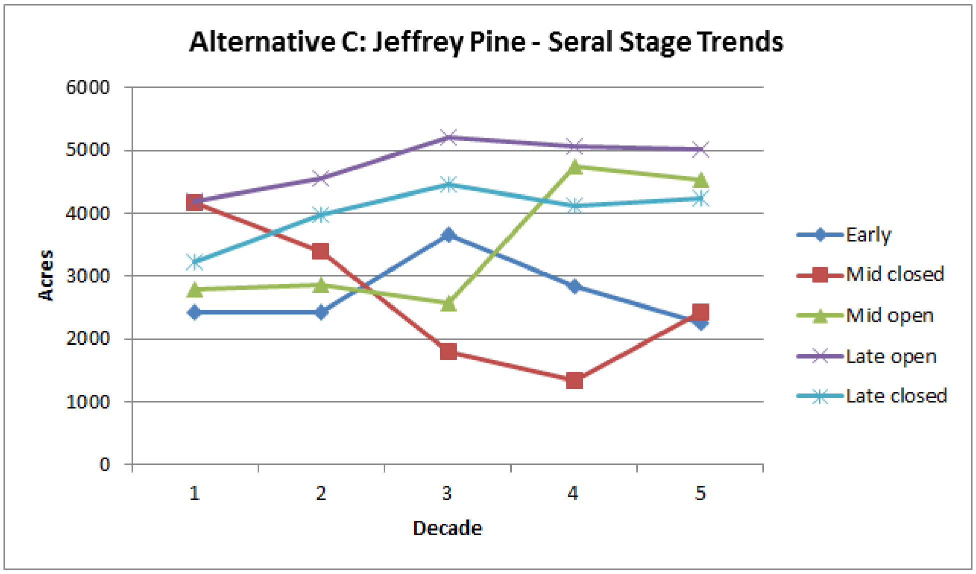


Figure 3 61. Jeffrey pine trends over time for each seral stage in Alternative C.

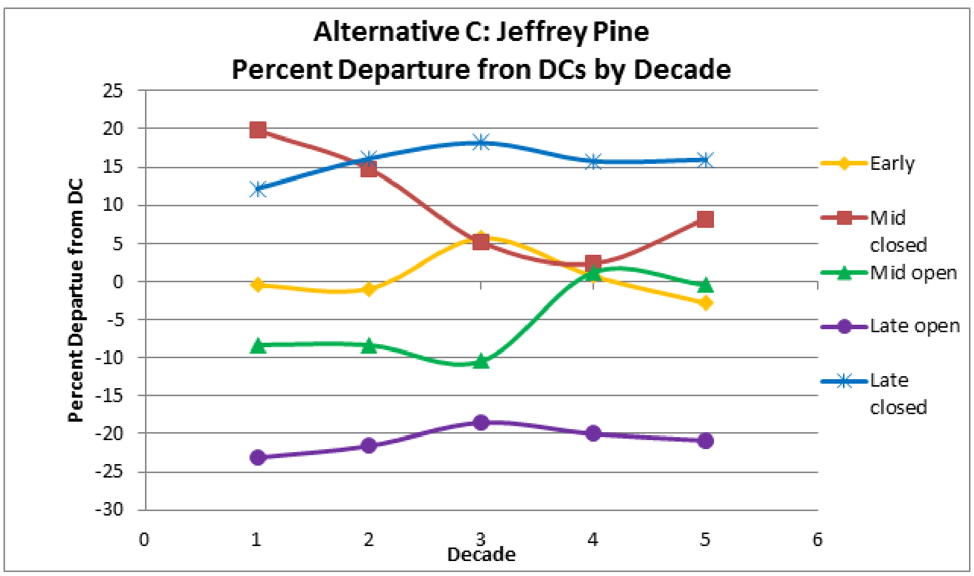


Figure 3 62. Jeffrey pine percent departure from desired conditions in Alternative C.

The red fir type trends (Figures 3-63 and 3-64) all stages except mid open towards the reference conditions. Overall, red fir trends towards having more late seral open, but less late closed. The desired conditions for forest structure would not be achieved over the 50 years modeled.

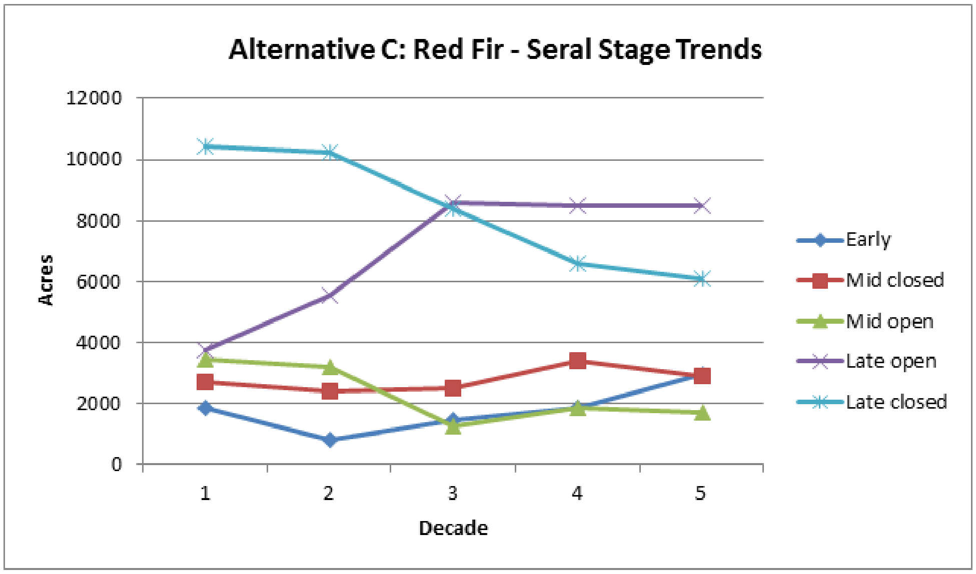


Figure 3 63. Red fir trends over time for each seral stage in Alternative C.

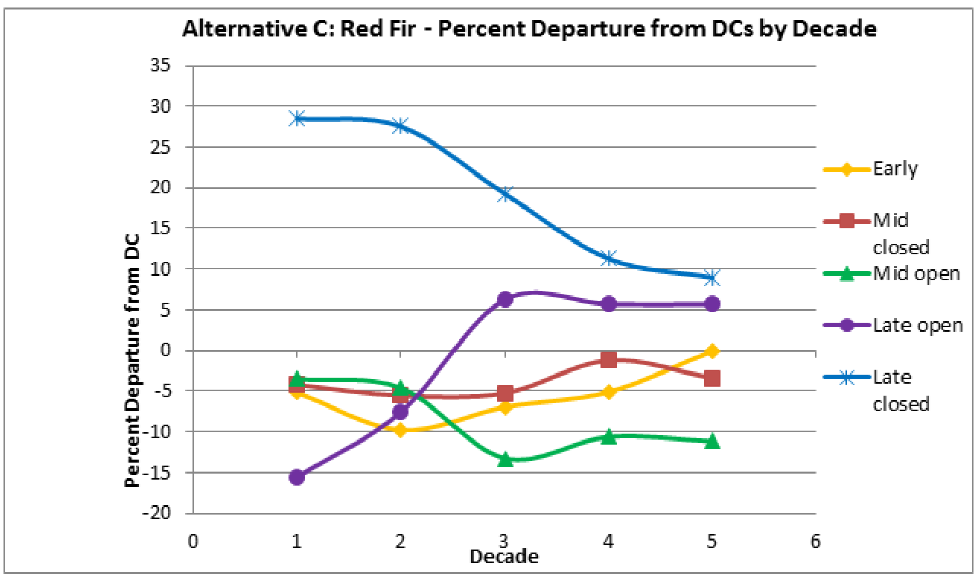


Figure 3 64. Red fir percent departure from desired conditions in Alternative C.

The forest inventory is reduced from 4.2 million CCF to nearly 3.8 million CCF in 50 years. Figure 3-65 indicates that net growth eventually exceeds net removals, however, net removals exceeds the net growth due to accelerated amount of treatment acres. Treatments over time account for a greater amount of change than in alternative A or B. This means that the current forest conditions are somewhat likely to improve relative to forest health under this alternative over time.

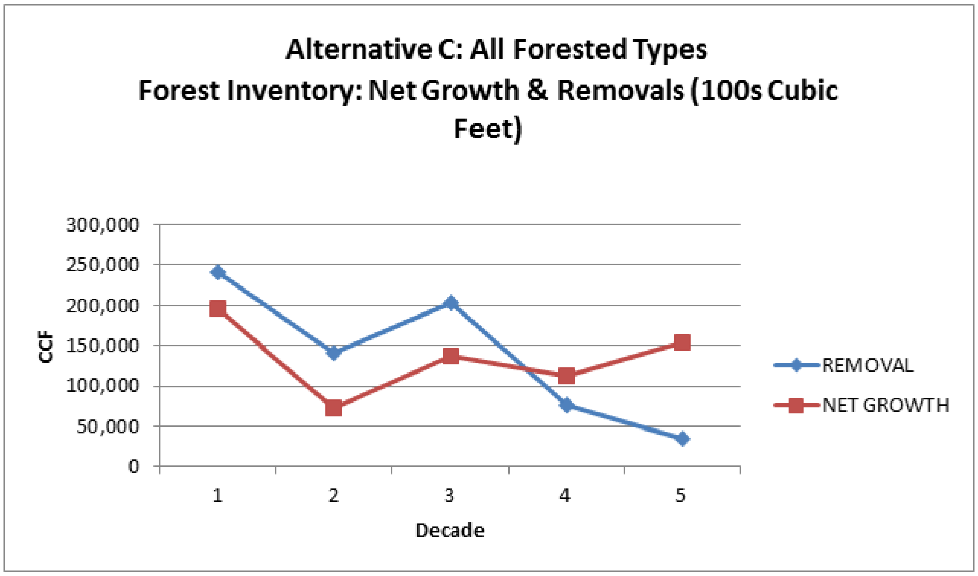


Figure 3 65. Net growth and removals (in 100s of cubic feet of volume) in Alternative C.

In Figure 3-66, the alternative does show an increase of approximately 2 percent in the amount of large trees. The graph does not show that at some point in the future, this trend would likely decrease as growing space requirements become more and more challenging to trees of this size.

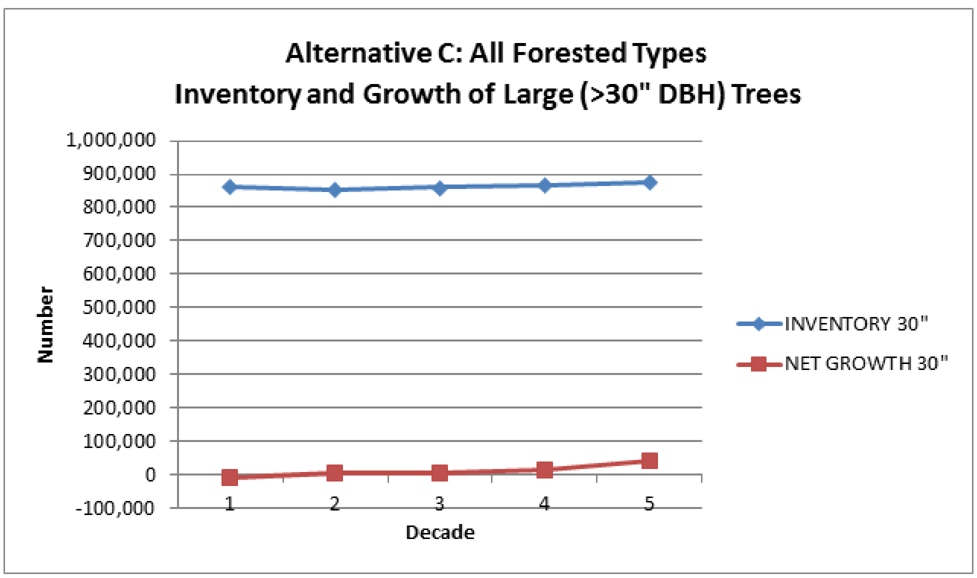


Figure 3 66. Inventory and growth of large trees greater than 30 inches in diameter in Alternative C.

Forest Vegetation

Of all of the alternatives, Alternative C makes the most progress toward desired conditions, in all three major forest types. At the end of 50 years all seral stages (including early) are much closer to their desired proportional representation on the landscape than they are today.

Alternative C was developed in part to demonstrate a quicker achievement of desired conditions, and the outcomes portrayed in the graphics above demonstrate its effectiveness. The total number of large trees remains similar across the 50 year simulations in this alternative, but their proportional representation goes up, since stands are thinning, and the mean diameter of large trees also rises, such that greater basal area is contained in larger trees at the end of the scenarios.

Alternative D

In this alternative, the treatments are under similar limitations as in Alternative A, but include a lower tree cutting diameter limit of 12 inches DBH. There is more of an emphasis on using hand treatments and prescribed fire with less emphasis on the use of mechanized equipment to accomplish treatments. In addition, treatments in this alternative would focus primarily in the WUI defense zone, rather than in the entire WUI.

Overall, the forest under this alternative increases both late seral open and closed while mid seral open and closed stages decline (Figure 3-67). This change is likely due to a proportional amount of growth in the mid seral stages growing into the late seral stages. The effect of treatments may be minimal towards this change as the treatments prescribed for this alternative follow a thin from below prescription. In terms of restoring forest structure each forest type needs to be viewed relative to departure from reference conditions. In this alternative the overall increase in large trees appears small, perhaps due to the diameter limit on tree cutting, which would not cause treatments to result in increased quadratic mean diameter.

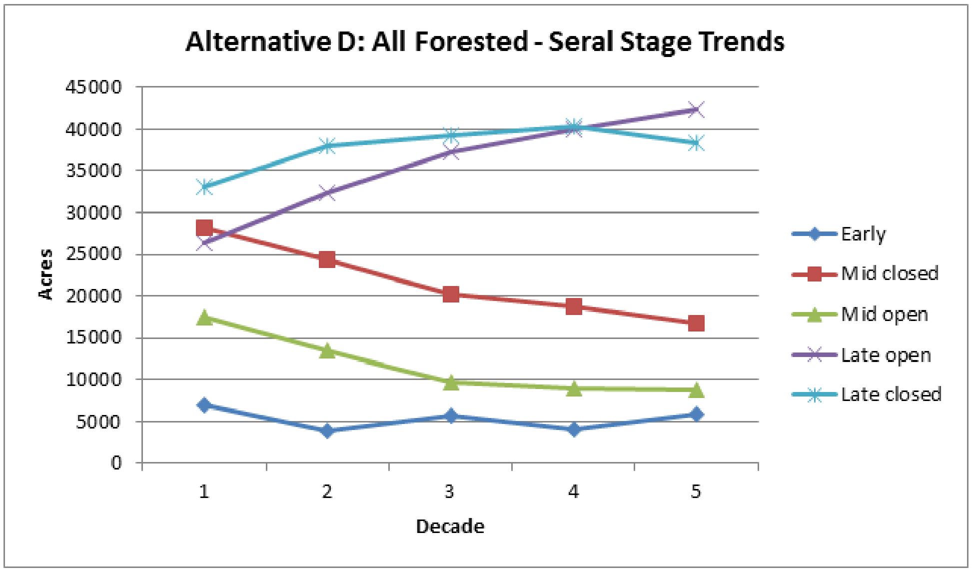


Figure 3 67. All Forested trends over time for each seral stage in Alternative D.

The white fir/mixed conifer type trends (Figures 3-68 and 3-69) mid closed towards the reference conditions while the other stages all move away. Overall, white fir/mixed conifer does trend towards having more of both late seral open and closed, but does not grow substantially larger amount of large tree, thus would not meet the goal for this alternative. The desired conditions for forest structure would not be achieved over the 50 years modeled.

The total acres in the white fir/mixed conifer type do not change in 50 years.

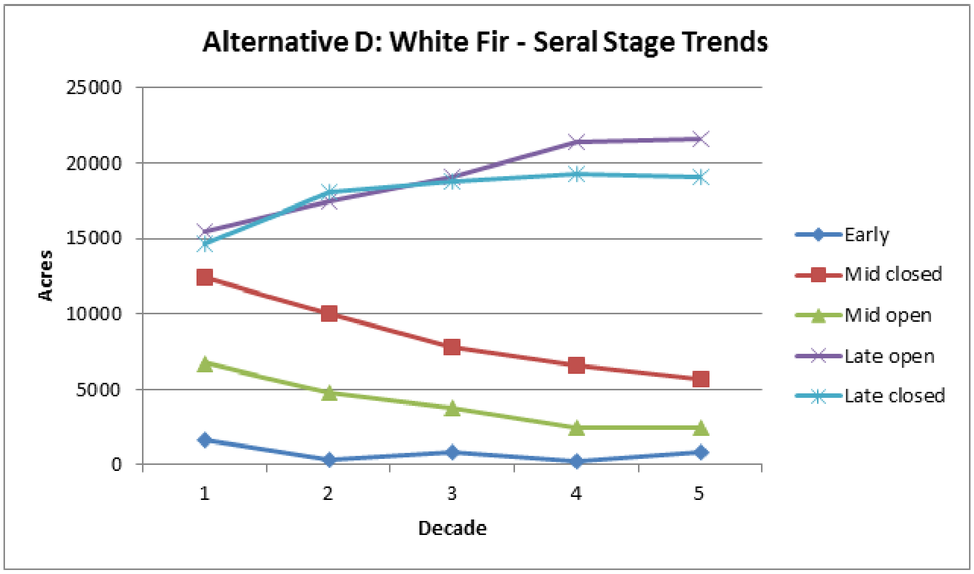


Figure 3 68. White fir-mixed conifer trends over time for each seral stage in Alternative D.

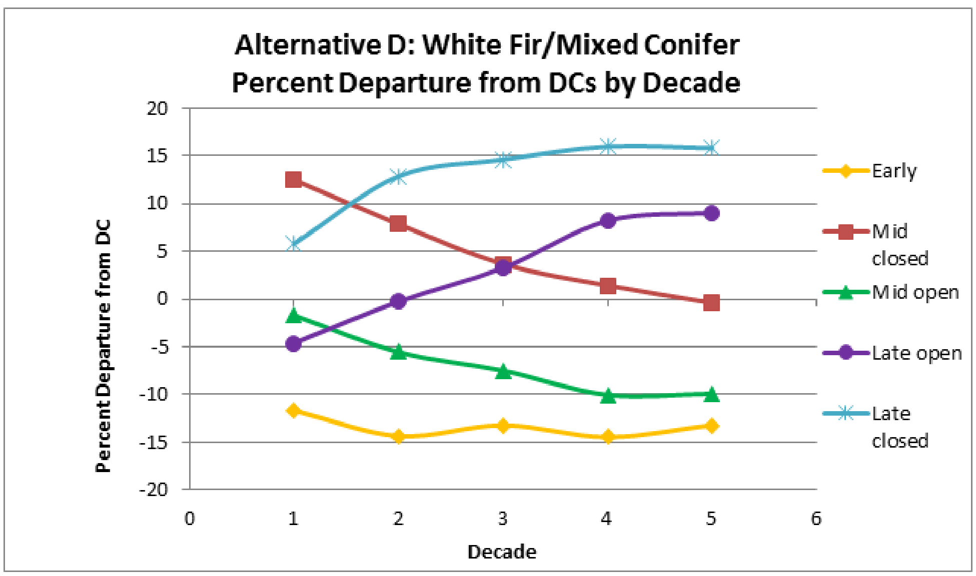


Figure 3 69. White fir-mixed conifer percent departure from desired conditions in Alternative D.

The Jeffrey pine type trends (Figures 3-70 and 3-71) mid closed towards the reference conditions while the other stages all move away. Overall, Jeffrey pine does trend towards having more of both late seral open and closed. However, meeting the desired conditions for forest structure would not be achieved over the 50 years modeled.

The increase in total acres in the Jeffrey type is less than 1,200 acres in 50 years. Cannot explain for this increase since there is not change from type conversion in the white fir/mixed conifer type.

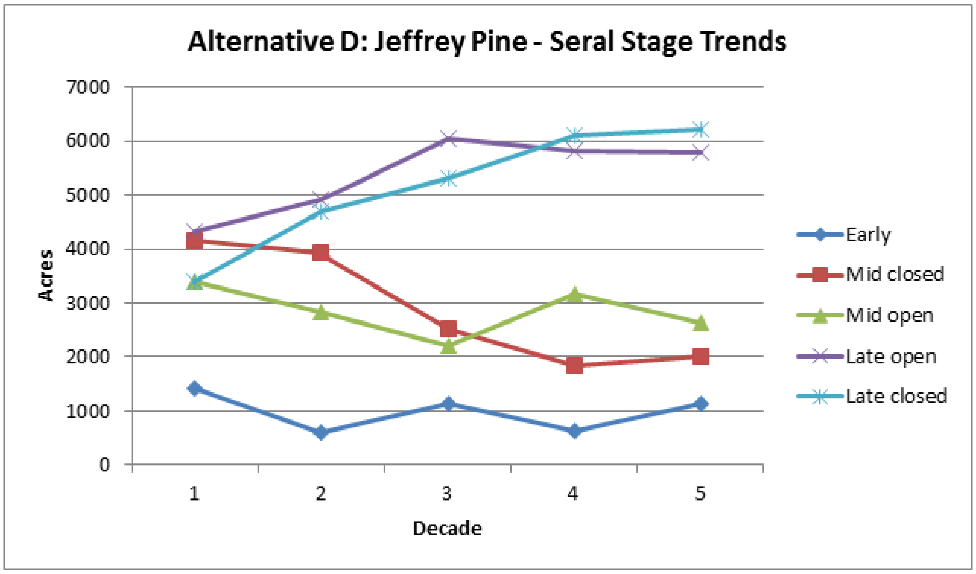


Figure 3 70. Jeffrey pine trends over time for each seral stage in Alternative D.

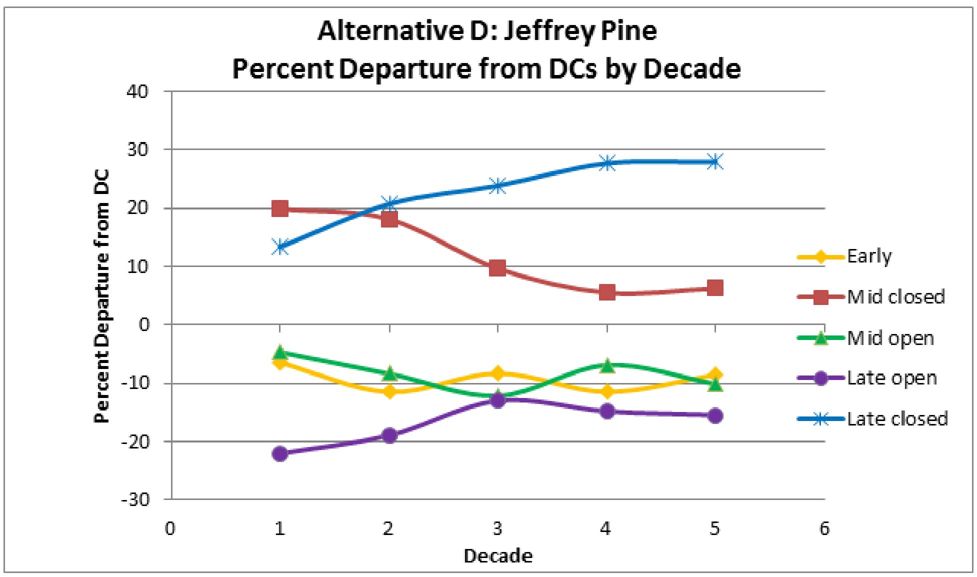


Figure 3 71. Jeffrey pine percent departure from desired conditions in Alternative D.

The red fir type trends (Figures 3-72 and 3-73) mid open and late open and closed towards the reference conditions while the early moves away. Overall, red fir trends towards having more late seral open, but less late closed. The desired conditions for forest structure would not be achieved over the 50 years modeled.

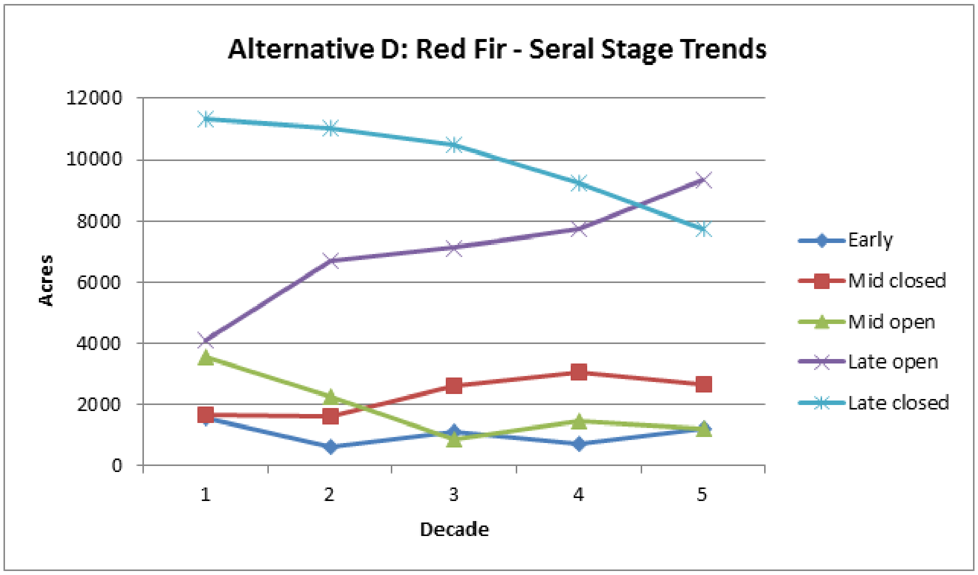


Figure 3 72. Red fir trends over time for each seral stage in Alternative D.

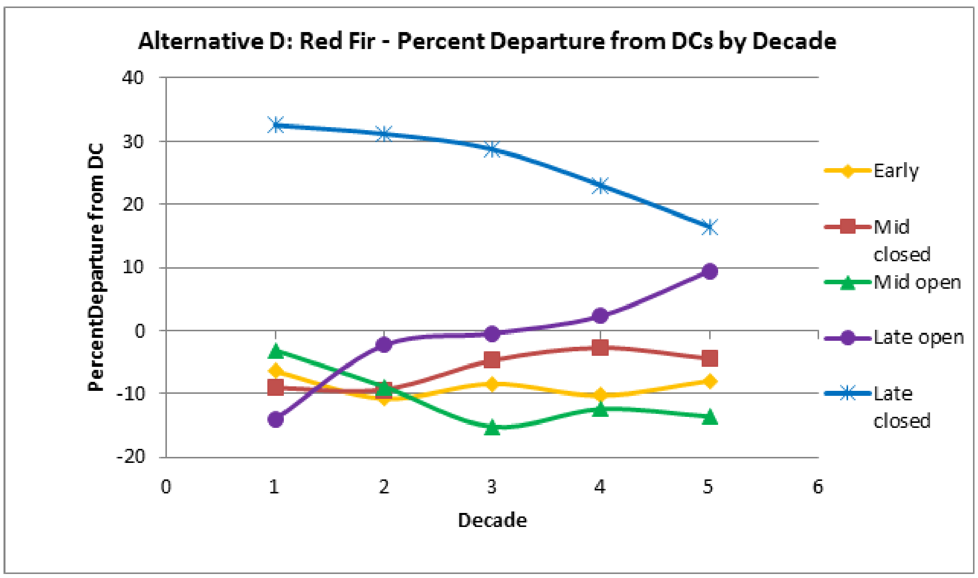


Figure 3 73. Red fir percent departure from desired conditions in Alternative D.

The forest inventory grows from 4.2 million CCF to nearly 4.9 million CCF in 50 years. Figure 3-74 indicates that net growth far exceeds net removals. Treatments over time account for a negligible amount of change. This means that the current forest conditions are less likely to improve relative to forest health under this alternative over time.

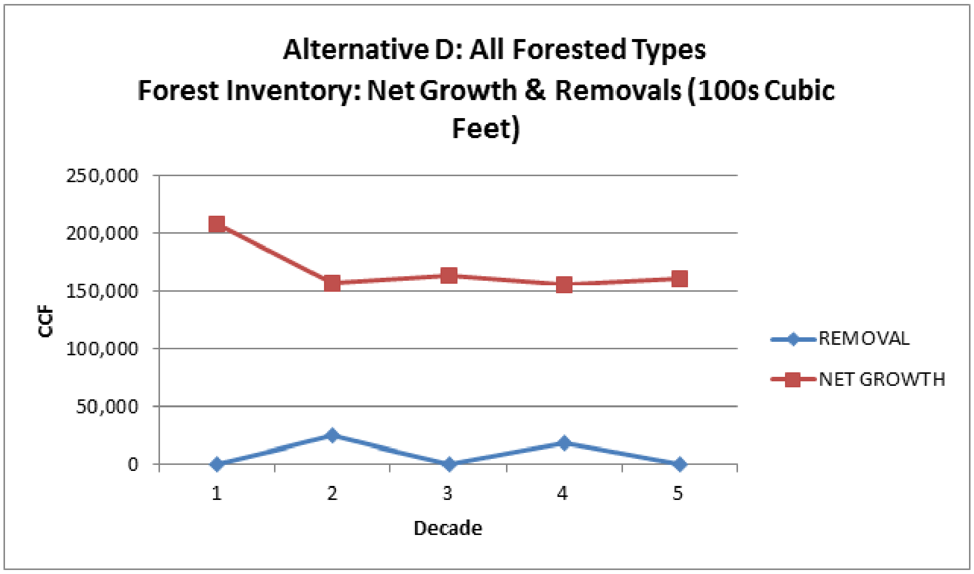


Figure 3 74. Net growth and removals (in 100s of cubic feet of volume) in Alternative D.

In Figure 3-75, the alternative does show an increase of approximately 15 percent in the amount of large trees. The graph does not show that at some point in the future, this trend would likely decrease as growing space requirements become more and more challenging to trees of this size. This increase in large trees trends towards meeting the goal of the alternative, but could be at greater risk of a future drop due to higher density levels.

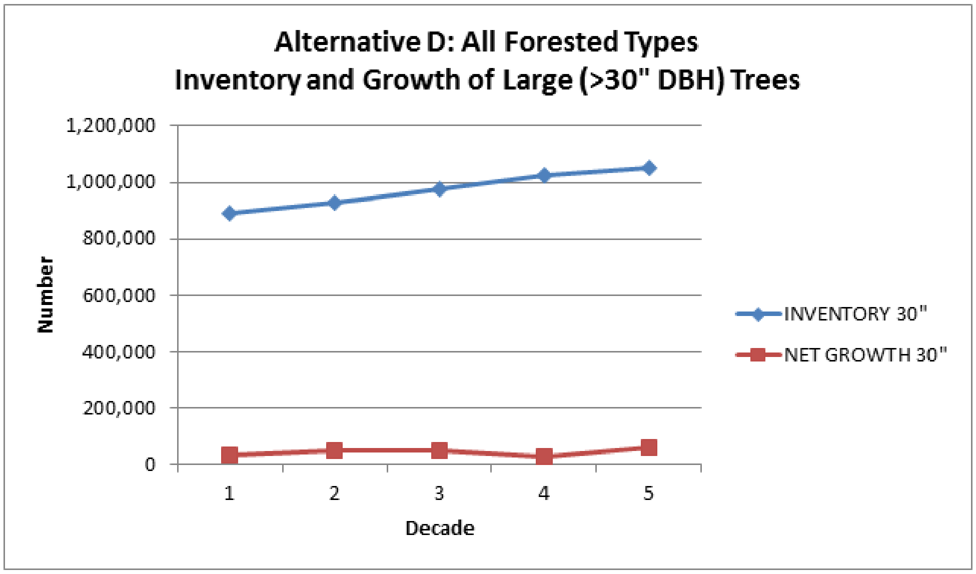


Figure 3 75. Inventory and growth of large trees greater than 30 inches in diameter in Alternative D.

Forest Vegetation

In this alternative, forest restoration would not be likely. Given the limit on diameter for tree cutting to smaller trees and the emphasis on hand and prescribed fire treatments, conditions for treatment could be

far fewer than what was modeled. Reliance on prescribed fire for accomplishing treatments means that the certain conditions must be present, which cannot be relied upon with any consistency. The current densities in the mid and late seral stages would continue to increase, posing greater risk of mortality from fire, drought, and bark beetles. Without the ability to thin stands of trees where the diameters exceed 12 inches DBH (except through the use of prescribed fire and managed wildfire, which requires conditions that we cannot control so is difficult to implement), the health of the forest stands would steadily decline, because the a greater proportion of stands have mean diameters greater than 20 inches, which will continue to increase. The majority of forested acres appear to move towards late seral, however this is in the absence of disturbance, and future trends are predicted to include steadily greater inertia for fire due to increasing fuels, drier summers, and lower snowpack. From the annual aerial mortality surveys from 2000 to 2011, much of the bark beetle related mortality comes from larger trees in overstocked stands at high densities. This condition would pervade most if not all of the stands that develop under this alternative, tremendously increasing risk of mortality from wildfire and bark beetle outbreaks while lowering scenic stability.

Alternative E (Same as Alternative B)

In this alternative, forest vegetation treatments are intended to aid in the restoration of forest structure and composition. There are exceptions to the diameter and canopy closure limits. However, cutting large trees or thinning to lower densities would be implemented where the objective is to enhance the promotion of mid seral to late seral, longevity of late seral stands, or the resiliency of any stand. These objectives involve standards and guidelines that are of a finer level of detail than can be modeled at this level. Although these objectives aim to improve overall forest health, they also target other resource improvements, e.g., wildlife habitat or scenic stability. There is allowance for the creation of openings within the mid seral stage of up to 10 acres in size to establish early seral habitat.

Overall, the forest under this alternative increases late seral open without changing late seral closed. There is a moderate decrease in mid closed while mid seral open remains unchanged (see figure 3-76 below). This change is likely due to a proportional amount of growth in the mid seral stages growing into the late seral stages. The effect of treatments may be minimal towards this change despite a prescription to move some mid seral to early seral through the use of group selection with reserves prescription. In terms of restoring forest structure each forest type needs to be viewed relative to departure from reference conditions. This alternative appears to make modest improvement in the restoration of forest structure. In addition more of the forestland moves toward late seral stages.

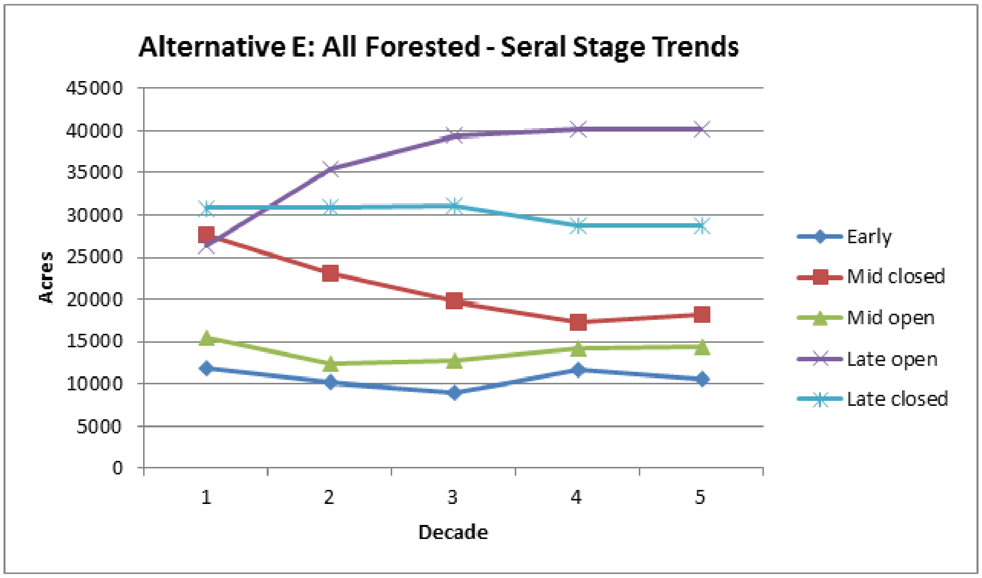


Figure 3 76. All Forested trends over time for each seral stage in Alternative E.

The white fir/mixed conifer type trends (see Figures 3-77 and 3-78) nearly all seral stages towards the reference conditions despite some small changes away from the reference. Overall, white fir/mixed conifer does trend towards having more of both late seral open and closed.

The decrease in total acres in the white fir/mixed conifer type from type conversion to Jeffrey pine is less than 1,400 acres in 50 years.

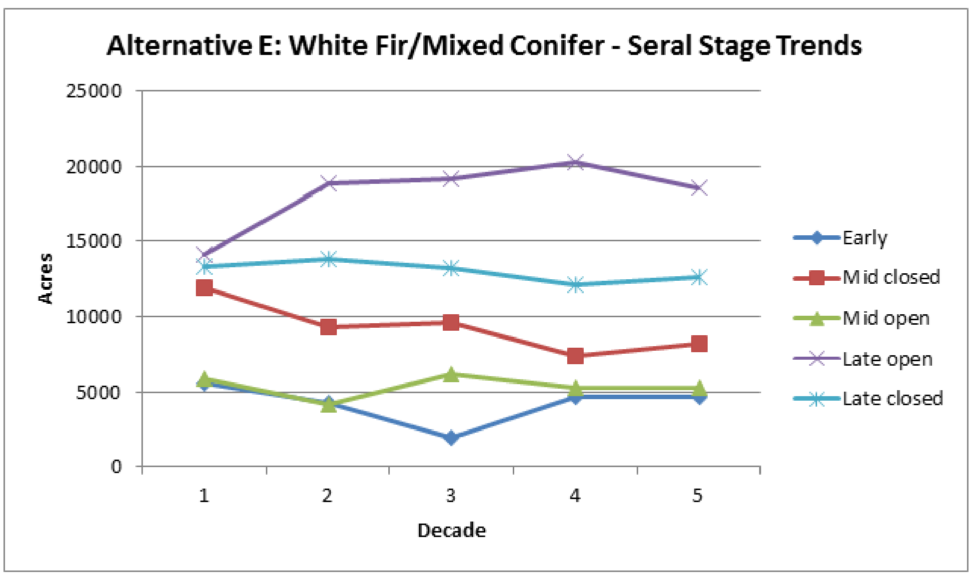


Figure 3 77. White fir-mixed conifer trends over time for each seral stage in Alternative E.

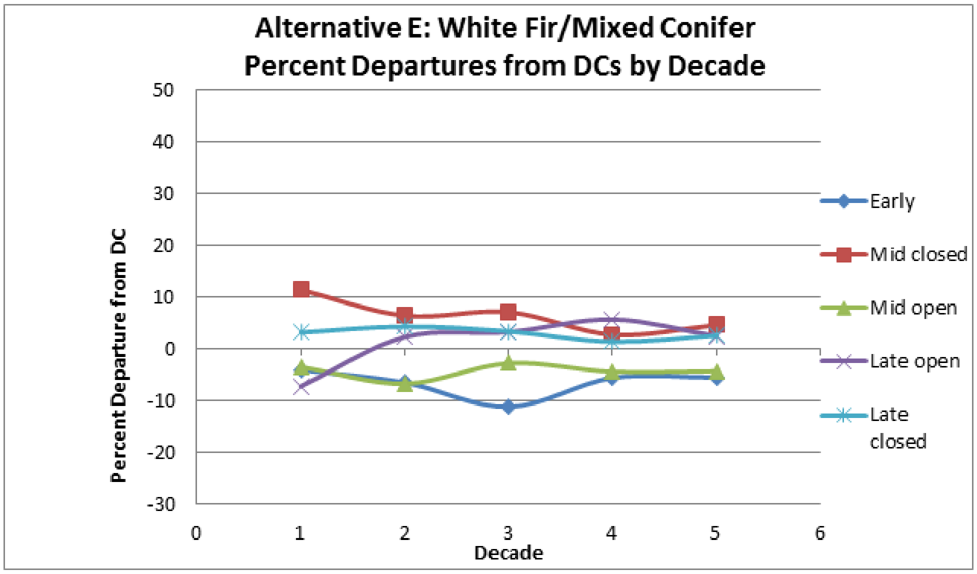


Figure 3 78. White fir-mixed conifer percent departure from desired conditions in Alternative E.

The Jeffrey pine type trends (see Figures 3-79 and 3-80) nearly all seral stages towards the reference conditions though the late stages remain well outside reference conditions. Overall, Jeffrey pine does trend towards having more of both late seral open and closed. However, meeting the desired conditions for forest structure would not be achieved over the 50 years modeled.

The increase in total acres in the Jeffrey type from type conversion from white fir/mixed conifer is less than 1,400 acres in 50 years.

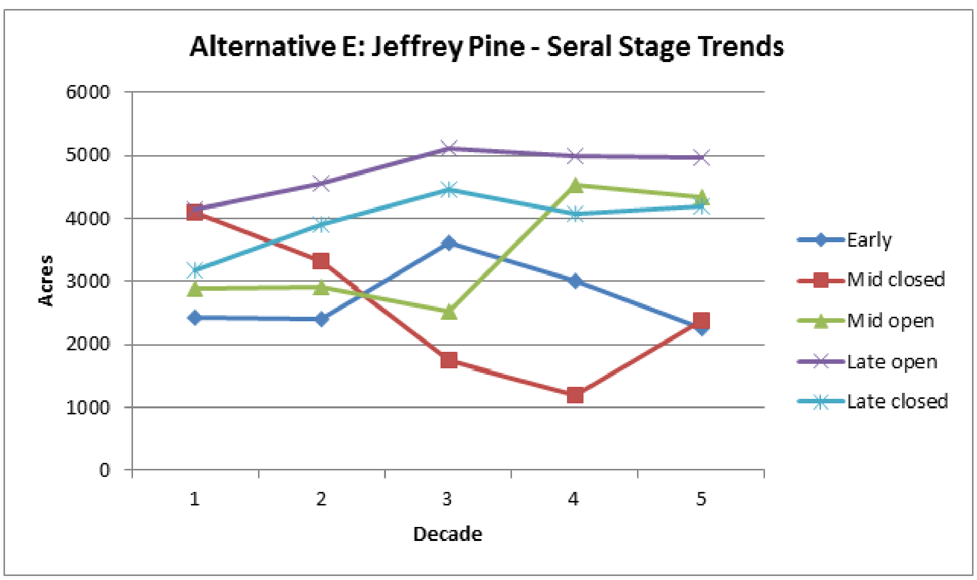


Figure 3 79. Jeffrey pine trends over time for each seral stage in Alternative E.

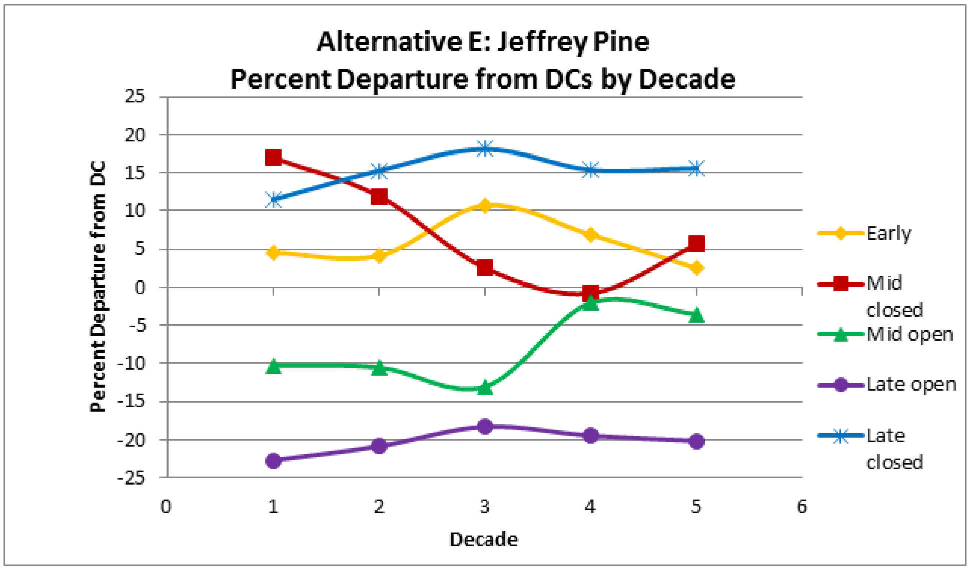


Figure 3 80. Jeffrey pine percent departure from desired conditions in Alternative E.

The red fir type trends (see Figures 3-81 and 3-82) late closed towards the reference conditions while the other stages move away. Overall, red fir trends towards having more late seral open, but less late closed. This decrease in late closed appears to result from modeled disturbances and not due to the modeled treatments. The desired conditions for forest structure would not be achieved over the 50 years modeled.

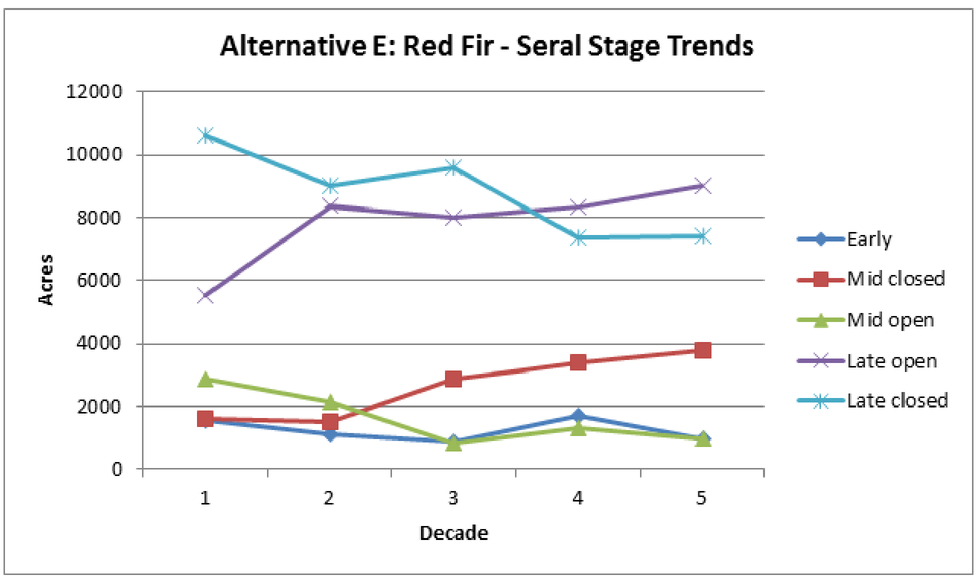


Figure 3 81. Red fir trends over time for each seral stage in Alternative E.

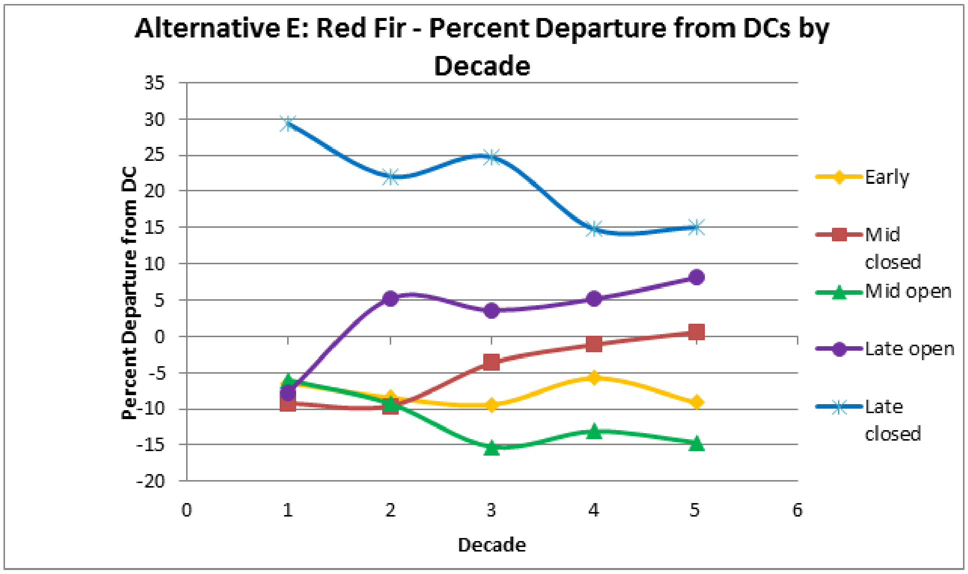


Figure 3 82. Red fir percent departure from desired conditions in Alternative E.

The forest inventory grows from 4.2 million CCF to nearly 4.3 million CCF in 50 years. Figure 3-83 indicates that net growth far exceeds net removals with the exception of the third decade in which modeled disturbance is likely why net removals exceeds the net growth. Treatments over time account for a greater amount of change than in alternative A. This means that the current forest conditions are somewhat likely to improve relative to forest health under this alternative over time.

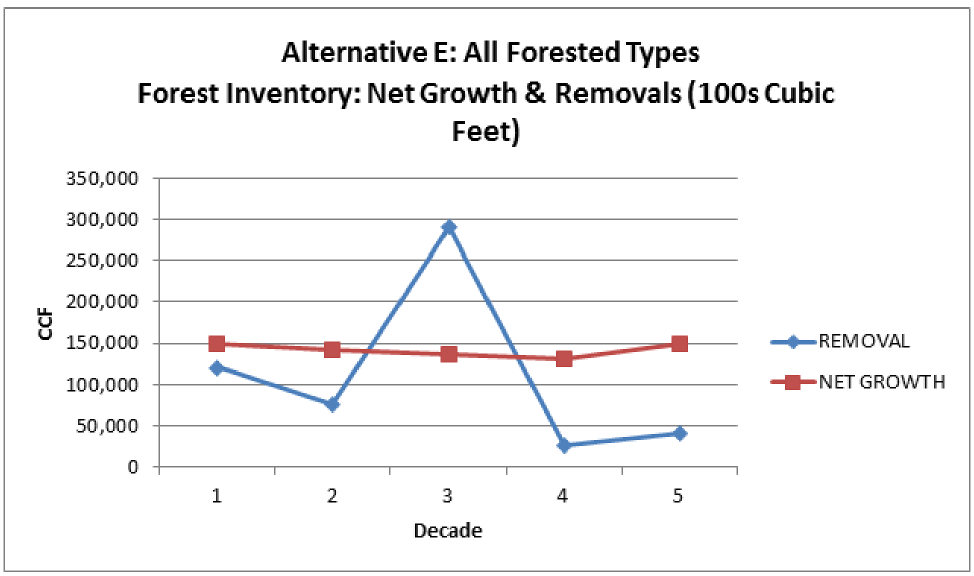


Figure 3 83. Net growth and removals (in 100s of cubic feet of volume) in alternative E.

In Figure 3-84, the alternative does show an increase of approximately 8 percent in the amount of large trees. The graph does not show that at some point in the future, this trend would likely decrease as growing space requirements become more and more challenging to trees of this size.

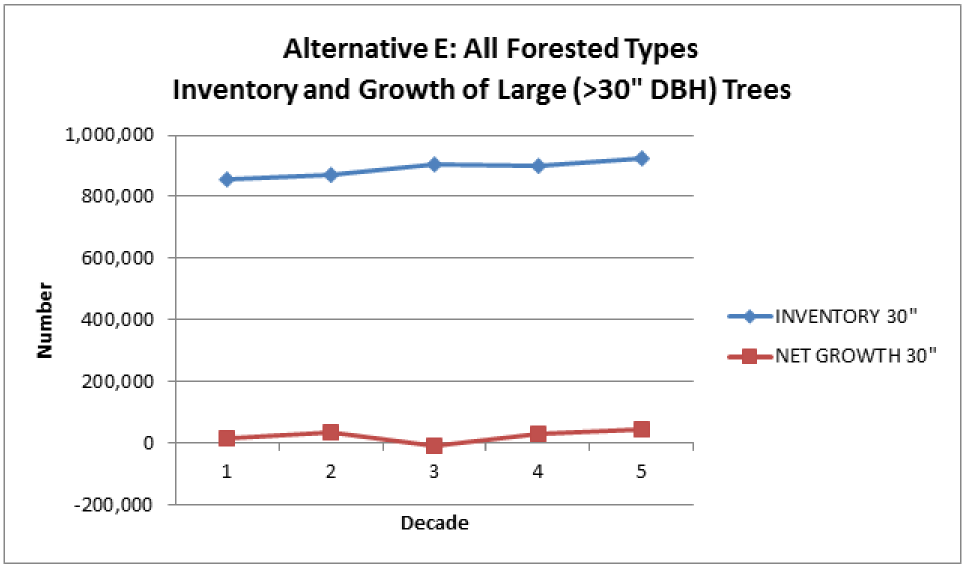


Figure 3 84. Inventory and growth of large trees greater than 30 inches in diameter in Alternative E.

Forest Vegetation

In this alternative there is a greater positive response towards the desired conditions. In particular, there is near achievement in the desired condition for white fir. In Jeffrey pine the trend towards reference conditions is positive. Early seral remains largely unchanged, but somewhat close to reference conditions. Much of the mid closed changes to mid open. While some mid seral is returned to early mid-way through the analysis, much of those gains are lost to growth into the mid seral stage. Prior thinning to enhance the mid stage would likely result in an increase in late seral open. According to the literature related to historic conditions of forest structure, the late seral stage in the Lake Tahoe Basin would have been mostly comprised of open canopy Jeffrey pine stands (Taylor, 2004).

Related to achieving forest vegetation goals in this plan are the following associated resource effects:

Wildlife

Although this alternative has the goal of restoring forest structure and composition, there is consideration of protected activity centers and home range core areas for spotted owls and Northern goshawks. Some restoration can occur in a small number of these areas, otherwise they are treated the same as in Alternative A.

3.4.11.4. Analytical Conclusions

The relationships between people and the environment are highly complex. The forest, as long as it is green and abundant, is assumed to be healthy and beautiful. As well, it is considered safe. However, most people view their relationship with the forest over a very short time-span (their lifetime) rather than in the centuries over which a forest grows. Current conditions in the forests at Lake Tahoe were largely brought about by human interventions through large-scale logging, urban growth, and fire exclusion. Although many forest management activities create some adverse human effects, including smoke, a greater management intervention is needed to better assure that the forest within the Lake Tahoe Basin continues to provide both ecosystem and human benefits for generations to come.

Sustaining a resilient forest at Lake Tahoe is principally a function of restoring and maintaining variation in forest structure of the major forest types (Graya and Azuma, 2005). The current status and projected

trends in the departure of forest structure from pre-settlement conditions indicate resilience is likely to be low due to future climate warming and increasing propensity to fire and insect outbreak. Forest restoration is desperately needed, but such work will require significant effort. These efforts will not be without uncertainty: uncertainty about the effects of climate change on the forest and forest-modifying disturbances (drought, bark beetles, fire); uncertainty about the ability of different forest management techniques to increase forest resilience; and uncertainty about the social demands on the forest and social perspectives of forest health und resilience.

The forest vegetation modeled outcomes are useful to providing a measure of understanding when balancing the integration of other resource objectives and their associated constraints on the type, size and timing of management treatments. However, the model outcomes represent a coarse-scale approach that cannot approximate the fine level of detail that might be needed to better describe aspects of other resources. For example, the model includes some constraints for protected wildlife habitat areas, but does not consider more detailed characteristics that managers of this resource may need.

Comparison of Consequences by Alternative

Alternative C would allow for the greatest progress towards restoring forest structure and composition over the life of the plan. Tree removal would be greatest in this alternative by treating more acres than the other alternatives using group selections with reserves, which could furnish a greater amount of early-seral habitat. However, the model indicates that greater amount of thinning may spur on greater growth, thus limiting the duration of the early seral stage. Thinning would also promote growth in the mid seral stands and while enhancing or prolonging the existing and future late seral habitat.

Alternatives A, B or E would make slower progress toward meeting desired conditions, but Alternative D would make the least progress.

Table 3 48. Relative Comparison of the Positive Effects of Each Alternative to Achieving Desired Conditions.

Indicator	Alt. A	Alt. B	Alt. C	Alt. D	Alt. E
Forest Structure	Low-Moderate	Moderate	Moderate-High	Low	Moderate
Forest Composition	Moderate	Moderate	High	Low	Moderate
Forest Resilience	Low-Moderate	Moderate	High	Low	Moderate

How the Alternatives Maintain or Achieve the Desired Conditions

Alternative A

This alternative would maintain treatment effectiveness within the WUI in the short-term, but eventually, increasing diameters and canopy closures would limit successive thinnings as the forest stands progress towards late seral. In the long-term, this limitation would hinder continued progress towards achieving and maintaining the desired condition throughout the Montane and Upper Montane zones.

Alternative B

This alternative would not be restricted by the same standards described in Alternative A. Progress would follow the same pace and extent as Alternative A, resulting in only achieving the long-term desired conditions of restoring forest structure and composition with the short-term consequences of fire and beetle risks.

Alternative C

This alternative would not be restricted by the same standards described in Alternative A. Twice the rate of progress as Alternative B would result in achieving the desired condition and maintaining existing treatment areas that would lower fire and beetle risks.

Alternative D

This alternative would not achieve the desired conditions. Maintenance of WUI treatments in the defense zone would be achieved, but falls short of restoring forest structure.

Alternative E

This alternative would not be restricted by the same standards described in Alternative A. Progress would follow the same pace and extent as Alternative A, resulting in only achieving the long-term desired conditions of restoring forest structure and composition with the short-term consequences of fire and beetle risks.

In summary, Alternative C puts in motion the treatments necessary for achieving the desired conditions more fully and in less time than Alternative A, B, D or E. Although no alternative meets the desired conditions within the life of the plan, alternative C establishes a pathway towards meeting the historic ranges of forest structure, composition and resilience. Based on indications of the direction climate change is taking, these historic ranges will likely be a milestone on the way to conditions with lower densities and larger portions of pine versus fir.

3.4.12. Interpretation and Education, Partnerships and Volunteers

3.4.12.1. Introduction

This section evaluates and discloses the potential environmental consequences on Interpretation and Education: Partnerships and Volunteers services that may result with the adoption of a revised land management plan.

Methodology

No modeling was used for this analysis. It is a qualitative analysis.

Assumptions

In the analysis for this resource, the following assumptions have been made:

- Taylor Creek Visitor Center continues to be managed as the major visitor information, conservation education, and interpretive facility for the Forest Service at Lake Tahoe. Future plans include replacement of the existing Visitor Center with a new structure designed to meet program needs as described in the 2010 Decision Notice and Environmental Assessment.
- The Tallac Historic Site will continue to be managed as a Special Interest Area as described in the 1988 LTBMU Forest Plan.
- Continue partnerships to leverage support and funding with Tahoe Heritage Foundation, Great Basin Institute, California Tahoe Conservancy, and others for interpretive and educational programs, facility maintenance/renovation/upgrades, etc.
- Partner with Nevada Department of Transportation on an East Shore Drive National Scenic Byway interpretive signage program.
- Form partnerships to nominate CA State Route 89 - West Shore Drive - as a National Scenic Byway.
- The expansion of conservation education programs to meet current conditions and trends will continue in the future. Partial funding for these educational programs is budgeted into future projects as a measure to increase project effectiveness.

3.4.12.2. Overview of the Affected Environment

Interpretation and Education

Interpretation and education on the LTBMU are provided through interpretive programs, conservation education and visitor services. The goal of the interpretation and education program of work is to educate visitors and the local community about public lands, natural and cultural resource management, recreation opportunities, and stewardship principles.

Providing a coordinated system of interpretive facilities and programs is an important way to help residents and visitors understand the connection between their behavior and the sustainability of Lake Tahoe's natural setting. Coordinated efforts include public-private partnerships, community outreach, and school programs.

The Taylor Creek Visitor Center and the Tallac Historic Site are the major public points of contact, providing guided and self-guided activities, educational programs, and living history throughout the summer months. Two interagency partnership facilities are located at Meyers Interagency Visitor Center and Explore Tahoe Visitor Center. Self-guided interpretive sites include Inspiration Point Overlook, Stateline Lookout Overlook, Logan Shoals Vista, and Lam Watah interpretive trail.

Interpretive Services staff strives to inspire visitors so that they can continue to learn about their natural and cultural resources and how to take care of them. Interpretive products include wayside exhibits, interpretive signage, self-guided trails, brochures, and programs.

The Conservation Education serves K-12 students in formal education programs in both the classroom and at forest sites. Conservation Education works with numerous state, federal and local agencies, non-government organizations and community volunteers to deliver programs. For high-school age students, students become actively engaged in community and forest projects through the Generation Green club and/or through a youth employment program in the summer.

Visitor Services staff are often the first Forest Service contact for the visiting public at forest offices and visitor centers. Visitor Services staff provide information on recreation opportunities, appropriate behavior, special events and attractions. Visitor service products include maps, and recreation opportunity guides. Sales of interpretive publications and maps are provided by the Tahoe Heritage Foundation.

The strategy for implementation of this program includes the continued use of partnerships, volunteers, grants, and community support. Delivery of this program fluctuates with annual Forest Service base program budgets where reduced budgets may lead to reduction in facility operating hours and/or overall program delivery. Increased budgets may result in expansion of program facility operations and increased program delivery. Portions of the program are budgeted into future projects as a measure to increase project effectiveness.

Forest Service employee Joy Barney is assisted demonstrating how trees absorb nutrients to a 5th grade class. Forest Service Conservation Education programs utilize nationally recognized curriculum and activity guides to educate local students outdoors and inside Lake Tahoe community classrooms.

Partnerships and Volunteers

The LTBMU relies on its dedicated partners and volunteers to successfully manage the NFS lands and to attain stewardship goals. Current partnerships with other entities help reduce hazardous fuel, build trails, restore history sites, provide interpretive programs, restore habitats, remove invasive plant, and take part in many other management activities

Partnerships include the Tahoe Heritage Foundation, Great Basin Institute, Lake Tahoe Unified School District, Nevada Air National Guard, RV and local volunteers, college interns, and numerous others.

Forest Service employee Jose Gomez recognizes youth for successfully completing the Jr. Forest Ranger program.
By offering interpretive programs to visitors, the LTBMU strives to better connect people to their public lands.

3.4.12.3. Environmental Consequences

Interpretation and Education

The overall program capacity and delivery fluctuates with annual budgets. The program will interpret direction and emphasis reflected in the final Forest Plan, regardless of alternative selection.

Partnerships and Volunteers

The overall program capacity and delivery fluctuates with annual budgets. The program will interpret direction and emphasis reflected in the final Forest Plan, regardless of alternative selection.

3.4.12.4. Analytical Conclusions

Comparison of Consequences by Alternative

Interpretation and Education

Consequences would be the same for all alternatives. There are no programmatic differences between the alternatives.

Partnerships and Volunteers

Consequences would be the same for all alternatives. There are no programmatic differences between the alternatives.

How the Alternatives Maintain or Achieve the Desired Conditions

Interpretation and Education

There would be no difference between the alternatives in how desired conditions are maintained or achieved.

Partnerships and Volunteers

There would be no difference between the alternatives in how desired conditions are maintained or achieved.

3.4.13. Lands Program

3.4.13.1. Introduction

There are four program areas within the lands program. The three primary program areas are the Land Acquisition and Adjustment Program, the Land Boundary and Title Program, and the Lands Special Uses Program. The fourth program area is the Land Withdrawal Program. This section evaluates and discloses the potential environmental consequences on the four lands program areas that may result from the adoption of Alternatives A, B, C, D or E.

Methodology

No statistical or analytical models were utilized. Acreage estimates are from current GIS data. Projections for lands activities are based on the historic trends since the 1988 plan and current needs and demands.

Assumptions

In the analysis for this resource, the following assumptions have been made:

- The current urban areas within the Lake Tahoe Basin will not undergo any large scale expansion. New private residential and commercial development will be within the existing urban and developed areas.
- Major transportation and utility corridors will not be designated in the Lake Tahoe Basin.
- The Lake Tahoe Basin is not suitable for large scale energy development projects.
- Most of the land suitable for acquisition by the Forest Service has already been acquired.
- Acquisitions of environmentally sensitive lands will continue under the analysis and recommendations of the Land Acquisition Plan for the Lake Tahoe Basin Final EIS, January 1982, as amended, but the purchase program for small urban subdivision lots is basically completed.

3.4.13.2. Overview of the Affected Environment

Land Acquisition and Adjustment Program

The primary focus of the land adjustment program in the Lake Tahoe Basin has been the acquisition of private lands to increase public ownership, protect important resource values, make the lands available for public use and recreation, and to prevent the development of environmentally sensitive lands. The overall goal is to protect the water quality and public use at Lake Tahoe.

Land acquisition by the Forest Service and state and local governments has been a predominant factor in arriving at the current management status in the Lake Tahoe Basin. Around the turn of the 19th century when the three National Forests that included the Lake Tahoe Basin were created, parts of which now comprise the LTBMU, there were only about 30,000 acres remaining in federal ownership. Nearly all the rest of the Lake Tahoe Basin had been transferred to private ownership by the public land laws and railroad grants. Today there are approximately 154,000 acres under National Forest ownership within the LTBMU. Within the Lake Tahoe hydrologic basin, about 78% of the land is under National Forest ownership. Total public ownership, including state and local government ownership within the Lake Tahoe Basin is near 88%. This exceeds the goals for National Forest and public ownership in the 1988 plan of 75%, and 85%, respectively.

In general, land acquisition by the Forest Service may occur by purchase, exchange, or donation. Purchases are primarily funded by the Land and Water Conservation Fund as appropriated by Congress. Land exchanges require an equal exchange of values, in land or cash, and must result in a net public benefit. Donation must meet acceptable public land management purposes.

On the LTBMU there are three other funding sources for land purchases. The Santini/Burton Act passed in 1980 authorizes the purchase of environmentally sensitive lands anywhere in the Basin to protect them from development and preserve water quality. The emphasis is on acquiring small urban subdivision lots, although there is no restriction on the size of parcels that could be purchased. The Act was funded by the sale of BLM public lands in a designated area near Las Vegas, with annual appropriations from Congress to the LTBMU for purchases under the Act. In addition, the Southern Nevada Public Land Management Act (SNPLMA), passed in 1988, authorized the sale of public land in a much broader area around Las Vegas, with some of the proceeds to be used for land purchases in Nevada. Land purchases were funded on a competitive basis. SNPLMA also directed that land sales under the Act in the original Santini/Burton disposal area were to be set aside in a separate account for land acquisitions under the Santini/Burton Act at Lake Tahoe. These funds, referred to as SNPLMA-S/B, funds could be used in both states.

Prior to 1965, the primary means of federal land acquisition in the Lake Tahoe Basin was by land exchange. After 1965, the emphasis changed to purchases using the Land and Water Conservation Fund. After 1981, Santini/Burton funding became the primary means of purchasing land and the type of land to acquire switched to small urban lots, although larger parcels were still acquired. By 2000, about 3,500 urban lots had been acquired. In addition, both California and Nevada passed public bond acts to fund the purchase of additional small lots by each state. Between the two states, another 5,000 lots (approx.) were acquired. After 2000, the LTBMU started shifting the priority for land purchases to larger lots that blocked up ownership or had high resource values or improved public access. During the last 15 years, major land acquisitions by the LTBMU have included the Zephyr Cove/Dreyfus and Thunderbird Lodge lake front properties (BLM land exchanges), High Meadows, the headwaters of Cold Creek at 1,790 acres, Madden Creek north of Homewood Ski area at 284 acres, Quail Lake south of the Homewood Ski Area at 205 acres (all with SNPLMA/S-B funding) and Incline Lake at 753 acres (SNPLMA funding).

The LTBMU currently has an active land acquisition program, but at a much lower level of activity than at the height of the Santini/Burton small lot purchase program, when hundreds of purchases were completed in a single year. The LTBMU receives about 12 to 18 inquiries each year from potential sellers. The LTBMU does not actively seek out properties for purchase, but is still very successful in adding many of the key remaining parcels to the purchase program. This is a result of landowners being motivated to protect their properties from development. LTBMU staff screen potential purchases and conduct early negotiations. Suitable purchases are submitted to the Regional Land Adjustment Team for processing, as the LTBMU no longer has the authority from the Regional Office to process their own purchases. Primary funding is from the Santini/Burton SNPLMA fund, which also pays for case processing. At present, there is adequate funding for all properties in the current land purchase program.

The outlook for the land acquisition program on the LTBMU is that the number of suitable land purchase opportunities will steadily diminish. There are still properties that are suitable for National Forest acquisition, but most of the suitable properties have already been acquired by the LTBMU and state and local governments. The emphasis will be to acquire larger parcels, two acres or larger, that have important resource values such as recreational opportunities, watershed protection or wildlife values or improved public access, and to protect environmentally sensitive lands from development in accordance with the Santini/Burton Act. Another emphasis will be to acquire lands that improve management efficiency, such as inholdings or parcels that block up ownership or provide better access opportunities for management and project activities.

The purchase of large numbers of small urban lots under the Santini/Burton Act as directed under the 1982 Land Acquisition Plan for the Lake Tahoe Basin Final EIS and the 1988 Forest Plan is essentially completed and is no longer a program emphasis. With the exception of Placer County, the LTBMU will no longer purchase small lots that do not meet the criteria stated above. Essentially, the TRPA environmental thresholds for the acquisition of environmentally sensitive lands that are now protected from development have been met in El Dorado, Douglas and Washoe Counties. As a result, all lots with a TRPA Individual Parcel Evaluation Score (IPES) of 1 or higher can be considered as buildable in these three counties. A score of 0 is a lot in a Stream Environment Zone and is not considered buildable. The LTBMU policy as set out in an amendment to the 1982 EIS was to not purchase small lots with a buildable IPES score. Therefore, the only small lots in these 3 counties that qualify for purchase by the Forest Service are already protected from development. In Placer County, the buildable IPES score is still set at the original level of 725, so all lots with a lower IPES score still qualify for purchase by the LTBMU under the Santini/Burton Act. In Washoe County there is another factor that eliminates most small lots from consideration for purchase. In the late 1990s, the Office of General Counsel, which approves the title for all FS land acquisition, determined that the LTBMU could no longer purchase lots in Incline Village that were subject to the Covenants, Conditions, and Restrictions of the Incline Village General Improvement District, as they created conditions of title unacceptable to the U.S.

Therefore, emphasis on the purchase of small lots is greatly reduced. The LTBMU will consider the purchase or donation of IPES lots in El Dorado and Douglas Counties that improve management by improving overall land ownership patterns. In addition, the LTBMU will continue to purchase qualifying small lots from willing sellers in Placer County, as long as Santini/Burton funding is available, although there have been very few interested land owners in the last ten years.

In addition to the acquisition of lands, the land adjustment program includes the disposal of NFS lands in limited circumstances for specific purposes. The primary method for disposing of NFS lands is through land exchanges. In order to dispose of these lands in a land exchange, specific findings that the lands are suitable and have been identified for disposal are required, usually at the Forest Plan decision level. Reasons for disposal may include that the lands are no longer suitable for National Forest management. In addition there must be an overall improvement in public benefits from the exchange. Several small land exchanges were completed on the LTBMU in the 1990s.

In general, NFS lands within the Lake Tahoe Basin have important natural resource and public recreation values, and most lands were acquired for specific public purposes and benefits. Other than small urban lots, NFS lands on the LTBMU should be retained in public ownership; no NFS lands are identified as suitable for disposal.

Another way NFS lands can be transferred to local, state or private ownership is through federal legislation. One nine-acre parcel on the LTBMU was transferred to Washoe County for the Incline Village Elementary School. More recently, another 22-acre parcel at Skunk Harbor was transferred to the Dept. of Interior to be held in trust for use by the Washoe Tribe.

In addition, on the LTBMU, the Forest Service has a special authority in the Santini/Burton Act for the transfer of lands acquired under the Santini/Burton Act to state or local governments as set forth in Sec. 3(a)(4)(b):

"Lands acquired under the Burton Santini Act shall be administered as a part of the United States National Forest System; except that the Secretary of Agriculture, acting through the chief of the Forest Service, may, in the case of lands which are unsuitable for Forest Service Administration, transfer such lands or interests therein to an appropriate unit of State or local government with appropriate deed restriction to protect the environmental quality and public recreational uses of the lands concerned."

This authority was used to transfer urban lots to Washoe, Douglas and El Dorado Counties and the City of South Lake Tahoe as part of the Erosion Control Grants Program. Under the Santini/Burton Act, the use of urban lots for erosion control projects was suitable and the construction of erosion control structures was authorized on more than 300 lots. The following criteria were developed to determine when lots under permit for erosion control project should be transferred to the responsible party:

The criteria used by the LTBMU to determine whether lands were currently unsuitable for Forest Service administration in these situations were:

1) A permanent urban storm water treatment structure or improvement was installed that requires long term maintenance, and,
2) The area of encumbrance was 25% or greater than the total size of the parcel, and
3) The parcel did not have resource or management values that required retention.

During the late 1990s, 115 parcels were transferred under this program. Each deed for these transfers included extensive and specific deed restrictions to protect the parcels from other forms of development and to preserve public access and recreation values. There have been no additional transfers since that time period. There is not a specific monitoring program to ensure the compliance with deed restrictions.

On December 15, 2000, the USDA Office of Inspector General issued an audit report on the LTBMU Land Acquisition and Urban Lot Management Programs under the Santini/Burton Act (Report No: 08003-5-SF). The report directed the LTBMU to work with the State Governments to find opportunities to consolidate ownership of urban lots between the agencies to improve ownership and management efficiencies. The LTBMU has had discussions with both Nevada State Lands and the California Tahoe Conservancy (CTC) to identify opportunities for land adjustments to meet this recommendation. The LTBMU is currently in active discussions with CTC to develop broad scale land adjustments to improve each agency's land ownership and management. Since both of these state agencies are land management agencies with similar management objectives for their land in the Lake Tahoe Basin, land adjustments with them offer the best opportunity to improve overall management and present the least concern for future monitoring of the deed restrictions on parcels transferred to them.

Land ownership adjustments with CTC and Nevada State Lands are the preferred means of improving overall ownership and management efficiency at Lake Tahoe. The primary constraint is the need for adequate funding and staffing to process the land adjustments.

Lands Special Uses Program

Lands (or non-recreation) special use authorizations allow occupancy, use, or rights and privileges on NFS lands for federal, state and local agencies, private industry, and private individuals. Special use authorizations may include permits, leases, or easements. Uses that can be authorized include public or private roads, utilities including electric, gas, cable TV, fiber optic, water and sewer facilities, communication sites and facilities, water quality and erosion control structures, research projects, monitoring facilities, filming, photography, and commercial education activities. The program screens proposals for use of NFS lands to determine if the proposed use needs to be located on NFS lands and is a suitable use, and issues permits or leases authorizing the occupancy of NFS lands including terms and conditions to protect resource values and other Forest users. Once a use is authorized, the program monitors the use for compliance with the terms and conditions of the permit, collects fair market rental, unless rental is waived, and ensures that the use is terminated and the land restored when the use is no longer needed.

The LTBMU has an active and growing Lands special uses program. As of December, 2011, the LTBMU administered 170 permits and leases as shown in Table 3-49.

Table 3 49. Special Use Permits issued by the LTBMU, as of 12/9/2011

Issued Permits		**170**
Utilities	Gas	1
	Electric	2
	Water	36
	Sewer	10
	Telephone	3
	TV	1
Roads		46
Communication Sites	Broadcast	3
	Non-broadcast	5
	Other	1
Erosion Control		30
Research Study		7
Other		26
Expired Permits		41*

* Older (long-term) permits with no expiration date: 31 (mostly roads and utilities).

There is a backlog of expired permits. Most are still in use, and in accordance with the special uses handbook and policy, are still considered as active authorizations with annual rental collected when appropriate. The total area of NFS lands under permit for Lands uses is 841 acres.

Once a use is authorized, it is monitored on a regular basis to ensure compliance with the terms of the permit and to ensure that no resource damage is occurring. In addition, there is an increasing emphasis on monitoring the use of Forest Service system roads and other roads for maintenance and repair activities to ensure that permittees are not damaging the roads and are performing their share of road maintenance. The many miles of powerlines crossing NFS lands require regular maintenance to remove hazard trees and maintain required line vegetation clearances. The work planned for each year is submitted in annual maintenance operating plans and reviewed and approved by the LTBMU. Hazard tree removal must be approved in a timely manner to ensure the integrity of electrical service and minimize fire potential.

In addition to the Lands uses under permit, there are numerous pre-existing third party rights located on NFS lands on the LTBMU. These are primarily in the form of easements for roads and utilities. Since most of the NFS lands in the LTBMU have been acquired (as opposed to established as public domain lands), there were often pre-existing utility and road easements in place when the lands were acquired by the Forest Service, and title was acquired subject to these easements. These easements are essentially

private property rights across NFS lands, and do add to the complexity of managing NFS lands in the Lake Tahoe Basin.

Although the Forest Service cannot interfere with these private rights, the Forest Service is still the underlying land owner. Repairs, construction and tree removal activities on these easements need to be coordinated with the LTBMU. In addition, where existing facilities and roads are causing resource damage or erosion to adjacent NFS lands, the Forest Service can require corrective actions, including the installation of BMPs. Also, a good number of these easements do not have adequate access for the vehicles needed to maintain and repair the facilities, and the owners need to utilize Forest Service System roads to manage their easement.

In the past, these third party easements often were not addressed, and third party rights to FS System roads were often not known by the FS. Currently, whenever a permit for utilities across NFS lands is amended or re-issued, a primary objective is to also identify all related facilities of the applicant that are located on NFS lands, and to identify all roads that need to be used to maintain the facilities. Although no authorization is needed for the easements, this effort allows the LTBMU to monitor use of the easements, manage use of system roads and prevent unnecessary resource damage. These easements also present a large additional workload for the Lands special uses program.

The demand for lands use authorizations on the LTBMU appears to be increasing. Ten to fifteen proposals are submitted each year. The proposals are primarily for utility system upgrades, new cellular, wireless and other communication sites, erosion control structures funded by the erosion control grant program, new bicycle and recreation trails, and new permits to replace expired permits. This trend is likely to continue, especially for upgraded water systems to improve fire protection and for new and updated wireless communication facilities.

Allowing the use of NFS lands for renewable energy development is a high priority for the Forest Service. However, the Lake Tahoe Basin is a specially designated management area where water quality, scenic and recreational resources are the highest priority. Therefore, the Lake Tahoe Basin is not suitable for large scale energy development. On the other hand, opportunities for small scale, site specific solar, wind, and geothermal projects that are compatible with visual resource and water quality objectives should still be encouraged.

There are no major utility transmission corridors designated through the Lake Tahoe Basin. Additionally, major efforts to identify new utility corridors throughout the western states to facilitate renewable energy development over the last 10 years have not identified the need for a corridor through the Lake Tahoe Basin. To preserve the scenic and recreational values at Lake Tahoe, and in consideration of the topographical constraints in the Basin, no major utility corridors should be identified or designated through the Lake Tahoe Basin.

Future requests for Lands authorizations on the LTBMU will continue to be evaluated on a case by case basis. The primary criteria will continue to be that the use of NFS land is necessary, the proposed use is a suitable and appropriate use of NFS lands, and the proposed use can be compatible with other existing uses and resource management objectives.

Land Boundary and Title Program

The boundary and title program involves the survey, retracement and signing of the property boundaries between NFS lands and adjacent private, state, local government and other federal lands, the maintenance of land ownership, status and title records, and the identification and resolution of unauthorized uses of NFS lands (encroachments) and title claims on NFS lands.

Timely location and signing of NFS boundaries is necessary for a variety of reasons. Boundaries need to be located and clearly signed before the design and implementation of forest projects such as fuels reduction and forest health projects, ecosystem restorations projects, and special use authorizations to ensure that Forest Service activities do not intrude onto nonfederal land. Locating boundaries is necessary to identify encroachments and clearly signed boundaries are necessary to prevent additional encroachments. In addition, marking and signing boundaries identifies and locates NFS lands for public use and enjoyment.

The demand for timely location and signing of NFS land boundaries on the LTBMU in support of forest project work and encroachment identification is greatly increased by the large areas of urban interface, especially the 3,500 urban subdivision lots. Also, boundary signs and even survey monuments tend to be lost at a higher than normal rate in these areas.

There are approximately 400 miles of NFS boundary that need to be maintained on the LTBMU. There is about another 100 miles of boundary that does not need to be maintained between adjacent National Forests and water bodies. The boundary program has been very active over the last ten years due to the large number of forest projects that have been designed and implemented, especially the fuels treatments of the urban lots. Over the last ten years, 376.5 miles of boundary have been located and signed. This includes boundaries that have been retraced more than once due to delays in project implementation. The boundary program is funded almost entirely by the forest management programs needing boundary work for their projects.

The priorities for boundary management are 1) support the LTBMU's project needs, 2) identify, resolve, and prevent encroachments, and 3) identify NFS lands for public recreational use.

The title program is also very active on the LTBMU. This is driven by the same factors as the boundary program, the ownership of numerous small subdivision lots and the many miles of general forest boundary adjacent to residential development. Encroachments on NFS lands range from wood piles and vehicle parking to landscaping, volleyball courts, horseshoe pits, bicycle obstacle courses, driveways, decks, and portions of garages and houses. These unauthorized uses can cause serious resource damage and must be removed before FS project work can proceed to eliminate liability and safety concerns.

Since 2007, 260 encroachments have been resolved with 88 cases resolved just in 2010 and 2011. There is a known backlog of 68 cases, with the potential for a much larger backlog that has been reported but not confirmed. Most of the encroachments are located on urban lots and identification and resolution are funded by the urban lots program. Encroachments on general forest lands are funded by Lands appropriated funding.

The priorities for resolving encroachments are 1) clearing lands of encroachments for forest project work, 2) stopping encroachments that are causing resource damage, especially soil disturbance and water quality and erosion problems and restoring the damage, and 3) encroachments involving major improvements such as driveways, deck and buildings.

In addition to encroachments, there is a backlog of between 20 and 40 title cases on the LTBMU. These involve unauthorized improvements on NFS lands where the owner of the improvements can make a title claim against the FS for the improvements. These claims on the LTBMU nearly all result from the improvements having been in place when the land was acquired by the Forest Service and the improvements were not identified and properly removed before the Forest Service accepted title to the land. With Regional Office approval, these title cases are resolved through boundary line adjustments that give the owners clear title to their improvements.

In the future, the level of activity in the boundary and title programs will be determined by the level of forest management project work on the LTBMU, since that is the primary funding source.

Land Withdrawals

A withdrawal closes public lands or NFS lands to entry under the general land laws, including the mining laws. The general land laws included entry and appropriation of public lands for homesteading, stock raising homesteads, desert land entries, and the filing of mining claims under the mining laws. Most forms of entry have been repealed, but the general mining laws are still in effect. National Forest System lands within the LTBMU that are not withdrawn are open to entry under the general mining laws.

Withdrawals are made to protect wilderness areas, areas with special resource or cultural values, lands for water and hydroelectric projects, and developed recreation and administrative facilities. On the LTBMU a total of 31,816 acres are in withdrawals. Of these lands, 23,886 acres are under statutory withdrawal for designated wilderness areas. Most of these acres are for the Desolation Wilderness, but portions of the Granite Chief and Mt. Rose wildernesses are included. The remaining 7, 930 acres of withdrawals are administrative withdrawals for developed recreation sites, administrative sites and water project withdrawals. The statutory withdrawals for wilderness areas are part of wilderness designation and can only be changed by legislation. The administrative withdrawals can be continued as long as the purpose for the withdrawal continues or they can be terminated, opening the areas to entry under the mining laws.

As long as the lands under administrative withdrawals are still being used for the purpose of the withdrawals, the withdrawals should be continued to protect the lands from the filing of mining claims.

Since there is only very limited potential for locatable minerals in the LTBMU and very few active mining claims, there is no specific need currently identified to pursue additional withdrawals on the LTBMU. If additional areas needed for administrative sites, developed public recreation areas, special interest areas, wetlands or preservation of cultural resources are identified that need additional protection from entry under the General Mining Laws, the Forest Service may pursue withdrawal of those areas.

3.4.13.3. Environmental Consequences

Land Acquisition and Land Adjustment Program

The objective of acquiring the remaining qualified properties for FS management within the Lake Tahoe Basin depends on willing sellers with suitable properties and the availability of funding for the purchases. The objective and results will not be affected or changed by any of the five alternatives.

The objective of pursuing opportunities to consolidate ownership of urban lots with Nevada State Lands and California Tahoe Conservancy will be determined by available funding and staffing in the FS and the two state agencies. The objective and completion of land adjustments will not be affected or changed under any of the alternatives.

Land Special Uses Program

The demand for additional Lands special use authorizations will be driven by the need for NFS lands by private and local and state governments for additional utilities, roads, communication facilities, erosion control projects and other uses requiring formal authorizations. This will not change or be affected by any of the alternatives. The goal of not authorizing additional infrastructure in roadless areas and environmentally sensitive or incompatible areas remains the same in all alternatives.

Land Boundary and Title Program

The desired condition of this program is to have all boundaries marked and maintained to standard and to remove and prevent all encroachments on NFS lands. The reality is that the funding and

accomplishments in the boundary and title program are determined by the level of forest management projects which does vary in the alternatives. However, whichever alternative is adopted, the actual level of project work will be determined by available funding. In general, the more forest project work that is planned and implemented, the more boundary and title support will be needed, and more miles of boundary will be maintained and more title cases resolved.

Land Withdrawals

The goal of retaining existing administrative withdrawal as long as the use or resource value for which the withdrawal was implemented remains, will not change or be affected by any of the alternatives. The acres of statutory withdrawals for designated wilderness will only change if additional wilderness designations are made. Alternatives C and D would both recommend additional wilderness designations and could result in additional acres of land being withdrawn if the designations are actually approved by Congress. That would be a consequence, not a preferred or desired condition from a program standpoint.

3.4.13.4. Analytical Conclusions

Comparison of Consequences by Alternative

Land Acquisition and Land Adjustment Program. The objectives and accomplishments of the land acquisition and land adjustment program will remain the same under all four alternatives and will not be affected by the alternatives.

Land Special Uses Program. The objectives and accomplishments of the lands special uses program will remain the same under all four alternatives and will not be affected by the alternatives. The number and type of lands uses authorized will not change under any alternative.

Land Boundary and Title Program. Assuming an equal level of funding for all alternatives, Alternatives A, B and E would result in a similar level of accomplishments in maintaining land boundaries and preventing and resolving encroachments. Alternative C with a more active forest management approach would result in an increase in accomplishments with the most proactive boundary and title program. Alternative D with a lower level of active forest management would result in a lower level of boundary and title accomplishments.

Land Withdrawals. None of the alternatives would affect the goal of retaining existing administrative withdrawals as long as they are needed. Alternative C could result in additional acres under statutory withdrawal if the recommendation for wilderness designation for the Dardanelles Roadless Area is implemented. Alternative D could result in the most acres under statutory withdrawal if the recommendation for wilderness designation for both the Dardanelles and Freel Roadless Areas is implemented. Again, this is just a result and has no management implications from a Lands program standpoint.

How the Alternatives Maintain or Achieve the Desired Conditions

There would be no difference between the alternatives in how desired conditions are maintained or achieved.

3.4.14. Management Indicator Species (MIS)

3.4.14.1. Introduction

The 1982 National Forest System Land and Resource Management Planning Rule (1982 Planning Rule) requires the selection of management indicator species (MIS) during development of forest plans (1982: 36 CFR 219.19(a) (1)). This section summarizes the MIS selected for the revised Land and Resource Management Plan (LRMP) and the conditions they are to represent. Details regarding the identification and selection of these MIS, including the reasons for their selection, as required under the Planning Rule ((1982: 36 CFR 219.19(a) (1)), can be found in the 2007 Sierra Nevada Forests Management Indicator Species (SNFMIS) Amendment Final Environmental Impact Statement (FEIS) (USDA Forest Service 2007a) and SNFMIS Amendment Record of Decision (ROD) (USDA Forest Service 2007b), which are hereby incorporated by reference.

The Forest Service selects species as Management Indicator Species (MIS), one of a variety of elements to address National Forest Management Act (NFMA) requirements related to diversity of plant and animal communities. Species are selected as MIS "because their population changes are believed to indicate the effects of management activities" (1982: 36 CFR 219 (a) (1)). They are to be used during planning to help compare effects of alternatives (1982: 36 CFR 219.19(a) (2)), and as a focus for monitoring (1982: 36 CFR 219.19(a) (6)). Where appropriate, MIS shall represent the following groups of species (36 CFR 219 (a) (1)):

- Threatened and endangered species on State and Federal lists;
- Species with special habitat needs that may be influenced significantly by planned management programs;
- Species commonly hunted, fished, or trapped;
- Non-game species of special interest; and
- Species selected to indicate effects on other species of selected major biological communities or on water quality.

Although species from all 5 categories are to be considered, there is no requirement or compelling need to choose one or more species from each category. Instead, the categories provide a universe from which the appropriate MIS may be selected (USDA Forest Service 2007b, p.12).

In 2007, the USDA Forest Service, Pacific Southwest Region Deputy Regional Forester amended the MIS lists and associated monitoring for 10 National Forests in the Sierra Nevada, including the LTBMU, to improve the effectiveness of those lists to meet their intended purpose, and to improve economic efficiency to make MIS monitoring affordable, and hence, more implementable (USDA Forest Service 2007b). Suitability and Feasibility criteria were used to identify the MIS. The suitability criteria used were: (a) The species is linked to a habitat or ecosystem component that is affected by Forest Service management activities, and (b) The population changes of the species are thought to primarily indicate the effects of Forest Service land management activities versus indicating the effects of other factors. The feasibility criteria used were: (a) There is an available, tested methodology (either currently being implemented or readily available to implement) to monitor the population or habitat of the species); (b) the methodology, including data analysis, can be implemented within budget constraints; and (c) the methodology gives information regarding population or habitat status and change of the species that is useful to informing management decisions. Additional details on these criteria and how they were applied can be found in USDA Forest Service 2007a, Appendix B.

The LTBMU proposes to retain the MIS in the 2007 SNFMIS Amendment ROD (USDA Forest Service 2007b). As noted by the Deputy Regional Forester in the ROD (USDA Forest Service 2007a):

- "Species selected for inclusion on the MIS list must occur in and rely on the habitat they are intended to represent. MIS population changes must be related to habitat changes that might result from forest management.

The previous Forest MIS lists included a variety of species whose population changes were not clearly related to habitat changes on National Forest System lands (for example rainbow trout). The Deputy Regional Forester (USDA Forest Service 2007a) also pointed out that:

- "Our experience implementing forest plans shows that many management issues transcend individual Forest boundaries. To more clearly examine and understand the effects of our management activities, MIS should range across multiple forests."

The previous Forest MIS lists were created without consideration of the MIS list on neighboring Forests and the lack of coordination and standardization among the Forests resulted in a lack of understanding of the effects of management activities on the Forests. In addition it was clearly noted (USDA Forest Service 2007a) that:

- "Species selected as MIS must occur on National Forest System lands in sufficient numbers to allow collection of meaningful information. For example, rare species are often difficult to find and monitor. "

- "Proven monitoring protocols must exist for each MIS selected."

- "Selected MIS must not be significantly affected by human influences outside the management prerogative of the Forest Service. "

Thus the LTBMU, based on not only its small size in comparison to other Forests in the Sierra Nevada, but also on the rationale provided by the Deputy Regional Forester in the 2007 SNFMIS Amendment (USDA Forest Service 2007a) on why a consistent species list is needed for MIS across the Sierra Nevada Forests, has chosen to retain the current MIS list as decided by the 2007 SNFMIS ROD (USDA Forest Service 2007a).

The MIS chosen from the 2007 SNFMIS ROD (USDA Forest Service 2007a) that occur on the LTBMU are seven (7) terrestrial habitats and ecosystem components with nine (9) associated MIS, as well as aquatic macroinvertebrates as the MIS for lacustrine and riverine habitat. These MIS and their associated habitats or ecosystem components are listed in Table 3-50.

There are benefits of using a shared list, rather than coming up with a new list just for the LTBMU, which, due to the small size and limited resources of the LTBMU, could be limited in the monitoring data available, the resources for future monitoring and analysis, the reduced ability to ascertain the connection between habitat changes and population trends, etc.

These major habitats and ecosystem components were selected because they can be affected by Forest Service management on the LTBMU, as well as on other national forests in the Sierra Nevada (USDA Forest Service 2007a, pages 17-20). These species were selected as MIS because they are associated with the indicated major habitat or ecosystem component and their population changes are believed to indicate the effects of land management activities (1982: 36 CFR 219.19(a)(1)), and were selected via a process that considered all known plant and animal species present on the 10 National Forests within the Sierra Nevada, including 692 terrestrial vertebrate species; the consideration process is documented in detail in the SNFMIS Amendment FEIS, Appendix B (USDA Forest Service 2007a).

The LTBMU also proposes to utilize the monitoring strategies identified in the 2007 SNFMIS Amendment ROD (USDA Forest Service 2007b). For the terrestrial MIS, the monitoring strategy is habitat monitoring and distribution population monitoring at the Sierra Nevada scale, including sampling on the LTBMU. Bioregional (Sierra Nevada scale) monitoring was selected because many management issues transcend individual forest boundaries and monitoring of MIS across neighboring forests enables a clearer examination and understanding of the effects of management activities (USDA Forest Service 2007b). In addition, in many cases, forest scale information does not provide the most meaningful biological data and maintaining a separate, uncoordinated monitoring effort on each individual forest is not strategic and is an inefficient use of money and resources (USDA Forest Service 2007a). Population distribution monitoring tracks the changes in the presence at the Sierra Nevada scale of the species across a number of sample locations. Habitat monitoring tracks the status and trends at the Sierra Nevada scale of each of the CWHR habitat types. For the aquatic macroinvertebrates, the monitoring strategy is bioregional habitat and bioregional Index of Biological Integrity. This bioregional monitoring has been conducted since 2008 or 2009 at the Sierra Nevada scale, including on the LTBMU (USDA Forest Service 2010a).

Table 3 50. Management Indicator Species (MIS) components for the Lake Tahoe Basin Management Unit

Habitat or Ecosystem Component	**CWHR Type(s) defining the habitat or ecosystem component[1]**	**Management Indicator Species Common Name *Scientific Name***	**Category (s)**
Riverine & Lacustrine	**Habitats:** Lacustrine (LAC) and riverine (RIV)	aquatic macroinvertebrates	Species selected to indicate effects on other species of selected major biological communities or on water quality.
Riparian	**Habitats:** Montane riparian (MRI), valley foothill riparian (VRI)	**yellow warbler** *Dendroica petechia*	Non-game species of special interest
Wet Meadow	**Habitats:** Wet meadow (WTM), freshwater emergent wetland (FEW)	**Pacific tree frog** *Pseudacris regilla*	Non-game species of special interest
Early and Mid Seral Coniferous Forest	**Habitats:** Ponderosa pine (PPN), Sierran mixed conifer (SMC), white fir (WFR), red fir (RFR), eastside pine (EPN), tree sizes 1, 2, 3, and 4 all canopy closures	**Mountain quail** *Oreortyx pictus*	Species commonly hunted, fished, or trapped
Late Seral Open Canopy Coniferous Forest	**Habitats:** Ponderosa pine (PPN), Sierran mixed conifer (SMC), white fir (WFR), red fir (RFR), eastside pine (EPN), tree size 5, canopy closures S and P	**Sooty (blue) grouse** *Dendragapus obscurus*	Species commonly hunted, fished, or trapped
Late Seral Closed Canopy Coniferous Forest	**Habitats:** Ponderosa pine (PPN), Sierran mixed conifer (SMC), white fir (WFR), red fir (RFR), tree size 5 (canopy closures M and D), and tree size 6.	**California spotted owl** *Strix occidentalis occidentalis*	Non-game species of special interest; Forest Service Sensitive Species
		Pacific marten[2] *Martes caurina*	Non-game species of special interest; Forest Service Sensitive Species
		northern flying squirrel *Glaucomys sabrinus*	Non-game species of special interest
Snags in Green Forest	**Ecosystem Components:** Medium and large snags in green forest	**hairy woodpecker** *Picoides villosus*	Species with special habitat needs that may be influenced significantly by planned management programs.
Snags in Burned Forest	**Ecosystem Components:** Medium and large snags in burned forest (stand-replacing fire)	**black-backed woodpecker** *Picoides arcticus*	Species with special habitat needs that may be influenced significantly by planned management programs.

[1] All CWHR size classes and canopy closures are included unless otherwise specified; dbh = diameter at breast height; Canopy Closure classifications: S=Sparse Cover (10-24% canopy closure); P= Open cover (25-39% canopy closure); M= Moderate cover (40-59% canopy closure); D= Dense cover (60-100% canopy closure); Tree size classes: 1 (Seedling)(<1" dbh); 2 (Sapling)(1"-5.9" dbh); 3 (Pole)(6"-10.9" dbh); 4 (Small tree)(11"-23.9" dbh); 5 (Medium/Large tree)(>24" dbh); 6 (Multi-layered Tree) [In PPN and SMC] (Mayer and Laudenslayer 1988).

[2] This species was classified as American marten (Martes americana) but recent genetic and morphological evidence classifies this species as Pacific marten (Martes caurina) and of the subspecies sierrae (Dawson and Cook 2012).

Since adoption of the 1982 planning regulations (36 CFR 219, 1982), the management indicator species concept has been reviewed and critiqued by the scientific community (Caro and O'Doherty 1999, Simberloff 1998, Noss 1990, Landres et al. 1988, and Weaver 1995). These reviews identify proper uses and limitations of the indicator species concept. They generally caution against overreaching in use of indicator species, especially when making inferences about ecological conditions or status of other species within a community. Caution is needed because many different factors may affect populations of each species within a community, and each species' ecological niche within a community is unique. Additional information regarding scientific criticisms of the MIS concept is discussed in the 2007 Sierra Nevada Forests Management Indicator Species (SNFMIS) Amendment Final Environmental Impact Statement (EIS) (USDA Forest Service 2007a, p.4).

The 2007 SNFMIS Amendment EIS and Record of Decision focused on identifying MIS which can be used to test the assumption that if habitat is managed a certain way, MIS populations will respond in a certain way (USDA Forest Service 2007a, p.4). This use of MIS has not been negated by the recent scientific criticisms summarized above. Thus, the selected MIS and associated monitoring identified in the 2007 SNFMIS Amendment and the LTMBU Plan Revision are designed to meet the NFMA requirement for MIS in light of this current scientific understanding of the MIS concept. The MIS process is but one tool used to develop management strategies and monitoring programs designed to meet NFMA requirements related to diversity of plant and animal communities.

Some of the other elements used in comprehensive planning for plant and animal diversity include: objectives and standards in forest plans for maintenance and restoration of desired ecological conditions, management of important ecosystems and ecosystem components, such as aspen, snags and down logs, and plants that are culturally important to Native Americans, and biological evaluations and assessments at both the forest plan and site-specific project levels.

Other elements important to monitoring the effects of forest plan implementation on plant and animal diversity include, where appropriate: monitoring key ecological conditions, monitoring management activity levels, monitoring species of interest, including watchlist species, change detection of vegetation structure and species composition, monitoring water quality, monitoring plants that are traditionally important to Native Americans, and monitoring of threatened, endangered, and sensitive species.

The MIS categories (1982: species (36 CFR 219 (a)(1))) applicable to the LTBMU MIS are identified in Table 3-49. Further information regarding these categories is in the SNFMIS Amendment ROD (USDA Forest Service 2007b, pp.4-5). The comparison of the effects of alternatives related to MIS (1982: 36 CFR 219.19(a)(2)) is found in the Environmental Consequences section below. Monitoring related to the MIS (1982: 36 CFR 219.19(a)(6)) is discussed in the Monitoring Plan.

3.4.14.2. Affected Environment

The species present in the area selected as MIS for the LTMBU are identified and the reasons for their selection is summarized in this section, as required by (219.19(a)(1)); more detailed information is found in the SNFMIS Amendment FEIS (USDA Forest Service 2007a, pp.37-40) and ROD (USDA Forest Service 2007b).

In addition, the status and trend of each MIS habitat and associated MIS are summarized in this section. The current bioregional status and trend of populations and/or habitat for each of the MIS is discussed in detail in the Sierra Nevada Forests Bioregional Management Indicator Species (SNF Bioregional MIS) Report (USDA Forest Service 2010a). The map of the Sierra Nevada bioregion in context to the ten national forests is displayed in Figure 3-87, at the end of this resource section.

Lacustrine/Riverine Habitat (Aquatic Macroinvertebrates)

Reason for selection as an MIS

Aquatic macroinvertebrates were selected as the MIS for lacustrine and riverine habitats because they represent a diverse group of relatively sedentary species that react strongly and predictably to management activities (Hawkins et al. 2000, Knapp et al. 2005, Fore 2007, Herbst et al. 2012). Variation in their relative abundance may be interpreted to determine whether water quality and aquatic habitats have been impaired relative to reference condition (EPA 2006) the standard for compliance with the Clean Water Act. Reference condition is defined as the relative absence of impacts from land management activities such as timber harvest, grazing, road building, and mining (Ode and Schiff 2009). Since it may be virtually impossible to find an undisturbed reference site with no road building or other land use history, a relaxed standard for reference condition, allowing for some disturbance (e.g., no more than 1 km/km^2 rather than no roads in the reference watershed) has sometimes been adopted. Sensitivity to alteration of habitat for such features as water temperature, riparian vegetation, sedimentation, nutrients and water chemistry vary within the macroinvertebrate community, allowing interpretation of what factors may be compromising water quality and aquatic habitats (Hawkins et al. 2000, Hodkinson and Jackson 2005, Knapp et al. 2005, Herbst et al. 2006, EPA 2006, Ode 2007a, Fore 2007, Rehn 2009, Herbst and Silldorff 2009, Larsen and Ormerod 2010, Herbst and Cooper 2010, Reylea et al. 2012, Herbst et al. 2012).

Sierra Nevada Bioregional Status and Trend

Aquatic macroinvertebrates were designated as aquatic Management Indicator Species in the 2007 SNFMIS ROD and sampling has occurred annually since 2009, which has not provided enough time to track trends in Sierra Nevada bioregional condition. However, it is possible to reach some conclusions about the trend of native aquatic fauna, including aquatic invertebrates, based upon the SNEP (1996) evaluations. A major conclusion of that evaluation was that “the aquatic/riparian systems are the most altered and impaired habitats of the Sierra.”

In the summary volume, SNEP (1996) concluded that amphibian species at all elevations have severely declined throughout the Sierra Nevada. Dams and impoundments, which block fish access to streams, together with degraded conditions above dams, have led to loss of about 90% of the historic anadromous fish habitat in the Sierra. Local degradation of habitats has led to significant impacts on aquatic invertebrates, which make up the vast majority of aquatic species in the Sierra Nevada.

This downward trend reflects a legacy of extensive past use of the Sierra Nevada Province resources for timber harvest, road building, mining, grazing and water diversions (Kattelmann 1996). For the SNEP assessment, Moyle et al. (1996) summarized the status of forty fishes native to the Sierra Nevada: Six (15%) are formally listed by the federal and/or state government as threatened or endangered species, twelve (30%) are considered to be species of special concern because they are in trouble statewide and are potential candidates for listing or because they have limited distributions, four (10%) are in decline in the Sierra Nevada but are probably in less trouble than elsewhere, and eighteen (45%) seem to have stable or expanding populations for native fish species of the Sierra Nevada Province. Introduced, alien fish species were identified as a major reason for the declines of native fishes. The 2001 FSEIS for the Sierra Nevada Province (USDA Forest Service 2001c) concluded that “fishes of the Sierra Nevada can be characterized as having declined in population size. Most of these declines have occurred over the last 50 years.”

Bioregional monitoring for Sierra Nevada MIS to date was summarized in the 2010 Sierra Nevada Forests Bioregional MIS Report (USDA Forest Service 2010). For aquatic macroinvertebrates, condition and trend was determined by analyzing macroinvertebrate data using the predictive, multivariate River Invertebrate Prediction And Classification System (RIVPACS) (Hawkins et al. 2000) to determine whether the macroinvertebrate community has been impaired relative to reference condition (Ode and

Schiff 2009) within perennial water bodies. This monitoring consists of collecting aquatic macroinvertebrates according to a rotating panel design (Stevens and Olsen 2004) to assess all perennial waters and measuring stream habitat features according to the Stream Condition Inventory (SCI) manual (Frasier et al. 2005). Evaluation of the condition of the biological community is based upon the "observed to expected" (O/E) ratio, which is a reflection of the number of species observed at a site versus the number expected to occur there in the absence of impairment (Hawkins et al. 2000, SWAMP 2006, Ode and Schiff 2009). Sites with a low O/E scores have lost many species predicted to occur there in the absence of anthropogenic disturbance, which is an indication that the site has a lower than expected richness of species sensitive to disturbance and is therefore impaired.

Sierra Nevada MIS monitoring for aquatic (benthic) macroinvertebrates was conducted in 2009 and 2010. Benthic macroinvertebrates were collected from stream sites during both the 2009 and 2010 field seasons according to the Reachwide Benthos (Multihabitat) Procedure (Ode 2007b). The initial BMI data from 2009 and 2010 found 46% (6 of 13) of the surveyed streams indicate an impaired condition and 54% (7 of 13) indicate a reference or non-impaired condition (see USDA Forest Service 2010a: Table BMI-1).

Forest (LTBMU)-Specific Data

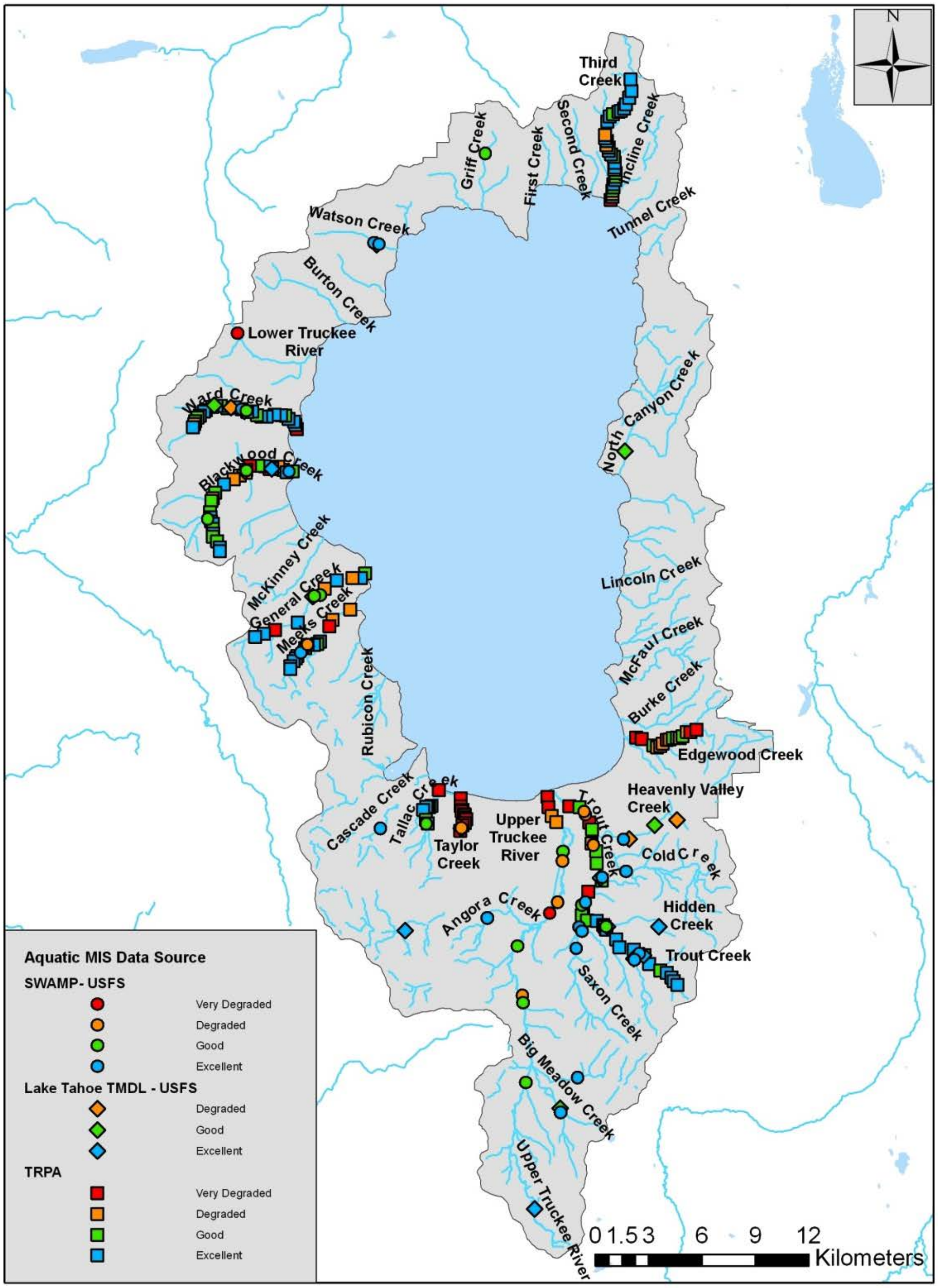
There are currently 127,055 acres of lacustrine (LAC) and riverine (RIV) habitat in the LTBMU. Of this area, 122, 278 acres or about 96% include Lake Tahoe. In general, lacustrine and riverine habitat conditions in the LTBMU are influenced by alteration of native riparian vegetation, urban development and bank instability (Herbst 2005, 2009, HydroScience 2005), as well as the threat of aquatic invasive species becoming established within the ecosystem. In addition, water uses throughout the LTBMU and land uses adjacent to various lacustrine and riverine habitats influence the amount of water that is available in these habitats. The major focus of the Lake Tahoe TMDL restoration work is controlling the influx of fine sediments that enter Lake Tahoe from two main tributary sources: bank erosion from the Upper Truckee River and Blackwood Creek together provide 20% of all fine sediment delivered to Lake Tahoe. Ward Creek is also a major contributor of sediment to Lake Tahoe (HydroScience 2005).

The Lake Tahoe Basin has a rich data set for aquatic macroinvertebrates. Four main sources of data were included in this analysis. The Tahoe Regional Planning Agency (TRPA) collected 169 samples during 2003, with systematic sampling along major stream longitudinal profiles. Data with calculated RIVPACS O/E scores were also available for 1998-2007 from legacy U.S. Forest Service monitoring, the Tahoe Regional Planning Agency (TRPA), the State's Surface Water Ambient Monitoring Program (SWAMP) and Lake Tahoe TMDL sampling. Together, these four data sets provided site-condition information for 231 samples with intensive sampling along 10 major tributaries to Lake Tahoe (Figure 3-85 and Figure 3-86).

In general, the aquatic MIS communities of streams tributary to Lake Tahoe are in good condition with about 150 sites sampled (almost 65%) in reference condition according to the Observed to Expected ratios (i.e., $0.7 < O/E < 1.3$, Figure 3-86). Sites with low O/E scores show a loss of sensitive-species richness. Sites with high O/E scores are degraded because they are out of balance with normal community composition and enhanced elevated richness may indicate nutrient enriched conditions. There is some indication that for samples closer to the lake margin, a higher proportion of sites are degraded (Herbst 2005, Fore 2007). Even though Blackwood and Ward creeks have experienced more impacts and have higher levels of bank erosion than other tributaries, it is noteworthy that the distribution of scores for these two creeks was quite similar to the relatively undeveloped sites along Meeks and General creeks (Herbst 2005, Figure 3-85). Erosion rates are relatively high for both Blackwood and Ward creeks, but the influence of fine sediments is attenuated where stream gradients are high enough to prevent fine sediment deposition. Trout Creek site scores also reveal that site conditions deteriorate nearest to Lake Tahoe, again reflecting a high degree of development there (Herbst 2009). In contrast, the Trout Creek headwaters are generally in good to excellent condition.

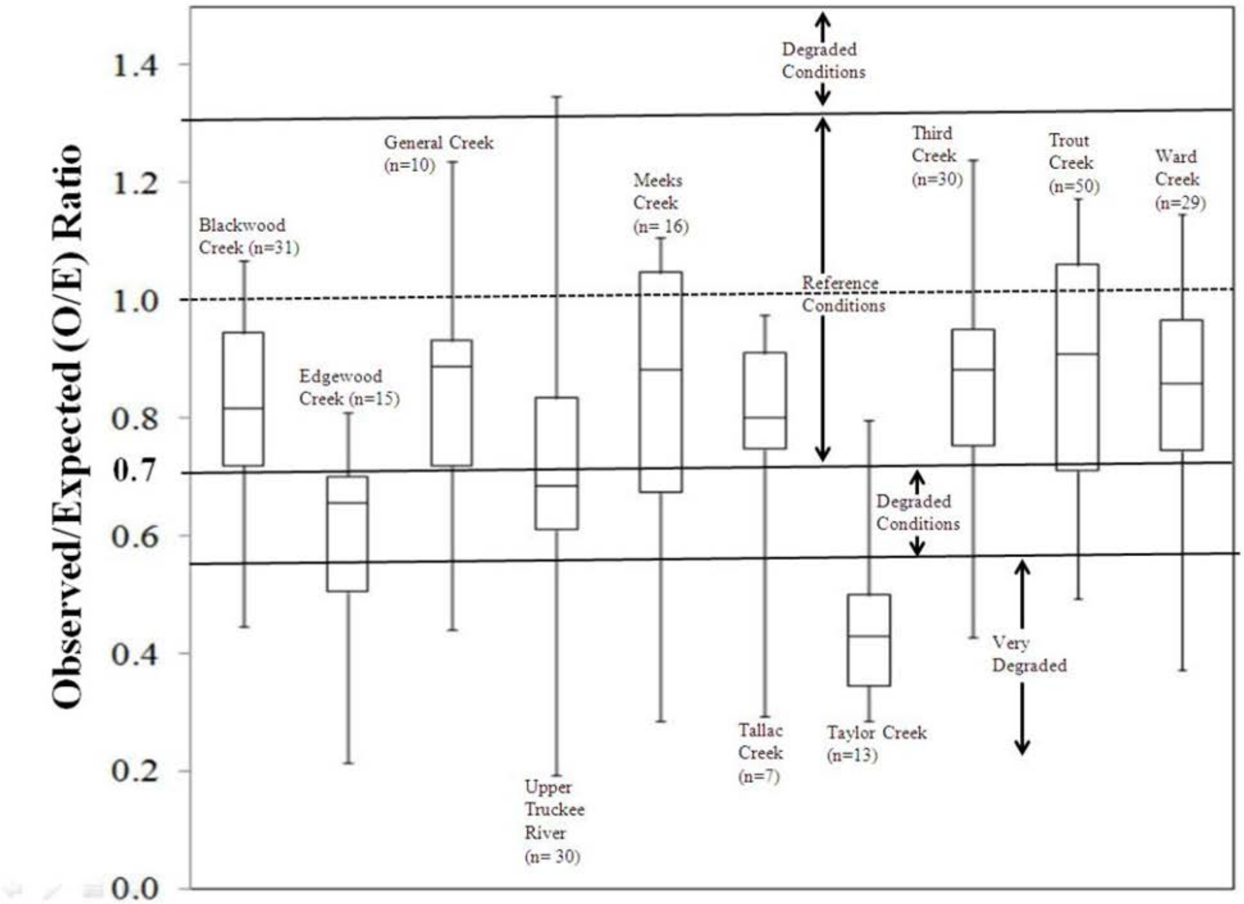
Among the ten tributaries for which substantial data were available in the Lake Tahoe Basin, three showed degraded conditions, with median O/E scores less than reference condition: the Upper Truckee River, Edgewood Creek and Taylor Creek. The relatively low scores, were concentrated in the lower sections of the river near Lake Tahoe. Higher in the watershed (e.g., above the confluence with Angora Creek), all but one score were in reference condition.

Edgewood Creek scores were depressed as would be expected since there is a high level of development (i.e., golf course, ski resort and roads) in close proximity. Taylor Creek had the lowest scores overall which is an indication of the low gradient, slack water conditions there and manipulations of flow by a dam operation below Fallen Leaf Lake. Taylor Creek also receives a kokanee salmon run each year and as a result the decomposing spawned-out salmon elevate the nutrient levels significantly.



Note: Site condition classes are based on RIVPACS O/E scores for data sets from the LTBMU, State of California SWAMP Perennial Streams Assessment, Tahoe Regional Planning Agency (TRPA) and Lake Tahoe TMDL.

Figure 3 85. Map of Lake Tahoe Basin distribution and condition of 231 aquatic MIS sites for streams tributary to Lake Tahoe.



Note: Condition classes were assigned based on RIVPACS Observed -to-Expected ratios, with reference or undegraded scores ranging from 0.7-1.3. Community composition of degraded sites varied from conditions predicted to occur in the absence of significant human-caused disturbance by at least 30 percent. Box-and-whisker plots display and contrast the distribution of site conditions for 10 major tributaries with median, 25th and 75th percentile scores, and whiskers showing the full range of scores. Note that the Upper Truckee River had the greatest range of site condition scores. The poorest scores were concentrated in the downstream sites while the sites in the reference condition range were concentrated in the upstream reaches (e.g., above confluence with Angora Creek).

Figure 3 86. Condition scores for 231 sites sampled from 1998-2007 along 10 major tributaries of Lake Tahoe.

Riparian Habitat (Yellow warbler)

Reason for selection as an MIS

Yellow warbler is selected as the MIS for riparian habitat. The CWHR system indicates that the yellow warbler is associated with riparian habitats. This species is usually found in riparian deciduous habitats in summer (cottonwoods, willows, alders, and other small trees and shrubs typical of low, open-canopy riparian woodland) (CDFG 2005). Yellow warbler is dependent on both meadow and non-meadow riparian habitat in the Sierra Nevada (Siegel and DeSante 1999). This species has been monitored since 2009 as part of the Sierra Nevada Forests bioregional monitoring (USDA Forest Service 2010). In addition, it is also monitored via the USGS's Breeding Bird Survey (BBS) (Sauer et al. 2007) and adequate data have been obtained for calculating Sierra-wide BBS trends (Siegel and DeSante 1999).

Sierra Nevada Bioregional Status and Trend

Habitat. Bioregional monitoring for Sierra Nevada MIS to date is summarized in the 2010 Sierra Nevada Forests Bioregional MIS Report (USDA Forest Service 2010a). There are currently 38,140 acres of riparian habitat on NFS lands in the Sierra Nevada. Over the last two decades, the trend is stable.

Forest-specific habitat data: There are approximately 1,688 acres of riparian habitat in the LTBMU. Riparian habitat condition is compromised by encroaching shade tolerant conifers, especially lodgepole pine trees that are competing with native riparian vegetation.

Population Distribution. Bioregional monitoring for Sierra Nevada MIS to date is summarized in the 2010 Sierra Nevada Forests Bioregional MIS Report (USDA Forest Service 2010a). Monitoring of the yellow warbler across the ten National Forests in the Sierra Nevada has been conducted since 2009 in partnership with PRBO Conservation Science, as part of a monitoring effort that also includes mountain quail, hairy woodpecker, and fox sparrow (USDA Forest Service 2010a, http://data.prbo.org/partners/usfs/snmis/). Yellow warblers were detected on 13.7% of 160 riparian point counts in 2009, 19.4% of 397 riparian point counts in 2010, and 22.1% of 402 riparian point counts in 2011; additional detections were documented on upland point counts (Ibid). The average abundance (number of individuals recorded on riparian passive point count surveys) was 0.166 in 2009, 0.309 in 2010, and 0.313 in 2011. Current data indicate that the yellow warbler population continues to be distributed at established sample sites across the Sierra Nevada (USDA Forest Service 2010a).

Forest-specific population distribution data: Bioregional monitoring for Sierra Nevada MIS includes sample points on the LTBMU; yellow warblers were detected at 4 of 15 riparian point count stations in 2010 and 4 of 14 riparian point count stations in 2011 (http://data.prbo.org/partners/usfs/snmis/). In addition, yellow warblers have been detected during various monitoring efforts over a number of years on the LTBMU:

- Yellow warblers were detected at 7 of 105 forest wide monitoring sites on the LTBMU between 2002-2005 (LTBMU 2007a);

- Yellow warblers were detected at all 10 meadow sites monitored in the LTBMU in 2006 (Borgmann et al. 2006).

Wet Meadow Habitat (Pacific Chorus [Pacific tree] frog)

Reason for selection as an MIS

The Pacific Chorus Frog (formally known as the Pacific tree frog) is selected as an MIS for wet meadow habitat. This broadly distributed species requires standing water for breeding; tadpoles require standing water for periods long enough to complete aquatic development, which can be as long as 3 or more months at high elevations in the Sierra Nevada (CDFG 2005). During the day during the breeding season, adults take cover under clumps of vegetation and surface objects near water; during the remainder of the year, they leave their breeding sites and seek cover in moist niches in buildings, wells, rotting logs or burrows (ibid). This species has been monitored since 2002 as part of the Sierra Nevada Forest Plan Amendment Amphibian Monitoring Program, and, since 2009, the monitoring has been tracked as part of the Sierra Nevada Forests bioregional monitoring (USDA Forest Service 2010a).

Sierra Nevada Bioregional Status and Trend

Habitat. Bioregional monitoring for Sierra Nevada MIS to date is summarized in the 2010 Sierra Nevada Forests Bioregional MIS Report (USDA Forest Service 2010a). There are currently 61,247 acres of wet meadow habitat on NFS lands in the Sierra Nevada. Over the last two decades, the trend is stable (USDA Forest Service 2010a).

Forest-specific habitat data: There are approximately 2,684 acres of wet meadow habitat in the LTBMU. Some wet meadow complexes in the LTBMU are at risk of desiccation from channel incision and adjacent land uses that influence water patterns and retention. In addition, conifers are encroaching on a number of meadows and meadow perimeters in the LTBMU. There are a number of ongoing restoration projects in the LTBMU that are aimed at restoring wet meadow conditions.

Population Distribution. Bioregional monitoring for Sierra Nevada MIS to date is summarized in the 2010 Sierra Nevada Forests Bioregional MIS Report (USDA Forest Service 2010a). Since 2002, the Pacific chorus frog has been monitored on the Sierra Nevada forests as part of the Sierra Nevada Forest Plan Amendment (SNFPA) monitoring plan (USDA Forest Service 2006a, 2007a, 2009, 2010b; Brown 2008). Almost 70% of sample watersheds were occupied by Pacific chorus frog at least once during the period of 2002-2007, and 79.6% of 108 historically occupied watersheds were found to be occupied by breeding frogs in 2008 (USDA Forest Service 2010a). In 2009, an estimated 95% of likely historically occupied watersheds were occupied by the Pacific chorus frog (USDA Forest Service 2010b). These data indicate that Pacific chorus frog continues to be present at these sample sites, and current data indicate that the chorus frog population continues to be distributed at established sample sites across the Sierra Nevada (USDA Forest Service 2010a).

Forest –specific population distribution data: Bioregional monitoring for Sierra Nevada MIS includes sample points adjacent to the LTBMU. In addition, Pacific chorus frogs were detected during 2002-2004 on the LTBMU: in 2003-2004, Pacific chorus frogs (formerly known as Pacific treefrogs) were detected in 87 (57.2%) of 148 lentic aquatic sites sampled using visual encounter surveys, in addition to being detected at 1 of 9 pitfall trap monitoring arrays in 2002 (LTMBU 2007).

Early and Mid Seral Coniferous Forest Habitat (Mountain quail)

Reason for selection as an MIS

The mountain quail was selected as the MIS for early and mid seral coniferous forest (ponderosa pine, Sierran mixed conifer, white fir, red fir, and eastside pine) habitat. The California Wildlife Habitat Relationships System (CWHR) system indicates that this species is highly associated with these forest habitats. Early seral coniferous forest habitat is comprised primarily of seedlings (<1" dbh), saplings (1"-5.9" dbh), and pole-sized trees (6"-10.9" dbh). Mid seral coniferous forest habitat is comprised primarily of small-sized trees (11"-23.9" dbh). The mountain quail is found particularly on steep slopes, in open, brushy stands of conifer and deciduous forest and woodland, and chaparral; it may gather at water sources in the summer, and broods are seldom found more than 0.8 km (0.5 mi) from water (CDFG 2005). Historically, the mountain quail has been monitored by the California Department of Fish and Wildlife (formerly California Department of Fish and Game) as part of its program to manage harvest species (CDFG 2004a). Since 2009, this species has been monitored as part of the Sierra Nevada Forests bioregional monitoring (USDA Forest Service 2010a).

Sierra Nevada Bioregional Status and Trend

Habitat. Bioregional monitoring for Sierra Nevada MIS to date is summarized in the 2010 Sierra Nevada Forests Bioregional MIS Report (USDA Forest Service 2010a). There are currently 530,851 acres of early seral and 2,776,022 acres of mid seral coniferous forest (ponderosa pine, Sierran mixed conifer, white fir, and red fir) habitat on NFS lands in the Sierra Nevada. Over the last two decades, the trend for early seral is decreasing (changing from 9% to 5% of the acres on NFS lands) and the trend for mid seral is increasing (changing from 21% to 25% of the acres on NFS lands).

Forest-specific habitat data: There are approximately 36,000 acres of early and mid seral habitat on the LTBMU (see Table 3-40 in section 3.4.11 Forest Vegetation). This estimate was revised from the DEIS to be more consistent with SPECTRUM modeling data sources and output. Please see section 3.4.11

Forest Vegetation for additional explanation of acreage calculation. The CWHR types defining early and mid seral habitat for the LTBMU include Jeffrey pine, white fir/mixed conifer, and red fir. These types differ slightly from the CWHR types provided in Table 3-49 in that Jeffrey pine is used instead of ponderosa pine because there is very little ponderosa pine in the LTBMU. Jeffrey pine category includes east side pine. White fir/mixed conifer is used to represent white fir and Sierra mixed conifer CWHR types; the white fir/mixed conifer combined types are very similar to white fir and Sierra mixed conifer CWHR types but the LTBMU generally does not have Douglas fir and Black oak which are characteristic of Sierra mixed conifer in lower elevations.

Although recent fires in the LTBMU (i.e., Gondola, Showers, Angora, Washoe) have resulted in the creation of some early seral vegetation, they weren't deliberate restoration efforts and there has not been deliberate restoration of early seral stages in the LTBMU over the life of the current Forest Plan. Mid seral closed canopy white fir/mixed conifer dominates the mid seral stage.

Population Distribution. Bioregional monitoring for Sierra Nevada MIS to date is summarized in the 2010 Sierra Nevada Forests Bioregional MIS Report (USDA Forest Service 2010a). Monitoring of the mountain quail across the ten National Forests in the Sierra Nevada has been conducted since 2009 in partnership with PRBO Conservation Science, as part of a monitoring effort that also includes fox sparrow, hairy woodpecker, and yellow warbler (USDA Forest Service 2010a; Point Blue Conservation Science [date unk]). Mountain quail were detected on 40.3% of 1659 point counts in 2009, 47.4% of 2266 point counts (and 56.7% of 464 playback transects) in 2010, and 40.8% of 2342 point counts (and 48.9% of 472 playback transects) in 2011, with detections on all 10 national forests all three years (Ibid). The average abundance (number of individuals recorded on passive point count surveys) was 0.103 in 2009, 0.081 in 2010, and 0.078 in 2011. These data indicate that mountain quail continue to be distributed across the 10 Sierra Nevada National Forests, and current data indicate that the mountain quail population continues to be distributed at established sample sites across the Sierra Nevada (USDA Forest Service 2010a).

Forest -specific population distribution data: Bioregional monitoring for Sierra Nevada MIS includes sample points on the LTBMU; mountain quail were detected at 4 of 10 upland point count stations in 2009, 6 of 8 upland point count stations in 2010, and 6 of 20 upland point count stations in 2011, in addition to detections at the riparian point count stations in 2010 and 2011 (Point Blue Conservation Science [date unk]). In addition, mountain quail were detected at 62 of 105 forest wide monitoring sites on the LTBMU, and were detected in all sub-watersheds between 2002-2005 (LTBMU 2007a).

Late Seral Open Canopy Coniferous Forest Habitat [Sooty (blue) grouse]

Reason for selection as an MIS

The sooty grouse (formally known as the blue grouse) is selected as the MIS for late seral open canopy coniferous forest (ponderosa pine, Sierran mixed conifer, white fir, red fir, and eastside pine) habitat. This habitat is comprised primarily of medium/large trees (equal to or greater than 24 inches dbh) with canopy closures less than 40%. The CWHR system indicates that sooty grouse is highly associated with this habitat. This species occurs in open, medium to mature-aged stands of fir, Douglas-fir, and other conifer habitats, interspersed with medium to large openings, and available water, and occupies a mixture of mature habitat types, shrubs, forbs, grasses, and conifer stands (CDFG 2005). Empirical data from the Sierra Nevada indicate that Sooty Grouse hooting sites are located in open, mature, fir-dominated forest, where particularly large trees are present (Bland 2006). Sooty Grouse is being monitored by California Department of Fish and Game as part of its program to manage harvest species (Bland 2006), as well as through the Breeding Bird Survey (BBS) (Siegel and DeSante 1999, Sauer et al. 2007).

Sierra Nevada Bioregional Status and Trend

Habitat. Bioregional monitoring for Sierra Nevada MIS to date is summarized in the 2010 Sierra Nevada Forests Bioregional MIS Report (USDA Forest Service 2010a). There are currently 63,795 acres of late seral open canopy coniferous forest (ponderosa pine, Sierran mixed conifer, white fir, red fir, and eastside pine) habitat on NFS lands in the Sierra Nevada. Over the last two decades, the trend is decreasing (changing from 3% to 1% of the acres on NFS lands).

Forest-specific habitat data: There are approximately 20,500 acres of late seral open canopy habitat on the LTBMU (see Table 3-40 in section 3.4.11 Forest Vegetation). This estimate was revised from the DEIS to be more consistent with SPECTRUM modeling data sources and output. Please see section 3.4.11 Forest Vegetation for additional explanation of acreage calculation. The CWHR types defining early and mid seral habitat for the LTBMU include Jeffrey pine, white fir/mixed conifer, and red fir. These types differ slightly from the CWHR types provided in Table 3-49 in that Jeffrey pine is used instead of ponderosa pine because there is very little ponderosa pine in the LTBMU. Jeffrey pine category includes east side pine. White fir/mixed conifer is used to represent white fir and Sierra mixed conifer CWHR types; the white fir/mixed conifer combined types are very similar to white fir and Sierra mixed conifer CWHR types but the LTBMU generally does not have Douglas fir and Black oak which are characteristic of Sierra mixed conifer in lower elevations. As with mid seral habitat, late seral open canopy habitat is dominated by white fire/mixed conifer.

P**opulation Distribution.** Bioregional monitoring for Sierra Nevada MIS to date is summarized in the 2010 Sierra Nevada Forests Bioregional MIS Report (USDA Forest Service 2010a). The sooty grouse has been monitored in the Sierra Nevada at various sample locations by hunter survey, modeling, point counts, and breeding bird survey protocols, including California Department of Fish and Wildlife (formerly California Department of Fish and Game) Blue (Sooty) Grouse Surveys (Bland 1993, 1997, 2002, 2006); California Department of Fish and Wildlife hunter survey, modeling, and hunting regulations assessment (CDFG 2004a, CDFG 2004b); Multi-species inventory and monitoring on the LTBMU (LTBMU 2007a); and 1968 to present – BBS routes throughout the Sierra Nevada (Sauer et al. 2007). These data indicate that sooty grouse population continues to be present across the Sierra Nevada, except in the area south of the Kern Gap where they are apparently absent (Bland 2008 referencing Bland in press). Sooty (blue) grouse continue to be detected and bagged through hunting across the Sierra Nevada (CDFW 2004b). In addition, modeling based on game take survey and habitat acres indicates that the spring breeding population can more than sustain the total annual mortality, including hunting mortality (CDFW 2004a). Blue or sooty grouse have continued to be detected on BBS routes in the Sierra Nevada (Sauer et al. 2007). As of 1999, BBS data indicate an increasing tendency (Siegel and DeSante 1999).

Forest-specific population distribution data: Monitoring conducted by the California Department of Fish and Game related to hunter surveys, modeling, and hunting regulations assessment includes the LTBMU (CDFG 2004a, 2004b). In addition, sooty grouse (also known as blue grouse) were detected at 32 of 105 forest wide monitoring sites and 10 of 148 lentic sites (17% of all combined sites) on the LTBMU, and were detected in all sub-watersheds, between 2002-2005 (LTBMU 2007a).

Late Seral Closed Canopy Coniferous Forest Habitat (California spotted owl, Pacific marten, and northern flying squirrel)

Reasons for selection as an MIS

California spotted owl

The California spotted owl is selected as an MIS for late seral closed canopy coniferous forest (ponderosa pine, Sierran mixed conifer, white fir, and red fir) habitat. The CWHR system and various data from the

Sierra Nevada (USDA Forest Service 2001) indicate that this species is highly associated with closed-canopy late seral coniferous forest. This habitat is comprised primarily of medium/large trees (equal to or greater than 24 inches dbh) with canopy closures above 40% within ponderosa pine, Sierran mixed conifer, white fir, and red fir coniferous forests, and multi-layered trees within ponderosa pine and Sierran mixed conifer forests. The California spotted owl is strongly associated with forests that have a complex multi-layered structure, large-diameter trees, and high canopy closure (CDFG 2005, USFWS 2006). It uses dense, multi-layered canopy cover for roost seclusion; roost selection appears to be related closely to thermoregulatory needs, and the species appears to be intolerant of high temperatures (CDFG 2005). Mature, multi-layered forest stands are required for breeding. The mixed-conifer forest type is the predominant type used by spotted owls in the Sierra Nevada: about 80 percent of known sites are found in mixed-conifer forest, with 10 percent in red fir forest (USDA Forest Service 2001). California spotted owl has been monitored in the Sierra Nevada since the late 1980s (USDA Forest Service 2006a), and, since 2009, the monitoring has been tracked as part of the Sierra Nevada Forests bioregional monitoring (USDA Forest Service 2010a).

Pacific marten

The Pacific marten is selected as an MIS for late seral closed canopy coniferous forest (ponderosa pine, Sierran mixed conifer, white fir, and red fir) habitat. The CWHR system and various data from the Sierra Nevada (USDA Forest Service 2001) indicate that this species is highly associated with closed-canopy, late seral coniferous forest. This habitat is comprised primarily of medium/large trees (equal to or greater than 24 inches dbh) with canopy closures above 40% within ponderosa pine, Sierran mixed conifer, white fir, and red fir coniferous forests, and multi-layered trees within ponderosa pine and Sierran mixed conifer forests. Martens prefer coniferous forest habitat with large diameter trees and snags, large down logs, moderate-to-high canopy closure, and an interspersion of riparian areas and meadows. Important habitat attributes are: vegetative diversity, with predominately mature forest; snags; dispersal cover; and large woody debris (Allen 1982). Key components for westside and eastside marten habitat can be found in the Sierra Nevada Forest Plan Amendment FEIS (USDA Forest Service 2001), Volume 3, Chapter 3, part 4.4, pages 20-21. The Pacific marten has been monitored since 2002 as part of the Sierra Nevada Forest Plan Fisher and Marten Status and Trend Monitoring, and, since 2009, the monitoring has been tracked as part of the Sierra Nevada Forests bioregional monitoring (USDA Forest Service 2010a).

Northern flying squirrel

The northern flying squirrel is selected as an MIS for late seral closed canopy coniferous forest (ponderosa pine, Sierran mixed conifer, white fir, and red fir) habitat.

The CWHR system indicates that this species is highly associated with closed-canopy, late seral coniferous forest. This habitat is comprised primarily of medium/large trees (equal to or greater than 24 inches dbh) with canopy closures above 40% within ponderosa pine, Sierran mixed conifer, white fir, and red fir coniferous forests, and multi-layered trees within ponderosa pine and Sierran mixed conifer forests. The northern flying squirrel occurs primarily in mature, dense conifer habitats intermixed with various riparian habitats, using cavities in mature trees, snags, or logs for cover (CDFG 2005).

Sierra Nevada Bioregional Status and Trend

Habitat. Bioregional monitoring for Sierra Nevada MIS to date is summarized in the 2010 Sierra Nevada Forests Bioregional MIS Report (USDA Forest Service 2010a). There are currently 1,006,923 acres of late seral closed canopy coniferous forest (ponderosa pine, Sierran mixed conifer, white fir, and red fir) habitat on NFS lands in the Sierra Nevada. Over the last two decades, the trend is slightly increasing (changing from 7% to 9% of the acres on NFS lands); since the early 2000s, the trend has been stable at 9%.

Forest-specific habitat data: There are approximately 29,000 acres of late seral closed canopy habitat on the LTBMU (see Table 3-40 in section 3.4.11 Forest Vegetation). This estimate was revised from the DEIS to be more consistent with SPECTRUM modeling data sources and output. Please see section 3.4.11 Forest Vegetation for additional explanation of acreage calculation. The CWHR types defining early and mid seral habitat for the LTBMU include Jeffrey pine, white fir/mixed conifer, and red fir. These types differ slightly from the CWHR types provided in Table 3-49 in that Jeffrey pine is used instead of ponderosa pine because there is very little ponderosa pine in the LTBMU. Jeffrey pine category includes east side pine. White fir/mixed conifer is used to represent white fir and Sierra mixed conifer CWHR types; the white fir/mixed conifer combined types are very similar to white fir and Sierra mixed conifer CWHR types but the LTBMU generally does not have Douglas fir and Black oak which are characteristic of Sierra mixed conifer in lower elevations. Late seral closed canopy habitat is comprised primarily of white fir/mixed conifer and red fir types. Jeffrey pine represents many fewer acres of this seral stage in the LTBMU.

Population Distribution. Bioregional monitoring for Sierra Nevada MIS to date is summarized in the 2010 Sierra Nevada Forests Bioregional MIS Report (USDA Forest Service 2010a).

California spotted owl

California spotted owl has been monitored in California and throughout the Sierra Nevada through general surveys, monitoring of nests and territorial birds, and demography studies (Verner et al. 1992; Gutiérrez et al. 2008, 2009, 2010; USDA Forest Service 2001, 2004, 2006; USFWS 2006; Sierra Nevada Research Center 2007, 2008, 2009, 2010). A meta-analysis of data from 1990 to 2005 for the four spotted owl populations in the demography study areas (Eldorado NF, Lassen NF, Sierra NF, and Sequoia-Kings Canyon National Park) concluded that, with the exception of the Lassen study area, owl populations were stable, with adult survival rate highest at the Sequoia-Kings Canyon study site (Blakesley et al. 2010). The 95% confidence limit for lambda in the Lassen study area ranged from 0.946 to 1.001 (estimated value 0.973), which barely included 1, and the analysis estimated a steady annual decline of 2 – 3% in the Lassen study population between 1990 and 2005 (Blakesley et al. 2010). More recent analyses from the same four demography study areas suggest a decline in the owl populations in the Lassen, Sierra, and Eldorado National Forest study areas and an increase in owl populations in the Sequoia-Kings Canyon National Park study area. However, all estimators of population change in these studies had confidence intervals that overlapped 1.0 (Conner et al. 2013, Tempel and Gutiérrez 2013). The 95% confidence interval represents the reliability of the estimate of lambda (annual rate of population change) and delta (realized population change). Managers typically view a population as stable if the 95% confidence interval overlaps a lambda of one. As stated in Conner et al. (2013) “If a population is growing (lambda greater than 1), managers cannot tell whether the growth is from internal recruitment or immigration. Likewise, if a population is declining, managers cannot determine whether the declines are due to deaths within the population or emigration. Thus, additional information on specific vital rates is necessary to understand what is driving lambda and ultimately, the mechanisms driving population dynamics.” Therefore, although there is concern that there may be localized declines in the spotted owl populations, the confidence intervals overlapping one (1) makes it difficult to assess the probability of a decline. Causation for any potential decline in occupancy is unknown. Owls continue to be distributed throughout their existing geographic range. For more detailed information regarding the regional status of the spotted owl, please see section 3.4.23, Terrestrial Wildlife Species and Habitat.

Forest-specific population distribution data: There are currently 22 California spotted owl PACs (and associated HRCAs) on the LTBMU, following a re-mapping effort in 2008 to incorporate the most up-to-date detection, nest location, and land boundary information available. One PAC was added in 2013 following an assessment of new nesting behavior during the 2012 season. During the last 10 years (2003-2012), spotted owls have been detected in 16 (76%) of the 21 PACs that were monitored during this time (excludes the PAC added in 2013). Data for California spotted owl found in the LTBMU are stored on the

USDA Natural Resource Manager Natural Resource Information System (NRM NRIS) (http://fsweb.nris.fs.fed.us/products/Wildlife/index.shtml). For more detailed information regarding the local status of the spotted owl, please see section 3.4.23, Terrestrial Wildlife Species and Habitat.

Pacific marten

Pacific marten has been monitored throughout the Sierra Nevada as part of general surveys and studies since 1996 (e.g., Zielinski et al. 2005, Moriarty 2009). Since 2002, the Pacific marten has been monitored on the Sierra Nevada forests as part of the Sierra Nevada Forest Plan Amendment (SNFPA) monitoring plan (USDA Forest Service 2005a, 2006a, 2007c, 2009, 2010b). Current data indicate that, although marten appear to be distributed throughout their historic range, their distribution has become fragmented in the southern Cascades and northern Sierra Nevada, particularly in Plumas County. The distribution appears to be continuous across high-elevation forests from Placer County south through the southern end of the Sierra Nevada, although detection rates have decreased in at least some localized areas (e.g., Sagehen Basin area of Nevada County). For more detailed information regarding the regional status of marten and their habitat, please see section 3.4.23, Terrestrial Wildlife Species and Habitat.

Forest-specific population distribution data: Within the LTBMU, marten appear to be well distributed in the western and southern portions but are comparatively rare in the northern and eastern portions (Slauson et al. 2008). Slauson et al. (2008) analyzed data from several marten surveys that were conducted in the LTBMU between 1993 and 2005 and found that marten were detected at 36% of all sample units that were surveyed, occupying areas supporting mesic conifer forest typically dominated by red fir, white fir, western white pine, and lodgepole pine (Slauson et al. 2008). The majority of detections were made in the western (50% of sites) and southern (31% of sites) regions of the LTBMU. Detections in the northern and eastern portions of the LTBMU were scarce despite 30% of the total survey effort occurring in these two areas, and the authors suggested that these areas may have supported less suitable habitat conditions (e.g., open canopy) due to drier conditions and also likely influenced by the development that has altered the composition and connectivity of suitable habitat along the transition from mesic to xeric forest types from west to east in the LTBMU (Slauson et al. 2008). Due to the contemporary development patterns on the southern end of the LTBMU combined with natural factors, the southern distribution of martens in the LTBMU is most likely a peninsular distribution, extending from the southwest (Luther Pass area) where martens are likely able to move in and out the southern portion of the LTBMU. This peninsular distribution in the south portion of the LTBMU has no potential for input of martens from the north, south, or east due to the lack of suitable habitat combined with the substantial level of development that has occurred. Peninsular distributions of martens are more reliant on the existing conditions within their distribution to support their persistence than portions of the distribution better connected, such as the west shore population.

Slauson et al. (2008) stressed the importance of the west shore as the only known linkage for populations north and south of the LTBMU. Recent modeling suggests that the west shore of Lake Tahoe is part of an important corridor linking northern and southern populations (Spencer and Rustigian-Romsos 2012). Consistent with Slauson et al. (2008), there is a gap in marten occupancy and habitat just west of the LTBMU but suitability increases again just west of this gap, creating another parallel habitat corridor (Spencer and Rustigian-Romsos 2012) that may not have been identified in Slauson et al. (2008).

Two marten dens have been positively identified in the LTBMU with a third possible, although there are likely greater than 30 breeding females in the LTBMU in any given year, each using many dens for kit rearing (Slauson, pers. comm. 2011). All known/possible dens were discovered opportunistically in 2009 and 2012 and are predominantly on the west and southern portion of the LTBMU. One den that was positively identified in 2012 is located at an elevation of approximately 6650 feet and within the CWHR Jeffrey Pine type, class 5M. The den identified in 2009 is located at an elevation of approximately 6560 feet and within the CWHR Sierra Mixed Conifer type, class 4M. Table 1 in Moriarty et al. (2011)

indicates that various 4M habitat types (lodgepole pine, montane riparian, red fir, subalpine conifer, and white fir) are considered “high quality habitat” for marten. CWHR also classifies some 4M habitat as high quality denning habitat for marten.

Preliminary data from a study of marten in the Lake Tahoe Basin suggest that areas used by females for reproduction were stable and did not change annually which suggests that reproductive habitat is a limiting factor for marten populations (Slauson and Zielinski unpublished data). Thus the maintenance of existing suitable reproductive habitat is one of the most critical factors for maintaining marten populations and distributions.

Northern flying squirrel

The northern flying squirrel has been monitored in the Sierra Nevada at various sample locations by live-trapping, ear-tagging, camera surveys, snap-trapping, and radiotelemetry: 2002-present on the Plumas and Lassen National Forests (Sierra Nevada Research Center 2007, 2008, 2009, 2010), and 1958-2004 throughout the Sierra Nevada in various monitoring efforts and studies (see USDA Forest Service 2008d, Table NOFLS-IV-1). These data indicate that northern flying squirrels continue to be present at these sample sites, and current data indicate that northern flying squirrel populations are still widely distributed across the Sierra Nevada.

Forest-specific population distribution data: Northern flying squirrel were detected at 17 of 105 small mammal live trapping surveys on the LTBMU, and were detected in 6 of 9 sub-watersheds, between 2002-2005 (LTBMU 2007a).

Snags in Green Forest Ecosystem Component (Hairy woodpecker)

Reason for selection as an MIS

The hairy woodpecker is selected as the MIS for the ecosystem component of snags in green forests. The CWHR system indicates that this species is strongly associated with this ecosystem component. Medium (diameter breast height between 15 to 30 inches) and large (diameter breast height greater than 30 inches) snags are most important. The hairy woodpecker uses stands of large, mature trees and snags of sparse to intermediate density; cover is also provided by tree cavities (CDFG 2005). Mature timber and dead snags or trees of moderate to large size are apparently more important than tree species (Siegel and DeSante 1999). Historically, the hairy woodpecker has been monitored by the USGS’s the Breeding Bird Survey (BBS) (Sauer et al. 2007) and adequate data has been obtained for calculating Sierra-wide BBS trends (Siegel and DeSante 1999), as well as monitoring on the Plumas and Lassen National Forests (Sierra Nevada Research Center 2010). Since 2009, this species has been monitored as part of the Sierra Nevada Forests bioregional monitoring (USDA Forest Service 2010a).

Sierra Nevada Bioregional Status and Trend

Ecosystem Component

Bioregional monitoring for Sierra Nevada MIS to date is summarized in the 2010 Sierra Nevada Forests Bioregional MIS Report (USDA Forest Service 2010a). The current average number of medium-sized and large-sized snags (> 15" dbh, all decay classes) per acre across major coniferous and hardwood forest types (westside mixed conifer, ponderosa pine, white fir, productive hardwoods, red fir, eastside pine) in the Sierra Nevada ranges from 1.5 per acre in eastside pine to 9.1 per acre in white fir. In 2008, snags in these types ranged from 1.4 per acre in eastside pine to 8.3 per acre in white fir (USDA Forest Service 2008).

Data from the early-to-mid 2000s were compared with the current data to calculate the trend in total snags per acre by Regional forest type for the 10 Sierra Nevada national forests and indicate that, during this period, snags per acre increased within westside mixed conifer (+0.76), white fir (+2.66), productive hardwoods (+0.35), and red fir (+1.25) and decreased within ponderosa pine (-0.16) and eastside pine (-0.14)

Detailed information by forest type, snag size, and snag decay class can be found in the 2010 SNF Bioregional MIS Report (USDA Forest Service 2010a).

Forest-specific ecosystem component data: There are approximately 1.1 million snags greater than 15 inches dbh in the LTBMU with an average of about 7.15 snags/acre. Of the total snag count, approximately 850,000 are estimated to be snags in green forest. Total number of snags was derived by obtaining snags/acre Geographic Information Systems (GIS) data for each stratum from the USDA Forest Service Remote Sensing Lab (RSL) website Tree Report for the Lake Tahoe Basin and linking with the LTBMU GIS strata layer and acreage within each stratum on the LTBMU. The highest number of snags/acre is found in the mixed conifer-white fir and Jeffrey pine medium size class 920-30 inches QMD), medium density (40-70%). The mixed conifer-white fir type has the highest total number of snags, in part because this habitat type has the largest acreage in the LTBMU.

Population Distribution. Bioregional monitoring for Sierra Nevada MIS to date is summarized in the 2010 Sierra Nevada Forests Bioregional MIS Report (USDA Forest Service 2010a). Monitoring of the hairy woodpecker across the ten National Forests in the Sierra Nevada has been conducted since 2009 in partnership with PRBO Conservation Science, as part of a monitoring effort that also includes mountain quail, fox sparrow, and yellow warbler (USDA Forest Service 2010a, http://data.prbo.org/partners/usfs/snmis/). Hairy woodpeckers were detected on 15.1% of 1659 point counts in 2009, 16.7% of 2266 point counts (and 28.6% of462 playback transects) in 2010, and 11.8% of 2342 point counts (and 23.5% of 472 playback transects) in 2011, with detections on all 10 national forests in all years. The average abundance (number of individuals recorded on passive point count surveys) was 0.116 in 2009, 0.107 in 2010, and 0.100 in 2011. These data indicate that hairy woodpeckers continue to be distributed across the 10 Sierra Nevada National Forests.

Forest-specific population distribution data: Bioregional monitoring for Sierra Nevada MIS includes sample points on the LTBMU; hairy woodpecker were detected at 5 of 10 upland point count stations in 2009, 1 of 8 upland point count stations in 2010, and 5 of 20 upland point count stations in 2011, in addition to detections at the riparian point count stations in 2010 and 2011 (Point Blue Conservation Science 2013)

In addition, hairy woodpecker were detected at 75 of 105 forest wide monitoring sites on the LTBMU, and were detected in all sub-watersheds, between 2002-2005 (LTBMU 2007a).

Snags in Burned Forest Ecosystem Component (Black-backed woodpecker)

Reason for selection as an MIS

The black-backed woodpecker is selected as the MIS for the ecosystem component of snags in burned forests. Recent data indicate that black-backed woodpeckers are strongly associated with snags created by mid- and high-severity fires (severity classes indicating moderate to complete mortality of the tree layer) (Hutto 1995, Kotliar et al. 2002, Smucker et al. 2005, Saracco et al. 2011, Siegel et al. 2011), although some birds also forage in unburned forest (Fogg et al. 2012, Siegel et al. 2013). In a telemetry study, Siegel et al. (2013) found a strong negative relationship between average snag basal area density and home range, and a positive relationship between average live tree basal area density and home range size. Black-backed woodpecker nests are typically in snags, but in unburned forests can also be in living trees, including dead portions of live trees (Bond et al. 2012).

Sierra Nevada Bioregional Status and Trend

Ecosystem Component

Bioregional monitoring for Sierra Nevada MIS to date is summarized in the 2010 Sierra Nevada Forests Bioregional MIS Report (USDA Forest Service 2010a). The current average number of medium-sized and large-sized snags (> 15" dbh, all decay classes) per acre across major coniferous and hardwood forest types (westside mixed conifer, ponderosa pine, white fir, productive hardwoods, red fir, eastside pine) in the Sierra Nevada ranges from 1.5 per acre in eastside pine to 9.1 per acre in white fir. In 2008, snags in these forest types ranged from 1.4 per acre in eastside pine to 8.3 per acre in white fir (USDA Forest Service 2008).

Data from the early-to-mid 2000s were compared with the current data to calculate the trend in total snags per acre by Regional forest type for the 10 Sierra Nevada national forests and indicate that, during this period, snags per acre increased within westside mixed conifer (+0.76), white fir (+2.66), productive hardwoods (+0.35), and red fir (+1.25) and decreased within ponderosa pine (-0.16) and eastside pine (-0.14).

Detailed information by forest type, snag size, and snag decay class can be found in the 2010 SNF Bioregional MIS Report (USDA Forest Service 2010a).

These data include snags in both green forest and burned forest. Between 2000 and 2007, 211,000 acres underwent severe burn and 176,000 acres underwent moderate burn in the Sierra Nevada.

Since 2009, the bioregional monitoring effort for black-backed woodpecker has created a sampling frame of all fires that occurred within the 10 preceding years that included at least 124ac (50 ha) of conifer forest that burned at mid-severity and/or high-severity on one or more of the ten national forest units within the Sierra Nevada. The acreage within this sampling frame was 271,788 ac in 2009, 252,673 ac in 2010, and 543,917 ac in 2011.

Forest-specific ecosystem component data: Over the last 10 years, approximately 4500 acres have burned from wildfire in the LTBMU. Current wildfire severity monitoring studies in mixed conifer forests in the northern and central Sierra Nevada (USDA 2008) indicate that fires greater than 300 acres in mixed conifer forest under current conditions burn at severity proportions of 24% low severity (>40% mortality), 29% moderate severity (40-80% mortality) and 37% high severity (>80% mortality). We estimated the number of snags in burned forest based on the total number of snags estimated to be in the LTBMU (1.1 million), the assumptions for fire severity and mortality described above, and the assumption that the average stand in the LTBMU has approximately 100 trees/acre that are greater than 15 inches diameter-at-breast-height (dbh). Approximately 750 acres (approximately 24% of total burned area) of forest burned from the Angora fire have had most of the snags removed so this area does not have the same level of standing snags as other burned areas. Based on these assumptions, total estimated number of snags in burned forest in the LTBMU is 246,000.

Population Distribution. Monitoring of the Black-backed Woodpecker across the 10 National Forests in the Sierra Nevada has been conducted in partnership with The Institute for Bird Populations (IBP) (Forest Service 2010a, IBP 2002). The project began with a pilot study in 2008 (Siegel et al. 2008) and has subsequently been implemented fully in 2009-2012 (Siegel et al. 2010, 2011, 2012, and *in preparation*). Surveys of randomly selected fire areas 1-10 years post-fire have generally yielded Black-backed Woodpecker detections at around half (min = 48% in 2011; max = 75% in 2012) of the fires surveyed, and around 20% of the individual survey points surveyed (Table 3-51). During the years of full survey implementation (2009-2012), Black-backed Woodpeckers were detected in fire areas on all ten National Forest units surveyed in 2011 and 2012, and on all National Forest units surveyed except for Sierra National Forest in 2009 and 2010. These data indicate a stable population distribution in the Sierra

Nevada in which black-backed woodpeckers continue to be distributed across the 10 National Forests in the study area (ranging from the Modoc National Forest in the north to the Sequoia National Forest to the south).

Table 3 51. Number of surveyed fires with Black-backed Woodpecker detections, points surveyed[1]

Year	No. of Fires Surveyed	No. (Percent) of Fires with Black-backed Woodpecker Detections	No. of Points Surveyed	No. (Percent) of Points with Black-backed Woodpecker Detections
2008[1]	19	10 (53%)	371	68 (18%)
2009	51	28 (55%)	899	169 (19%)
2010	49	29 (59%)	860	132 (15%)
2011	50	24 (48%)	895	148 (17%)
2012	52	39 (75%)	953	207 (23%)

[1] (Each point with a transect of 10-20 survey points), and points with Black-backed Woodpecker detections during each year of MIS surveys for black-backed woodpecker.

[2] Pilot study in which methods differed slightly from methods in subsequent years.

Forest-specific population distribution data: Bioregional monitoring for Sierra Nevada MIS includes sample points on the LTBMU; black-backed woodpecker were detected within 3 of 3 surveyed fire areas (Angora, Gondola, and Showers) in both 2009 and 2010 and within 1 of 1 surveyed fire area (Angora) in 2011, and within 3 of 3 surveyed fire areas in 2012 (Angora, Gondola, and Showers) (IBP 2002, Siegel, pers. comm). Black-backed woodpeckers were also detected at the following LTBMU sites during the green forest MIS bird monitoring conducted by PRBO: 6 of 15 upland points in 2009 (no riparian sites were visited), 1 of 16 riparian points in 2010 but zero of 20 upland points, 3 of 20 upland points in 2011 but zero of 16 riparian points, and 3 of 20 upland points but zero of 16 riparian points in 2012. All upland detections were on the TB01A or TB01B transects which are within approximately 1km of the Angora Fire perimeter (Point Blue Conservation Science 2013; Roberts 2013).

Black-backed woodpeckers were also detected at the following LTBMU sites during the green forest MIS bird monitoring: 6 of 10 upland sites in 2009, 1 of 15 riparian sites in 2010, and 3 of 20 upland sites in 2011 (http://data.prbo.org/partners/usfs/snmis/). At the Angora Fire, 15 Black-backed Woodpecker nests were found in 2009 and 24 nests were found in 2010 by PSW researchers (Manley and Tarbill, 2012).

3.4.14.3. Environmental Consequences

This section evaluates the planning alternatives of the Lake Tahoe Basin Management Unit Land and Resources Management Plan in terms of both amount (range of percent change) and quality of habitat and of animal population trends of the MIS, and documents the effects of the planning alternatives on the habitats of the MIS, as required by the 1982 Planning Rule (1982: 36 CFR 219.19(a)(1)). Descriptions of the Forest Plan alternatives are found in Chapter 2.

Effects are described at the scale of the LTBMU and are based on an evaluation of the proposed management activities that differ under each alternative. Effects are not evaluated for actions that are not directly associated with management direction. For example, the evaluation of effects to snags in green forest does not include effects from hazard tree removal which is not part of direct management activities.

The SPECTRUM model was used to estimate trends towards achieving desired conditions for forest health and fuel reduction management under the five alternatives over a fifty year period after Plan implementation. A description of the model, including assumptions, applicability, and limitations, can be found in the section *3.4.11* (*Forest Vegetation*). It should be noted that the model was designed to meet the desired conditions of forest health and fuel reduction management and not to create wildlife habitat or evaluate condition or trends of wildlife habitat. For example, the model was provided with minimal information regarding wildlife habitat, only locations and restrictions on treatments in spotted owl and goshawk Protected Activity Centers (PACs) and spotted owl Home Range Core Areas (HRCAs). The model did not contain any other guiding parameters for wildlife habitat such as standards and guidelines related to the protection of den locations, nest locations for other bird species, connectivity of late seral habitat, or any other more qualitative guiding principal under each alternative. Furthermore, habitat associations and analysis of effects for terrestrial wildlife are based on CWHR classification which defines "open" canopy as S (10-24% canopy closure) and P (25-39% canopy closure), and "closed" canopy as M (40-59% canopy closure) and D (>60% canopy closure) but the model parameters differ from this definition for "open" canopy in the white fir and red fir forest types which is defined as <50% canopy closure, a 10 percent difference (*see* Forest Plan Table 1, located after the Forest Vegetation, Fuels, and Fire Management Desired Conditions. We don't anticipate this difference to significantly alter our interpretation of model output at the level of the Forest Plan but some late and mid seral open habitat may actually be considered closed (40-50% canopy closure) according to CWHR classification of wildlife habitat. Most importantly, the SPECTRUM model does not use an adaptive management framework which would serve as the cornerstone of the management approach under any alternative. Therefore, although the model results are described in this section as they would relate to trends in terrestrial wildlife habitat interpretations of model output should be made with caution.

Percent changes in seral stages predicted by the model for all alternative are categorized as: No change (0-10 percent change); or Increase or Decrease that is either Slight (11-20 percent change), Moderate (21-50 percent change), or Substantial (>50 percent change). These categories were selected to express predicted trends because there are a variety of limiting factors (e.g., den/nest locations, habitat connectivity, climate change) that would influence prescriptions and treatment decisions that are not incorporated into the model. Therefore, by using a range, we have conservatively estimated modeled predicted change.

Lacustrine/Riverine Habitat (Aquatic Macroinvertebrates)

Alternative A

Direct and Indirect Effects to Habitat

The acres of lacustrine and miles of riverine habitat are not expected to change over the next 15-20 years across the five Plan alternatives and all alternatives contain the same objectives to maintain and improve the habitat quality.

It is expected that lacustrine and riverine habitat quality would remain stable or improve over time given the emphasis of this alternative to protect and conserve aquatic habitat. Alternative A would continue to recognize the need and importance of healthy watersheds, stable stream channels, as well as the critical role of SEZs for their contribution to local water quality and lake clarity goals. This alternative would continue to recognize that activities adjacent to SEZs have the potential to deliver sediment to stream channels. Restoration of streams and related watershed processes is primarily linked to decreasing or eliminating sediment sources (stream banks, roads, and other infrastructure) and other non-point pollution sources with improving aquatic habitat conditions as secondary goals. The highest priority if a conflict in management would occur was given to 'the protection of water quality and the enhancement of the clarity of water in Lake Tahoe." The benefits of this work would be measured through assessments of watershed

and stream channel condition, and contributions to achieving total maximum daily load (TMDL) milestones.

Habitat quality could be impacted by a variety of management activities as well as legacy impacts from past land uses (e.g., grazing, water diversions) that have not been repaired. Vegetation resources management techniques under all alternatives pose some level of short term risk of soil erosion and subsequent impacts to water quality. These risks will be managed by a variety of established BMPs, and the standards and guidelines. BMPS and standards and guidelines are "measures to mitigate adverse effects" under all alternatives. Vegetation management activities will not adversely affect current 303d listings, or impact the forests ability to achieve TMDL milestones for upland source areas. The most significant risk to water quality as it relates to vegetation management practices are those associated with both permanent and temporary roads utilized as part of vegetation management projects. This is because roads can create linear conduits for concentrating flows and eroded sediments, if BMPS are not properly implemented and maintained.

Although there are currently no active allotments on the LTBMU, livestock grazing is considered a suitable use and often impacts stream, wetland and meadow form and function within a designated allotment. Livestock grazing has been known to widen channels, reducing the amount of pool habitat and raising water temperatures thus reducing dissolved oxygen (Hubert et al. 1984, Stuber 1985). These alterations in channel form and function reduce spawning habitat for aquatic organisms.

Alternative A allows for approximately 10% expansion of developed recreation sites, overnight accommodation units, and parking spaces. Alternative A also identifies a number of site-specific areas where recreation facilities could be expanded and new recreation facilities could be developed based on direction from the 1988 LTBMU Forest Plan (as amended). If pursued, new facilities, such as a new boat launch facility, or increased recreation activity pose high potential for both expansion of existing AIS and new introductions where developed recreation sites expand and provide direct/indirect access to waterbodies. Both water quality and biological communities are impacted by AIS.

For example, Asian clams, which are established in Lake Tahoe: 1) excrete elevated levels of nitrogen and phosphorus into the water at the lake-sediment interface where they reside, 2) filter high volumes of water (Way et al. 1990), and 3) are strongly correlated with algal growth, and 4) are an actively reproducing community in Lake Tahoe—producing at least two cohorts per season. Potential impacts include increases in benthic algal blooms, the decline of phytoplankton and zooplankton communities, degradation of aesthetic and recreational beach use through excess shell material deposition, disruption to Lake Tahoe fishes, increased levels of calcium through the concentration of dead shell matter with a promotion of other regional exotic species (e.g., the quagga mussel 2 *Dreissena rostriformis bugensis*), and out-competing Tahoe's native benthic invertebrates such as the Montane Pea clam (*Pisidium* spp.) and the Ramshorn snail (Planorbidae). Additionally, dense Eurasian watermilfoil mats alter water quality by raising pH, decreasing oxygen under the mats, and increasing temperature (Whittman et al. 2008).

Although newly established or expanded recreation infrastructure could contribute to increased potential for AIS establishment, other potential consequences of recreation expansion on soil erosion and water quality would be minimized through established standards and guidelines and BMPs. These measures would be part of any proposed changes in recreation infrastructure as well as roads, trails, and associated access facilities. In addition, the LTBMU will continue to pursue opportunities to either retrofit, relocate, or decommission roads and trails to reduce potential sediment and nutrient loading to Lake Tahoe, as part of the Uplands Forest TMDL management strategy.

The trend in aquatic macroinvertebrate species populations is expected to remain stable or improve where lacustrine and riverine habitat would be improved through restoration activities. However, the trend in

macroinvertebrates could be impacted where AIS transference occurred (primarily due to increased recreation infrastructure and activities) and where livestock grazing was permitted.

Alternative B

This alternative does not differ substantially in actions that would have anticipated effects on lacustrine and riverine habitat nor in the strategies, objectives, and standard and guidelines proposed except there is less potential for recreation expansion. Therefore, effects to habitat quality, quantity, and trend in macroinvertebrate species populations are similar to those described under Alternative B but at a level less than Alternative A because of the reduced potential for recreation expansion (and potential for AIS invasion and expansion).

Alternative C

Lacustrine/riverine habitat quality and trend in macroinvertebrate species populations are expected to remain stable or improve under this alternative. However, habitat quality and the trend in macroinvertebrates could be impacted where grazing is permitted, legacy impacts from past land use practices are allowed to persist, as recreation infrastructure is permitted to expand at a level greater than the other alternatives, and as miles of road open to passenger vehicles increases, which includes a combination of native, graveled, and paved surfaces. Where roads are paved, surface runoff of substances such as motor oil, gasoline, heavy metals, as well as toxic substance used in de-icing programs has the potential to reach aquatic habitats (Noss, 1995). However, an aggressive BMP retrofit program has disconnected most roads from stream channels. The recommendation for wilderness designation of Dardanelles Inventoried Roadless Area under Alternative C could result in limitations on any future watershed restoration activities that would involve the use of mechanical equipment.

Alternative D

Under Alternative D, additional future projects would not be planned to actively restore degraded stream channels. Some implementation of the National Watershed Improvement Program would occur, through removal of existing active stressors on these systems (such as poorly designed stream channel crossings or hydrologic diversions). However systems that are out of equilibrium (as exhibited by headcuts, incision, accelerated bank erosion) as a result of past land use practices, climate change or other stressors not under the control of the USFS management, would be allowed to adjust through natural processes. Therefore, the quality of lacustrine and riverine habitat would improve where currently planned restoration projects are implemented and various stressors are removed but quality could decline where natural processes are not sufficient to maintain or improve habitat quality due to legacy impacts from past land use practices, permitted grazing activities, and spread of AIS where removal focuses only on high priority species.

Currently planned USFS stream channel and watershed improvement restoration projects are expected to be achieved within the next 15-20 years, and the benefits of this work measured through assessments of watershed and stream channel condition, and contributions to achieving TMDL milestones. However under Alternative D, the achievement of longer term TMDL stream channel milestones and geomorphic equilibrium from reaches on NFS lands, may take several decades longer than could be achieved through active restoration.

Alternative D creates a greater risk to water quality with a reduction in vegetation management activities, because with limited active fuels management there is a subsequently greater risk of catastrophic wildfire. A synthesis of research on the impacts of wildfire on water quality was published by the Rocky Mountain Research Station of the US Forest Service (RMRS, 2005). The results from this synthesis conclude that the magnitude of effects on water quality is driven primarily by fire severity, which is a qualitative term describing the amount of fuel consumed. Wildfires are more severe than prescribed fire, and as a result

are more likely to produce significant effects on water quality in terms of sediment and nutrients. Canopy-consuming wildfires are expected to be the greatest concern to managers because of the loss of canopy coupled with the destruction of soil aggregates. These losses present the worst-case scenario in terms of impacts to water quality, particularly if followed by heavy rains on recently burned lands. A variety of studies in the Lake Tahoe Basin have found that fire suppression/exclusion has resulted in an accumulating forest floor with a build-up of large nutrient pools (Karam et al. 2013, Miller et al. 2010) that now provide a natural source of long term nutrient availability to surface waters in Lake Tahoe (Miller et al. 2010). As a consequence, stand and forest floor replacing wildfire may cause a large magnitude nutrient mobilization impact on runoff water quality (Johnson et al. 2007, Miller et al. 2010).

Through the passive management approach proposed in Alternative D, which includes removal of only high priority AIS and passive restoration, lacustrine and riverine habitat quality could decline through the life of the plan as there is a potential for a reduction in water quality/chemistry, lack of flood plain connectivity and associated stream shade, increased w/d ratios, increase of warm water fish and other medium to low priority AIS species, such as bullfrogs. Improvements, beyond just removing known stressors, to physical, chemical, or biological habitat elements would only be employed in cases that are needed to restore TECPS species life history traits.

Finally, recommendation for wilderness designation of Dardanelles and Freel Inventoried Roadless Areas under Alternative D would result in limitations on any future watershed restoration activities that would involve the use of mechanical equipment.

The trend in aquatic macroinvertebrate species populations on the LTBMU is expected to remain stable and improve where currently planned restoration projects are implemented. However, the trend in the macroinvertebrate population could decline where restoration is no longer implemented but stressors continue and habitat quality no longer meets the life history requirements of the species.

Alternative E

This alternative does not differ substantially from Alternative B in terms of actions that would have anticipated effects on lacustrine and riverine habitat. Therefore, effects on habitat quality, quantity, and trend in macroinvertebrate species populations are similar to those described in Alternative B.

Riparian Habitat (Yellow warbler)

Alternative A

The acres of riparian habitat are not expected to change over the next 15-20 years across the five Plan alternatives.

Under this alternative, habitat quality would remain stable with potential to improve because of watershed and aquatic habitat restoration projects. Ongoing restoration projects in the LTBMU plant native riparian vegetation such as willow and aspen in project locations. Restoration projects also remove encroaching conifers from riparian habitat as part of the project design. In addition, a number of current projects focus on the restoration of aspen stands throughout the LTBMU by removing encroaching conifers. Although these efforts have been successful, limits on the size of trees (30 inch dbh) that can be removed from stands under this alternative can substantially restrict the ability of these activities to remove larger encroaching conifers from aspen and other riparian stands.

The quality of riparian habitat under this alternative could be impacted if livestock grazing is authorized and by increased developed recreation infrastructure. Livestock may not only degrade water quality but also feed and trample on native riparian vegetation. Livestock grazing is considered a suitable use under all alternatives. Therefore, effects from this activity are shared by all alternatives.

Alternative A allows for approximately 10% expansion of developed recreation sites, overnight accommodation units, and parking spaces. Alternative A also identifies a number of site-specific areas where recreation facilities could be expanded and new recreation facilities could be developed based on direction from the 1988 LTBMU Forest Plan (as amended). If pursued, new and expanded facilities could degrade riparian habitat quality where it exists in proximity to this habitat type.

The trend in the yellow warbler population on the LTBMU is not well understood but the species has been detected during monitoring efforts since 2002. However, without formal species-specific monitoring, it can't be determined if the species' trend is stable, increasing, or decreasing. It is expected that restoration of riparian habitat with currently planned and future restoration projects would have a long term positive effect on the yellow warbler population in the LTBMU. The species could be impacted by grazing and/or where expanded developed recreation occurs within or adjacent to occupied or otherwise suitable habitat.

Alternative B

Restoration of riparian habitat would be the same as that described for Alternative A except this alternative allows the removal of larger conifers from stands, including riparian stands, under limited circumstances. Therefore, restoration of riparian habitats that are threatened by encroaching conifers may be more effectively restored under this alternative. In addition, this alternative allows for the potential expansion of developed recreation sites, overnight accommodation units, and parking spaces by approximately 5%, half of what is allowed under Alternative A. This alternative would focus on deferred maintenance of a facility before construction of a new one. Overall, riparian habitat quality is expected to remain stable with potential to improve under this alternative.

However, riparian habitat quality could be impacted. Similar to Alternative A, grazing is considered a suitable use under this and all alternatives. Grazing can degrade riparian habitat. Riparian habitat can also be impacted where recreation facilities are expanded but at a level less than Alternative A. Unlike Alternative A, improvements to forest access through trail and road upgrades could adversely affect the quality of riparian habitat where these access points traverse or occur in proximity to riparian habitat.

The trend of yellow warbler population could be positively affected where restoration of riparian vegetation meets the life history needs of the species and facilitates riparian vegetation recruitment in future years. The species could be impacted where expanded developed recreation occurs, grazing is implemented, and trail/road improvements are conducted within or adjacent to occupied or otherwise suitable habitat.

Alternative C

The quality and quantity of riparian habitat and trend in yellow warbler are expected to be the same as that described under Alternative B except that this alternative includes the potential for up to 15% expansion of developed recreation sites, an increase in road and trail upgrades, and the recommendation of Dardanelles Inventoried Roadless Area as a Wilderness Area. Increased developed recreation, and trail and road access could impact riparian habitat quality and the trend in yellow warbler populations where these facilities or features traverse or occur adjacent to riparian habitat. Habitat could be degraded from infrastructure construction and or increased human use, and fragmented by trails or roads. The recommendation for wilderness designation of Dardanelles Inventoried Roadless Area could reduce disturbance to this habitat type but could also limit future watershed restoration activities in this area.

Alternative D

Under Alternative D, future projects would not be planned to actively restore degraded riparian habitat following the completion of currently planned projects. Natural processes would be favored as a means of maintaining riparian habitat condition. The quality of riparian habitat would remain stable or improve

under this alternative but could decline because of the lack of active restoration to remove habitat stressors.

Vegetation management under this alternative emphasizes the use of prescribed and managed wildfire to meet desired conditions. Wildfire can assist in riparian habitat improvements such as aspen suckering and is a valuable restoration tool. However, implementation of prescribed fire as the primary tool for vegetation treatments could be complicated by the need for ideal weather conditions, air quality concerns, and public safety concerns. This alternative also limits the size of trees that can be removed (similar to Alternative A) and such limitations could impede restoration activities.

This alternative proposes a potential for reduction of recreation facilities by up 15% at each site, a perceived benefit where facilities that are decommissioned occur in or adjacent to riparian habitat. The potential for fewer facilities and visitors in these areas could have beneficial results for riparian areas. However, riparian habitat could be impacted where recreation capacity is unable to meet demand and visitors continue to use now unmanaged areas or begin to use areas that previously experienced relatively low user levels.

Livestock grazing is also considered a suitable use under this alternative and this activity could degrade riparian habitat.

Recommendation for Wilderness designation of Dardanelles and Freel Inventoried Roadless Areas under Alternative D could reduce disturbance to this habitat type but could also limit future watershed restoration activities in this area.

The trend in yellow warbler populations in the LTBMU is expected to benefit from improvement in habitat quality where restoration projects are implemented and where recreation pressures are alleviated. Conversely, there is potential for impacts where restoration is not implemented and habitat conditions no longer meet life history requirements.

Alternative E

This alternative does not differ substantially from Alternative B in terms of actions that would have anticipated effects on riparian habitat. Therefore, effects on habitat quantity, quality, and population trends in the yellow warbler are similar to those described in Alternative B.

Wet Meadow Habitat (Pacific Chorus (Pacific tree) frog)

Alternative A

Overall, the quality of wet meadow habitat is expected to improve under this alternative because of ongoing and future restoration efforts, vegetation treatments that remove encroaching conifers, and the use of prescribed fire as a restoration tool. Restoration would be limited by restrictions on the size of trees that can be removed under this alternative but in general, conifer removal under this alternative is expected to be a useful restoration tool. The quality of meadow habitat that is not selected for restoration could deteriorate where these meadows experience unabated conifer encroachment and desiccation from legacy land use impacts such as grazing, water diversion, channel incision, and road and trail construction. Meadow quality could also be impacted by the expansion of developed recreation infrastructure. Finally, wet meadow habitat could be impacted by livestock grazing, which if authorized could reduce native vegetation, increase soil compaction, increase erosion and sediment transport, and reduce water quality. These and other potential impacts could be confounded as a result of climate change which could reduce water availability to wet meadows.

It is uncertain how the overall quantity of wet meadow habitat in the LTBMU would trend under this alternative because the acreage of future restoration projects in wet meadow habitat are not known at this

time and the pace of meadow habitat degradation (and potential loss) at the local level is not well understood. The acres of wet meadow habitat would be expected to increase under this alternative as a result of ongoing and future restoration because these activities are aimed at reclaiming meadow habitat (particularly the conifer-encroached boundaries). However, wet meadow habitat not selected for restoration could be lost because of increasing conifer encroachment or legacy effects of past land uses that continue to degrade meadow quality.

The trend in the pacific tree frog population at the regional level is stable but the trend in the LTBMU is not well understood. It is expected that the population of the pacific tree frog in the LTBMU would respond positively to meadow restoration efforts but could be impacted by grazing, recreation expansion, and habitat degradation where restoration is not implemented.

Alternative B

Similar to Alternative A, ongoing and future planned restoration projects are expected to improve wet meadow habitat quality under this alternative. There is a greater potential for a positive trend in habitat quality under this alternative because the vegetation management strategy allows for the removal of larger diameter trees than Alternative A and both prescribed and managed wildfire allow for greater flexibility in putting fire on the landscape, all of which would afford more effective treatments to restore meadow habitat quality. Furthermore, this alternative includes additional objectives (beyond those under Alternative A) for the maintenance and protection of wet meadow habitat that would improve habitat quality.

Wet meadow habitat quality could be impacted by the expansion of developed recreation infrastructure but at a level less than Alternative A because this alternative allows up to 5% expansion and Alternative A allows up to 10% expansion. Like Alternative A, wet meadow habitat quality could be impacted by increased access to NFS lands and grazing. Like Alternative A, it is uncertain how the overall quantity of wet meadow habitat in the LTBMU would trend under this alternative. The acres of wet meadow habitat would be expected to increase under this alternative as a result of ongoing and future restoration projects because these activities are aimed at reclaiming meadow habitat (particularly the conifer-encroached boundaries). Moreover, this alternative includes objectives to restore meadows historically and currently occupied by willow flycatcher which could increase the acreage of wet meadow beyond that of Alternative A. However, wet meadow habitat not selected for restoration could be lost because of increasing conifer encroachment or remnant effects of past land uses that continue to degrade meadow quality.

It is expected that the population of pacific tree frog in the LTBMU would respond positively to meadow restoration efforts and would trend more positively than under Alternative A because of greater flexibility to remove large encroaching trees and use fire as a restoration tool, and less potential for recreation expansion. However, the population could still be impacted by grazing, recreation expansion (at a level less than Alternative A), and increased access to NFS lands.

Alternative C

Alternative C is similar to Alternative B with respect to restoration, vegetation management strategies, and meadow protection and restoration objectives. Therefore, it is expected that the quality of wet meadow habitat would increase under this alternative. Wet meadow habitat quality could be impacted by the potential to increase developed recreation facilities (more than any other alternative)trail and road upgrades. As with the other alternatives, grazing is considered a suitable land use under this alternative and could impact the quality of wet meadow habitat.

Wilderness recommendation of Dardanelles Inventoried Roadless Area could have positive and negative consequences for wet meadow habitat quality. The designation could increase dispersed recreation in wet meadow habitat and thereby increase recreation pressure but also reduce certain types of recreation (e.g.,

mechanized equipment) that may negatively influence wet meadows and associated species. There is potential for an increase in hiking, camping, pack animals, and domestic animals (dogs) that impact wet meadows. In addition, where the condition of wet meadows is being compromised in this area, future opportunities for restoration are limited.

Like Alternatives A and B, it is uncertain how the overall quantity of wet meadow habitat in the LTBMU would trend under this alternative. The acres of wet meadow habitat would be expected to increase under this alternative as a result of ongoing and future restoration projects because these activities are aimed at reclaiming meadow habitat (particularly the conifer-encroached boundaries). Moreover, this alternative includes objectives to restore meadows historically and currently occupied by willow flycatcher which could increase the acreage of wet meadow beyond that of Alternative A. However, wet meadow habitat not selected for restoration could be lost because of increasing conifer encroachment or remnant effects of past land uses that continue to degrade meadow quality.

It is expected that the population of pacific tree frog in the LTBMU would respond positively to meadow restoration efforts and would trend more positively under this alternative than under Alternative A because of greater flexibility to remove large encroaching trees and use fire as a restoration tool. However, the population could face the greatest impacts of all alternatives by the greatest potential amount of recreation expansion and increased access to NFS lands, and grazing.

Alternative D

In the absence of active restoration of wet meadow habitat under Alternative D, following the completion of currently planned projects, it can be expected that wet meadow habitat quality would diminish from continued conifer encroachment and recurring effects of past land uses that exacerbate meadow desiccation. This alternative also limits the size of conifers that can be removed outside the WUI defense zone (12 inches dbh), severely limiting the ability to remove trees that threaten meadow habitat quality. The emphasis on the use of prescribed fire under this alternative is a preferred disturbance tool used to improve meadow quality but the feasibility of implementation given weather conditions, air quality concerns, and public concerns, is low. Overall, this alternative would have the least potential to improve meadow resiliency in the face of climate change, including potential drought conditions.

Wilderness recommendation of Dardanelles Inventoried Roadless Area could have positive and negative consequences for wet meadow habitat. The designation could increase dispersed recreation in wet meadow habitat and thereby increase recreation pressure but also reduce certain types of recreation (e.g., mechanized equipment) that may negatively influence wet meadows and associated species. There is potential for an increase in hiking, camping, pack animals, and domestic animals (dogs) to impact wet meadows. In addition, where the quality of wet meadows is being compromised in this area, future opportunities for restoration are limited.

Although the long-term quantity of wet meadow habitat cannot be predicted with certainty because the current rate of degradation is unknown, the quantity of wet meadow habitat has potential to decrease where meadows are lost due to continued conifer encroachment and recurring impacts from past land uses and natural processes aren't enough to maintain or improve condition. The fewest acres of wet meadow habitat would be restored under this alternative. Therefore, it is expected that management under this alternative would result in the potential loss of the most acres of wet meadow habitat.

The trend in the population of the pacific tree frog is expected to respond positively where limited restoration efforts are conducted. However, without restoration and in the face of climate change, the pacific tree frog could trend negatively where habitat quality is diminished or meadow habitat is lost.

Alternative E

This alternative does not differ substantially from Alternative B in terms of actions that would have anticipated effects on wet meadow habitat. Therefore, effects on wet meadow quality, quantity, and trend in the pacific tree frog population are similar to those described in Alternative B.

Early and Mid Seral Coniferous Forest Habitat (Mountain quail)

Alternative A

Under Alternative A, the quantity of early seral habitat is predicted by the SPECTRUM model to moderately decrease for all forest types when analyzed together (white fir/mixed conifer, Jeffrey pine, red fir) as well as for individual forest types like Jeffrey pine and red fir (*see Table 3-78 in Section 3.4.23 Terrestrial Wildlife*). Early seral habitat is predicted to decrease substantially in the white fir/mixed conifer forest type. Under this alternative, an objective is to create early seral stage habitat from the mid seral stage. However, because there are limitations on the size of tree that can be thinned (<30 inches in diameter), early seral creation faces challenges under this alternative.

Mid seral closed canopy habitat is predicted to decrease moderately under this alternative for all forest types and for each individual forest type modeled. Mid seral open canopy habitat is predicted to decrease substantially overall. Under this alternative, mid seral habitat is moved to late seral habitat by cutting smaller diameter trees which changes the forest type. Therefore, changes in mid seral habitat under this alternative represent the movement of mid to late seral habitat as well as the artifact of current treatment methods which simply result in a large proportion of smaller diameter trees in the understory.

Under this alternative, the quality of early and mid seral habitat is expected to decline as stands become more dense and move towards later seral stages. The quality of early and mid seral habitat could also be impacted by developed recreation. The potential expansion of developed recreation sites, overnight accommodation units, and parking spaces by 10% at each site and creation of new sites could cause habitat degradation if recreation facilities are built in proximity to these habitat types and/or attract visitors to use these sites more frequently. Moreover, this alternative proposes the largest expansion of ski areas which could fragment and/or reduce mid seral habitat.

Although the population trend of mountain quail on the LTBMU is not well understood, the species has been detected over multiple years at many upland (and some riparian) sites on the LTBMU. The population of mountain quail would be impacted under this alternative by the modeled expectation that early and mid seral habitat would transition to later seral stages without replacement. The population of mountain quail could also be impacted by expanded or newly created developed recreation sites.

Alternative B

The quantity of early seral habitat is predicted to decrease slightly under this alternative for all forest types combined and in the white fir/mixed conifer forest type. Individually, early seral habitat is predicted to experience no change in the Jeffrey pine forest type but decrease moderately in red fir. Although early seral creation proposed under this alternative is not predicted to keep pace with loss (natural conversion) of this habitat type, the decrease in the quantity of early seral habitat is less than under Alternative A.

Mid seral closed canopy habitat is predicted to decrease moderately for all forest types combined but increase substantially in red fir forest(*see Table 3-78 in Section 3.4. 23 Terrestrial Wildlife*). Mid seral open canopy habitat is predicted to increase moderately in Jeffrey pine but decrease substantially in red fir. However, overall, when all forest types are analyzed together, mid seral open canopy habitat is predicted to experience no change. Some mid seral habitat would be converted under this alternative to

early seral and mid seral open habitat (from mid seral closed) and facilitated towards growth to late seral where appropriate to meet vegetation restoration objectives.

The quality of early and mid seral habitat would improve where prescribed and managed wildfire create and improve early seral (and possibly mid seral) habitat. Alternative B proposes the same acres/year of prescribed fire as Alternative A but allows for more acres/year of managed wildfire. However, there are several limitations to the effective use of fire for restoration that could restrict how often habitat is created by these means. Early and mid seral habitat quality could be impacted by developed recreation under this alternative, but at a level less than Alternative A, although potential effects would be location-specific. The potential expansion of developed recreation sites, overnight accommodation units, and parking spaces by up to 5% at each site could cause habitat degradation if recreation sites are expanded near these habitat types and/or attract visitors to use these sites more frequently. The potential for enhanced access to dispersed recreation activities under this alternative could also contribute to degraded habitat condition where trails would traverse or be in close proximity to this habitat type.

There is potential for an increasing trend in the population of mountain quail on the LTBMU where early and mid seral forest is maintained or created but the population would be impacted where creation does not keep pace with predicted loss, especially in early and mid seral closed canopy habitat but at a level less than Alternative A. The predicted changes in mid seral habitat is not expected to result in an adverse effect on the population trend of mountain quail in the LTBMU because much of this habitat would be converted to early seral stages or to mid seral open, habitat types that are used by mountain quail.

Alternative C

Like Alternatives A and B, Alternative C also proposes to create early seral habitat from mid seral habitat as well as promote the trend of some mid seral habitat towards late seral conditions. However, Alternative C (and B and E) also proposes to create mid seral open habitat from mid seral closed. This Alternative also proposes to thin more acres/year than any other alternative. Therefore, this alternative has a greater potential for short term (i.e., implementation) effects. However, effects would depend on location, resources, and scope of the project. The quantity of early seral habitat is predicted to experience no change for all forest types combined and in Jeffrey pine forest type. However, the quantity of early seral habitat is predicted to increase substantially in the red fir type but decrease slightly in white fir/mixed conifer forest type. This Alternative is more successful than Alternatives A and B at preserving acres of early seral habitat on the landscape.

Overall mid seral closed canopy habitat is predicted to decrease moderately under this alternative except in red fir where it would stay the same (*see Table 3-78 in Section 3.4. 23 Terrestrial Wildlife*). Conversely, mid seral open canopy habitat is predicted to increase slightly under this alternative in all forest types except red fir where it would moderately decrease. These predicted trends in the quality of mid seral habitat suggest that Alternative C is effective at converting some of the mid seral closed canopy habitat (except in red fir) to mid seral open canopy habitat to restore forest structure.

This alternative allows the most potential expansion of developed recreation sites, overnight accommodation units, and parking spaces (up to 15%) of all alternatives which could impact the quality of these habitat types. However, Alternative A also proposes the creation of a number of new sites. The potential expansion could cause habitat degradation if recreation expands near early and mid seral habitat types and/or attract visitors to use these sites more frequently. In addition, the potential for enhanced access to dispersed recreation activities through road and trail upgrades under this alternative could also contribute to degraded habitat condition where roads and/or trails would be in close proximity to this habitat type. Moreover, this alternative proposes a relatively large expansion of ski areas (but less than Alternative A) which could fragment and/or reduce mid seral habitat.

Overall, Alternative C appears to be more successful than any other alternative at creating and maintaining early and mid seral habitat. The modeled decrease in mid seral closed canopy habitat is the result of a vegetation management strategy that focuses on creating mid seral open and early seral habitat so it is not lost on the landscape. The population of the mountain quail would trend positively in response to improvement in habitat quantity and quality. Trends could be impacted by increased developed recreation as well as increased use of roads and trails throughout the LTBMU.

Alternative D

Like Alternatives A and B, Alternative D also proposes to create the same amount of early seral habitat from mid seral habitat each year as well as promote the trend of some mid seral habitat towards late seral conditions. However, this alternative emphasizes the use of hand thinning and prescribed fire to achieve desired conditions for these seral stages which can be a useful tool, especially for the maintenance of early seral habitat. However, the use of prescribed fire as the primary tool for forest structure restoration is limited by the need for appropriate weather conditions to burn, air quality concerns, public safety concerns, among others. The quantity of early seral habitat is predicted to decrease slightly under this Alternative but not as significantly as under Alternative A. Overall, the predicted trend in the quantity of mid seral habitat is similar to Alternative A with both mid seral closed and open canopy habitat decreasing moderately (Alternative A has mid seral closed canopy decreasing substantially, *see Table 3-78 in Section 3.4. 23 Terrestrial Wildlife*).

The population of mountain quail would be impacted under this alternative by the modeled expectation that early and mid seral habitat would decrease under this Alternative.

Alternative E

This alternative does not differ substantially from Alternative B in terms of management approaches that would have anticipated effects on early and mid seral habitat. Therefore, effects on habitat quality, quantity, and the trend in the mountain quail population are similar to those described in Alternative B.

Late Seral Open Canopy Coniferous Forest Habitat (Sooty blue grouse)

Alternative A

Late seral open canopy habitat is predicted to increase moderately under this alternative in all forest types and increase substantially in red fir forests.

The quality of habitat is expected to improve where vegetation management actively pursues the creation and maintenance of this habitat type. Late seral open canopy habitat could be impacted where developed recreation expands or new facilities are created. The potential expansion of developed recreation sites, overnight accommodation units, and parking spaces by up to 10% at each site and creation of new sites could cause habitat degradation if recreation facilities are built in proximity to these habitat types and/or attract visitors to use these sites more frequently. The potential for nearly double acres of ski areas could impact habitat quality.

Trend in the population of sooty blue grouse on the LTBMU is not well understood but the species has been detected during monitoring efforts since 2002. The sooty grouse population is expected to respond positively to the predicted increase in the quantity of habitat. The trend could be impacted by increased recreation, particularly ski area expansion, and increased access to NFS lands.

Alternative B

This alternative does not differ substantially from Alternative A in terms of management approaches that would have anticipated effects on late seral open canopy coniferous forest habitat. Late seral open

canopy habitat is predicted to increase substantially under this alternative, more than under Alternative A which is predicted to increase moderately. The quality of habitat and trend in sooty grouse is expected to be similar to that described for Alternative A because there is an overall increase in habitat under both alternatives. However, this alternative proposes less overall recreation expansion than Alternative A (and less ski area expansion).

Alternative C

This alternative does not differ substantially from Alternative A in terms of actions that would have anticipated effects on late seral open canopy coniferous forest habitat. And late seral open canopy habitat is also predicted to increase moderately under this alternative. Therefore, as with Alternative A, the quantity and quality of habitat and trend in sooty grouse is expected to be similar to that described for Alternative A. However, this alternative proposes more overall recreation expansion and upgrades to roads and trails than Alternative A (and B) and may have greater potential for effects but effects depend upon location and scope of project activities.

Alternative D

Like Alternative B, late seral open canopy habitat is predicted to increase substantially under this alternative. Therefore, the quality of habitat and trend in sooty grouse is expected to be similar to that described for Alternative B (and A). However, this alternative also includes the potential for a reduction in developed recreation sites, overnight accommodation units, and parking spaces by up to 15% which could improve habitat quality and positively influence the trend in sooty grouse more than any other alternative. However, impacts could occur because this alternative emphasizes the use of prescribed fire and hand treatments to achieve desired conditions which are considered preferred techniques (especially fire) for reintroducing disturbance to the landscape but feasibility of implementation is limited.

Alternative E

This alternative does not differ substantially from Alternative B in terms of management approaches that would have anticipated effects on late seral open canopy coniferous forest habitat. Therefore, effects on habitat quality and quantity, and trend in sooty grouse are similar to those described in Alternative B.

Late Seral Closed Canopy Coniferous Forest Habitat (California spotted owl, Pacific marten, and northern flying squirrel)

Alternative A

Late seral closed canopy coniferous forest habitat is predicted to increase moderately in all forest types under this alternative except red fir where it is expected to decrease slightly (*see Table 3-77 in Section 3.4. 23 Terrestrial Wildlife*). This alternative also uses OFEAs to designate late seral forest areas. Unfortunately, the OFEAs under this alternative were not delineated by the local unit, but through a regional process, and for the purpose of connecting habitats of old forest dependent species Sierra Nevada wide. These areas in the LTBMU do not contain all of the old or late seral forest stands in the LTBMU and lack standards and guidelines. Still, many spotted owl Protected Activity Centers (PACs) in the LTBMU overlap OFEAs.

Habitat quality under this alternative is predicted to become increasingly dense as tree removal is restricted. The high density of trees would put this habitat at a greater risk of bark beetle outbreaks and stand replacing fires, especially when combined with drought conditions (*see* 3.4.11 Forest Vegetation).

The quality of this habitat could also be impacted by the potential for recreation sites to expand by up to 10% and the potential for the acreage of ski areas to double. Expansion of recreation infrastructure, especially ski resorts, can cause adverse effects on species associated with late seral habitat. Expansion of

ski areas can lead to habitat degradation and fragmentation, high levels of human disturbance that may create effective use barriers for wildlife, loss of snags because of safety hazards, and increased night disturbance from lighting and trail grooming (Manley et al. 2010). Moreover, standardized Limited Operating Periods (LOPs) that are in place to protect nests and dens do not apply to recreation areas under this alternative but only to vegetation treatments.

The trend of the California spotted owl population on the LTBMU is not well understood despite long term survey efforts. Owls have been detected at 76% of the PACs on the LTBMU over the last 10 years. The trend at the regional level is also not well understood but recent results from long-term demography studies indicate the potential for a declining trend. The spotted owl population on the LTBMU would be expected to increase in response to the increase in late seral closed canopy coniferous forest habitat. However, the spotted owl population could be impacted by the increasingly dense stand conditions that are vulnerable to stand replacing events (and have reduced resiliency) as well as by the expansion of recreation infrastructure, particularly ski areas that remove trees, reduce canopy cover, and fragment habitat.

At the regional level, there are some gaps in marten distribution and some localized areas of decreased detections. Otherwise, the species is continuously distributed in high elevation forests from Placer County south. The trend in marten population is not well understood in the LTBMU but data indicate that marten are well distributed where suitable habitat exists, particularly in the southern and western portions of the LTBMU. Like the spotted owl, the marten population would be expected to increase in response to the increase in late seral closed canopy coniferous forest habitat. However, the marten population could be impacted by the increasingly dense stand conditions that are vulnerable to stand replacing events (and have reduced resiliency) as well as by the expansion of recreation infrastructure. Marten are known to occur at a variety of ski areas in the LTBMU and could be adversely impacted by ski area expansion due primarily to the loss of key habitat features such as dense canopy, intact forest, and understory structural complexity.

The trend in the northern flying squirrel population is not well understood at both the regional and LTBMU level. However, the species continues to be detected at regional survey areas and has been detected during monitoring on the LTBMU. Like the spotted owl and marten populations, the northern flying squirrel population on the LTBMU would be expected to increase in response to the increase in late seral closed canopy coniferous forest habitat. However, the flying squirrel population could be impacted by the increasingly dense stand conditions that are vulnerable to stand replacing events (and have reduced resiliency) as well as by the expansion of recreation infrastructure, particularly ski areas that remove trees, reduce canopy cover, and fragment habitat.

Alternative B

Under this alternative, the quantity of late seral closed canopy coniferous forest habitat is predicted to experience no change for all forest types combined and the white fir/mixed conifer forest type, increase moderately in the Jeffrey pine forest type, and decrease moderately in the red fir forest type (*see Table 3-77 in Section 3.4. 23 Terrestrial Wildlife*). The decrease in red fir is primarily driven by a substantial decrease in CWHR type 6 (decreases under all alternatives) and a slight decrease in 5M. CWHR type 5D is predicted to increase substantially in red fir under all alternatives.

Alternative B (and E) would emphasize the same concepts (desired conditions) originally designed for Alternative A OFEAs, but apply them to each location of late seral closed canopy forest throughout the LTBMU. That is, treatments would be designed to enhance/perpetuate the existing late-seral forest stands while enhancing/promoting mid-seral adjacent stands that most effectively connect late-seral habitats (e.g., spotted owl (PACs) and Home Range Core Areas (HRCAs)). In order to enhance or perpetuate late-seral stands, in some cases on a project-specific basis, prescriptions will need to have some flexibility in

order to accomplish this objective. That is, have the ability to kill or remove trees greater than 30 inches in diameter. This option, though an exception, will become more essential as larger trees become more prevalent, but still need space to grow. Such a prescription that includes this exception will focus primarily on outcomes with wildlife habitat in mind.

These flexibilities, although intended to improve the quality of late seral closed canopy coniferous forest habitat, have the potential to affect species associated with mature forest like marten, spotted owl, and northern flying squirrel. For example, removal of trees larger than 30 inches in diameter could alter the prey base, reduce the canopy cover, and/or increase potential for predation where the tree provided protection for nesting or denning locations. Nest trees would not be removed. All of these potential impacts are dependent on the treatment and scope of activities, a level of detail that is beyond the scope of this analysis since projects and locations are not assigned by any alternative.

The removal of large trees could also benefit the habitat of species associated with mature forest conditions. The limited exceptions under which a tree greater than 30 inches in diameter would be removed are focused, for the most part, on the enhancement of a stand and directed towards improving resiliency and reducing susceptibility to insects, disease, drought, and large-scale catastrophic fire over the long term. Removal of some larger trees could also promote the accelerated growth of adjacent trees to even larger diameters and reduce the risk for catastrophic fire where these trees are densely packed.

The lack of one-size-fits all minimum canopy retention levels for the general forest under this alternative (and C) as opposed to Alternative A (and D) could have negative impacts on species associated with dense canopy cover such as spotted owl, northern flying squirrel, and marten. Reducing the canopy cover in a stand could increase the risk of predation, alter thermal conditions of the stand, and cause displacement of individuals and/or their prey depending on the location and scope of treatments. These types of impacts could be of short duration and also be mitigated by strategic spatial and temporal spacing of treatments as well as the implementation of resource protection measures and LOPs at the project level. LOPs under this alternative apply to vegetation treatments. Reduction in the canopy of late seral closed canopy habitat is not expected to have lasting negative effects on these and other late seral associated species since the canopy would not typically be reduced to a point where late seral closed becomes late seral open canopy habitat. Ultimately, the purpose of treating late seral stands is to promote resiliency of this habitat for the long term and the quality of late seral closed canopy habitat is expected to improve under this alternative.

PACs continued to be protected under all alternatives. Restoration of PAC habitat under Alternatives B (and C and E) although intended to benefit the long term condition of habitat for the species, could temporarily affect habitat for spotted owls. The potential for impacts would depend on the location and scope of the specific restoration project. However, the intent of restoration is to improve habitat for the specific benefit of the spotted owl and goshawk and therefore, impacts, if they were to occur, would be temporary. Many potential impacts are not expected to occur because PAC restoration projects would be driven solely by the purpose and need to maintain and/or restore suitable habitat for spotted owls. Resource protection measures would be in place for any PAC restoration project (e.g., snag retention, canopy cover, etc.) in order to retain suitable habitat, including important structures, and limit the operating period to times of year when individuals are not breeding.

The long term benefit that can be realized by conducting focused restoration activities to maintain and/or improve habitat condition for spotted owls and goshawks in PACs, as opposed to doing nothing, may outweigh the short term impacts that could occur. Under the current direction under Alternative A (and Alternative D), treatments allowed in PACs are intended to reduce fuels and are permitted where PACs overlap the WUI. Many PACs overlap the WUI in the LTBMU. Fuel reduction treatments are an ongoing activity under all alternatives and would be designed to be consistent with achieving PAC desired condition. Still, many forested stands in the Sierra Nevada (and the LTBMU) that are outside WUI, are

becoming increasingly stocked with trees, particularly smaller, shade tolerant trees. Many stands also contain unusually high levels of slash and large downed wood. These dense, thicket-like conditions of trees can compromise the suitability of spotted owl nesting, roosting, and foraging habitat and make it more susceptible to catastrophic wildfire. Without some type of focus-driven restoration for the benefit of the stand condition for these species, PAC habitat could deteriorate over time and become more susceptible to widespread negative effects from insects, drought, disease, and catastrophic stand replacing fire.

Although fire is a historic part of the processes affecting habitat in the Sierra Nevada and insect outbreaks are also part of the ecological processes that influence forests within this region, the forested stands within the LTBMU are outside of their natural range of variability and more susceptible to high severity crown fires and massive, widespread die offs from insect outbreaks. Stand replacing fires and insect outbreaks that completely remove nest and roost trees, and that are on a large geographic scale (especially compared to the relatively small size of the LTBMU) are not likely to benefit these species. Therefore, the long term benefit of these focused restoration efforts are believed to outweigh the potential for short term effects.

The quality of late seral closed canopy coniferous forest is expected to improve under this alternative and be more resilient to potential stressors but impacts could occur from an increase in developed recreation (including ski facilities) but at a level less than Alternative A. Increased access to NFS lands through upgraded roads and trails could also degrade habitat where they traverse late seral closed canopy forest and disturb wildlife species.

The trends of the California spotted owl, Pacific marten, and northern flying squirrel populations in the LTBMU are expected to respond positively to the improvement in habitat quality. The species are expected to respond positively to the increase in CWHR type 5D. Population trends in these species may be impacted by short term challenges where large trees are removed and/or canopy cover is reduced as part of forest health treatments. However, the magnitude of such impacts would depend on location and scope of treatments as well as existing sensitive resources that are present. The treatments to enhance late seral closed canopy habitat quality are expected to have an overall positive effect on the long term condition of the habitat and improve resiliency and reduce the potential for large-scale catastrophic wildfire. The predicted decrease in late seral closed canopy red fir forest could impact these species but an increase in red fir 5D may provide additional denning or nesting habitat. Impacts to these species could also occur where developed recreation expands and where enhanced access to NFS lands degrades habitat and/or disturbs individuals.

Alternative C

The quantity of late seral closed canopy forest is predicted to decrease slightly overall, and moderately in red fir forest under this alternative but increase in Jeffrey pine and stay the same in white fir/mixed conifer forest types (*see Table 3-77 in Section 3.4. 23 Terrestrial Wildlife*). The trend in habitat quality is not known but it is expected to incur short terms impacts from intensive treatments but long-term improvement from more resilient stand conditions characterized by large trees. The trend in MIS populations under this alternative could be positively influenced in the long term by improvement in stand condition, but impacted by fewer overall acres of habitat and greater short term impacts. Alternative C would include the treatment of more acres/year than Alternative B. As a result, Alternative C has a greater potential for short term impacts on the trend of spotted owls, marten, and flying squirrels but the magnitude of effects would depend on location and scope of project activities. This alternative also has a greater potential for expansion of developed recreation sites than Alternative B (including ski areas but less than Alternative A) and roads and trails which could also impact the population trends of spotted owl, marten, and northern flying squirrel in the LTBMU where such expansion is in close proximity to occupied or otherwise suitable habitat.

Alternative D

Under Alternative D, the quantity of late seral closed canopy habitat is predicted to increase slightly overall, moderately in white fir/mixed conifer forests, increase substantially in Jeffrey pine forests, but decrease moderately in red fir forests (*see Table 3-77 in Section 3.4. 23 Terrestrial Wildlife*).

This alternative emphasizes the use of fire and hand treatments to restore forest structure, type, and resiliency. Under ideal conditions, fire would be considered a preferred disturbance type to reintroduce and improve forest health conditions. However, there are limited times throughout the year when fire can be safely used in the LTBMU to achieve these goals. Therefore, this alternative could have the potential for marked enhancement in the quality of late seral closed canopy habitat but it could be that logistical issues limit the applicability of this alternative.

Where fire is not used and hand treatments are incorporated as surrogates, this alternative limits the size of trees that can be cut outside the WUI to 12 inches in diameter. Although this approach does not risk the short term loss of any large trees that are preferred by wildlife, the potential long term decline in habitat quality may outweigh the potential short term risks associated with loss of a large diameter tree. Without the ability to continue to thin stands of trees where diameters exceed 12 inches dbh, the habitat quality would steadily decline because of the inability to remove competing trees in overly stocked stands (see 3.4.11, Forest Vegetation section of FEIS). As with Alternative A, dense stand conditions under this alternative could have disastrous consequences on the longevity and health of the habitat and increase susceptibility to large-scale disturbances such as catastrophic fire.

The trend of California spotted owl, Pacific marten, and northern flying squirrel populations in the LTBMU could respond positively to the reintroduction of fire, reduction in developed recreation sites, and increase in preferred habitat in the white fir/mixed conifer type (and Jeffrey pine) but could also be impacted by a moderate decrease in red fir late seral closed canopy forests and where dense conditions compromise stand integrity.

Alternative E

This alternative does not differ substantially from Alternative B in terms of the management approach and predicted trends in the quantity and quality of late seral closed canopy habitat that would have anticipated effects on late seral closed canopy coniferous forest habitat. Therefore the predicted population trends in spotted owls, martens, and northern flying squirrels are similar to those described under Alternative B. However, this alternative provides for clearer direction in the standards and guidelines and strategies to preserve late seral closed canopy habitat. For example, this alternative contains additional standards for the retention of canopy cover and basal area where late seral-associated species could be affected, including a standard to not reduce canopy lower than 10%. This alternative also includes a desired condition that spotted owl PACs have a minimum of 70% canopy cover and standards and guidelines for the minimum canopy cover retention levels. The standards and guidelines under this alternative also clarify the limited circumstances under which trees greater than 30 inches diameter can be removed. This alternative also clarifies that selected trees would not need to be removed but could be girdled for snag creation or felled for coarse woody debris. Alternative E proposes to restore the same number of PACs as Alternatives B and C but this alternative, more than the other alternatives, provides the clearest guidance for suitable PAC conditions.

Snags in Green Forest Ecosystem Component (Hairy woodpecker)

Alternative A

Under Alternative A, the number of snags greater than 15 inches dbh is expected to increase over time. Once a tree exceeds 30 inches dbh, the LTBMU is limited in the ability to remove this tree due to the standards and guidelines in place. Therefore, stand density would be expected to increase in such a way

that would make the stand more vulnerable to stress from competition or drought. More importantly, over the life of the Plan, the stand would be at a high risk for insect (e.g., beetle) outbreak that could exponentially increase tree mortality.

The trend in hairy woodpecker on the LTBMU is not well understood, but the species has been detected during monitoring on the LTBMU since 2002 and has been detected in all sub watersheds, indicating that they are distributed in suitable habitat throughout the LTBMU. It is expected that the population trend of the hairy woodpecker in the LTBMU would respond positively to the increase in snags in green forest. However, the species may be impacted due to the quality of the ecosystem component under this alternative which is predicted to be more dense than conditions that are typically considered suitable for the hairy woodpecker, a species that is strongly associated with stands of sparse to intermediate density.

Alternative B

Snags greater than 15 inches dbh are expected to increase over time under this alternative but with a potentially slower rate of snag recruitment than under Alternative A. Under this alternative, there are fewer constraints for removal of large trees through forest health-related treatments. Trees greater than 30 inches dbh can be removed where necessary to maintain the health of the stand and of nearby trees. Therefore, stands managed under Alternative B could experience fewer incidences of insect outbreaks, lower rates of disease transmission, and die offs from stress-related causes (i.e., drought, competition, etc.) than under Alternative A. Under this alternative, stands may have larger live trees than under Alternative A as well as conditions where snags are recruited over time and not created all at once.

The hairy woodpecker population trend in the LTBMU would respond positively to the increase in habitat, albeit at a rate potentially slower than Alternative A. The trend may also increase where there is an increase in stands of large and mature trees of sparse to intermediate density.

Alternative C

Snags greater than 15 inches dbh are expected to increase over time under this alternative but with a potentially slower rate of snag recruitment than under Alternatives A and B. Similar to Alternative B, trees greater than 30 inches dbh can be removed under this alternative as part of forest health-related treatments. However, management under this alternative can reduce stand density further than under Alternative B and in twice as many acres over the life of the Plan. Alternative C may not always thin to a stand density less than proposed under Alternative B but does have more flexibility to accomplish forest health and restoration goals by allowing for more intense treatments than Alternative B. In the long term (i.e., 50 years), the forest conditions under this alternative are expected to be more resilient than those under Alternative B because neighboring trees are expected to have less competition for limited resources, and snag recruitment will occur but is projected to occur at a rate slower than under Alternative B.

The population trend of the hairy woodpecker in the LTBMU would respond positively to the predicted increase in snags under this alternative, albeit at a rate potentially slower than both Alternatives A and B. The trend of the species may face short term impacts in the LTBMU where treatments reduce the potential for widespread snag creation from insect outbreak, disease transmission, stress, or other mortality agents associated with dense stand conditions. However, in the long term, the trend of the species may respond positively to the potential for an increase in stands of large and mature trees of sparse to intermediate density.

Alternative D

The effects of this alternative are expected to be similar to those under Alternative A but with a greater potential for snag recruitment from even more limited restrictions on the size of trees that can be removed (12 inches dbh) outside of the WUI. Therefore, there is expected to be much greater stand competition

for limited resources, greater vulnerability to insect outbreak and wildfire than under any other alternative. As a result, there may be a higher potential for widespread snag creation from insect outbreak or other stress agent over several years as compared to all other alternatives.

The population trend of the hairy woodpecker in the LTBMU would respond positively to the predicted increase in snags under this alternative, and potentially at a rate faster than any other alternative. However, stands under this alternative may be more dense than suitable for the hairy woodpecker, a species that is strongly associated with stands of sparse to intermediate density.

Alternative E

This alternative does not differ substantially from Alternative B in terms of actions that would have anticipated effects on snags in green forest habitat component. Therefore, effects to habitat quantity and quality, and trends in hairy woodpecker are similar to those described for Alternative B.

Snags in Burned Forest Ecosystem Component (Black-backed woodpecker)

Alternative A

Under this alternative, current procedures for prescribed fire would continue. An estimated 1,900 acres of prescribed fire (pile and understory burning) would be conducted annually under this alternative. The mortality of trees under prescribed burning during the past decade has been generally less than 20% of the project area. Therefore, it would be expected that the number of snags produced and recruitment of snags in burned forest would be similar to current conditions.

Under this alternative, it is estimated that approximately 290 acres would burn annually as managed wildfire which burns in varying degrees of intensity. This alternative would produce the least amount of snags in burned forest from managed wildfire because it allows managed wildfire in the fewest number of acres annually (only in Desolation Wilderness). See the *Fire and Fuels* section for details on modeling for managed wildfire. The quality (and quantity) of this ecosystem component could also be impacted by ability to remove snags after a large, catastrophic fire in all but a minimum of 10% of the total area affected by the fire.

The black-backed woodpecker is an opportunistic species whose populations fluctuate significantly with fire. Assessments to evaluate population trends are dependent on the availability of burned forest habitat. In the absence of fire, assessments of trends are difficult. The population trend of black-backed woodpeckers is considered stable at the regional level and appears stable on the LTBMU given that the species has been detected in all surveyed wildfire areas as well as in green forest habitat. It is expected that the black-backed woodpecker population trend in the LTBMU would remain stable under this alternative with potential to increase where fires occur, including prescribed fires depending on mortality, but could be impacted where snags are removed following a fire event, depending on the location and timing of removal (scope of a specific project).

Alternative B

In general, the acreage of prescribed fire and mortality from prescribed burning are the same as in Alternative A. Therefore, the effects on the quantity and quality of snags in burned forest ecosystem component from prescribed fire are expected to be similar to those described under Alternative A.

In terms of managed wildfire under this alternative, it is estimated that approximately 1,100 acres would burn annually. Alternative B permits managed wildfire on all NFS lands except the WUI defense zone. Therefore, it could be expected that Alternative B has a greater potential to produce snags in burned forest from managed wildfire than Alternative A. However, this alternative allows for the removal of snags after a fire event which could impact the quantity and quality of this ecosystem component; medium and large

snags would be retained in at least 10% of a burned area and 10% of high and mid severity patches would be retained.

The population trend of black-backed woodpeckers in the LTBMU would remain stable under this alternative with potential to increase at a level greater than Alternative A because managed wildfire is allowed outside of Desolation Wilderness. The population could be impacted where snags are removed following a fire event, depending on the location and timing of removal (scope of a specific project).

Alternative C

This alternative proposes to conduct prescribed burning on more acres (approximately 2300 annually) than any other alternative. The estimated mortality is the same as Alternatives A and B. Depending on mortality levels, more prescribed burning under this alternative could produce more snags in burned forest than Alternatives A and B.

In terms of managed wildfire, Alternative C permits managed wildfire on all NFS lands except the WUI Defense and Threat Zones (a larger area than Alternative A but smaller than Alternative B). It is estimated that approximately 720 acres would burn annually as managed wildland fire. Therefore, managed wildfire under this alternative could produce fewer snags in burned forest than Alternative B but more than under Alternative A. The quality and quantity of this ecosystem component could be impacted by the ability to remove snags after a fire event under the same direction as Alternative B.

The black-backed woodpecker population in the LTBMU would remain stable under this alternative with potential to increase where managed wildfire is allowed outside of Desolation Wilderness (at a level more than Alternative A but less than Alternative B) and more prescribed fire is conducted but be impacted where snags are removed following a fire event, depending on the location and timing of removal (scope of a specific project).

Alternative D

Alternative D proposes to conduct prescribed burning on the same number of acres annually as Alternative C which is more than that proposed under Alternatives A, B, and E. Mortality levels would be the same under all alternatives. The difference between Alternatives C and D is that Alternative D proposes to accomplish forest health objectives using fire as the primary tool (with some hand thinning) whereas Alternative C has the ability to prepare the landscape for fire by using mechanical treatments of stands first. Therefore, this alternative could potentially create the most snags in burned forest of all the alternatives from prescribed burning because fire is used as the primary tool and stands would have more dense pre-burn conditions. However, this alternative has significant implementation limitations that could restrict the ability of this alternative to meet desired conditions. Some limitations include current forecasted weather conditions, public concern, safety concerns, and air quality concerns.

It is estimated that the same number of acres would burn as managed wildfire annually under Alternative D as Alternatives B and E which is more than under Alternatives A and C. Forest stands would be thinned more conservatively under Alternative D (12 inch dbh limit) and more snags may be produced because of a greater potential for crown fire. If wildfire were to occur under this alternative, the potential for mortality from wildfire is greater than under any other alternative because of denser pre-burn stand conditions. Therefore, this alternative may produce more snags from managed wildfire than any other alternative. This alternative does not propose the removal of snags from burned areas unless where needed for public safety. Therefore, this alternative could feasibly retain more burned snags than any other alternative.

The population trend of black-backed woodpeckers in the LTBMU would remain stable but with the potential to increase more than under any other alternative because of the predicted increase in quantity of the ecosystem component and retention of this ecosystem component following a fire.

Alternative E

This alternative is similar to Alternative B in term of the strategies, acreage of prescribed fire and managed wildfire treated, and estimated mortality levels. However, this alternative includes a standard and guideline that more clearly articulates the value of snags in burned forest habitat and does not place a one-size-fits all retention level on this habitat type following a fire. Rather, restoration of habitat following a wildland fire requires the inclusion of wildlife objectives that prioritize retention of snag habitat. Therefore, the effects of this alternative on quantity and quality of snags in burned forest, and on trends on black-backed woodpeckers are similar to those described for Alternative B but this alternative has a greater potential to retain more acres of this habitat component on a project-specific basis, therefore having a greater potential for a positive trend in quality, quantity, and trend in black-backed woodpecker.

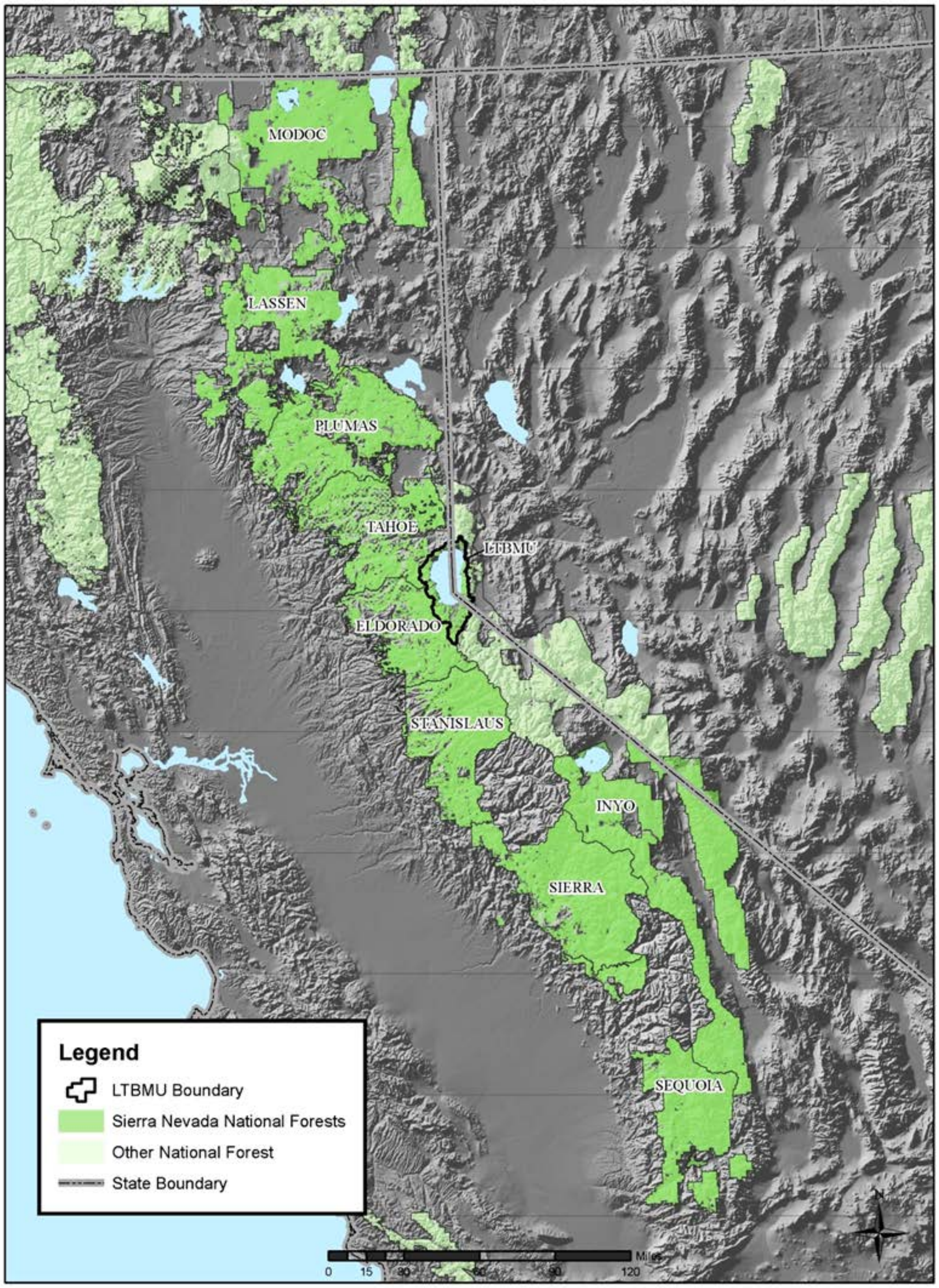


Figure 3 87. Map of the Sierra Nevada bioregion for MIS, comprised of ten national forests (including the LTBMU)

3.4.14.4. Analytical Conclusions

The acres of lacustrine habitat, miles of riverine habitat, and acres of riparian habitat are not expected to change over the next 15-20 years across the five Plan alternatives and all alternatives contain objectives, strategies, and standards and guidelines to maintain and improve the condition of these habitats (Table 3-52). These habitats are anticipated to remain stable or improve under all alternatives. However, the

quality of these habitats could be impacted by the expansion of developed recreation infrastructure (most under Alternatives C and A), increased access to NFS lands, grazing, and legacy impacts from past land uses that have not been repaired. Alternative D may present the greatest risk to habitat quality and trend in MIS because management takes a more passive approach to habitat restoration, allowing natural processes to maintain habitat following the completion of currently planned projects. In addition, under this alternative only high priority AIS would be removed, vegetation treatments would focus on prescribed fire and managed wild fire which has severe limitations and could increase the risk of catastrophic wildfire, and the reduction in recreation infrastructure could lead to unmanaged recreation where capacity is not met. The trend in macroinvertebrates is expected to remain stable with the potential to increase where restoration improves habitat quality and potentially decline without restoration. The local status of the yellow warbler is not well understood but it is expected that restoration efforts would have a positive effect on the population of yellow warbler but the population could decline where restoration is not implemented.

Wet meadows in the LTBMU are at risk of desiccation and loss from encroaching conifers and adjacent land uses, including the legacy impacts of past land management practices (e.g., channel incision, water diversion, and road and trail construction). It is difficult to predict how the quantity of wet meadow habitat would change in the long-term because the current rate of degradation is not understood and future restoration projects under Alternatives A, B, C, and E are not yet identified. The quantity of wet meadow habitat may increase where both ongoing and future restoration efforts are implemented (all Alternatives except D) but may decrease where restoration is not implemented which could occur under all alternatives but especially D. Wet meadow habitat quality has potential to improve under Alternatives A, B, C, and E with ongoing and future restoration projects, and especially under Alternatives B, C and E that have additional objectives beyond those in Alternative A for the maintenance and protection of this habitat type. Wet meadow habitat quality could improve under Alternative D given the emphasis on prescribed fire but the lack of future restoration efforts and restricted vegetation treatments could impact the condition of wet meadows, especially in the face of climate change. Alternatives A and particularly C pose impacts to wet meadow condition through the potential expansion of recreation and access on roads and trails. Wet meadow habitat quality could be impacted under all alternatives by grazing activities. The local trend of the pacific tree frog is not well understood. It is expected that the population would respond positively to restoration but could be impacted by grazing, lack of restoration (particularly under alternative D), and expansion of recreation and access to NFS lands (especially under Alternatives A and C).

Overall, based on results of the SPECTRUM model, Alternative C appears to have the greatest potential to create and maintain early and mid seral habitat. The quantity of early seral habitat is predicted to decrease for all forest types combined under Alternatives A, B, D, and E but experience no change under Alternative C. The quality of early and mid seral habitat would decline under Alternatives A and D because early and mid seral forests would transition to later seral stages and without replacement on the landscape. However, Alternative D proposes to use the most fire (prescribed and managed wildfire) that could help maintain and create this habitat but due to severe implementation limitation, it is not expected that this alternative could keep pace with loss. Habitat quality would be impacted by increased recreation and ski area expansion and additional miles of roads and trails, particularly under Alternatives A and C. The local trend in the mountain quail population is not well understood, but the population could be impacted by the decline in habitat quantity and quality, particularly under Alternatives A and D and by recreation and ski area expansion particularly under Alternatives A and C.

The quantity of late seral open canopy forest is predicted to increase under all alternatives. The quality of habitat would be expected to improve where vegetation management actively pursues the creation and maintenance of this habitat. The local trend in sooty grouse is not well understood but the species is expected to respond positively because of the increasing trend in habitat. Habitat quality and population

trend in sooty grouse could be impacted, especially under Alternatives A and C with the potential for expansion of developed recreation, ski areas, and upgrades to access through roads and trails.

The quantity of late seral closed canopy habitat is predicted to increase under Alternatives A and D for all forest types combined, experience no change under Alternatives B and E, and decrease slightly under Alternative C. Habitat quality is expected to improve under Alternatives B, C, and E as these stands become more resilient and include larger diameter trees. Habitat quality may decline under Alternatives A and D because of the potential for increasingly dense stand conditions (and increased risk of a stand-replacing disturbance) due to limitations on vegetation treatments (including the use of fire under Alternative D). The local trend in spotted owl, marten, and flying squirrel is not well understood, but these populations would be expected to respond positively in the long term to higher quality habitat and larger diameter trees under Alternatives B, C, and E. The populations are also expected to respond positively to more available habitat under Alternatives A and D. Habitat quality and MIS population trends could be impacted by a predicted decrease in CWHR size 6 habitat under all alternatives, recreation expansion (most under Alternative C), ski area expansion (most under Alternative A), decline in habitat quality under Alternatives A and D, and short term implementation impacts (large tree removal, canopy reduction) associated with Alternatives B, C, and E.

Snags in green forest are predicted to increase under all alternatives with the fastest trend predicted for Alternative D and the slowest trend under Alternative C. The quality of habitat would improve under Alternatives B, C, and E as snags are recruited because these stands would have larger diameter snags and less dense conditions than the stand under Alternatives A and D. Stands under Alternative A and especially under Alternative D could be more dense than stand conditions typically associated with this species. The local trend of the hairy woodpeckers is not well understood but the species is expected to respond positively under all alternatives as more snags are recruited, but could be impacted by dense conditions under Alternatives A and D, and slow recruitment rate under Alternative C.

Alternative D has the potential to create the most snags in burned forest because prescribed fire is proposed as a primary tool for vegetation management. Also, although Alternatives D, B, and E allow for the same number of acres managed as wildfire, Alternative D has the potential to create more snags because of the greater potential for crown fire from more dense stands conditions. Alternative D could also potentially retain the most snags but this depends on the location, severity, and extent of specific fires. The trend in the black-backed woodpecker would remain stable for all alternatives but have potential to improve with increasing snag creation under all alternatives but especially under Alternative D. The population could be impacted where snags are removed following a fire event (depending on the location and timing of removal), especially under Alternatives A, B, and C which have more intensive prescriptions.

Table 3 52. Summary of MIS habitat and population trends.

Habitat or Ecosystem Component and MIS	Metric	Trend Alternative A	Trend Alternatives B and E	Trend Alternative C	Trend Alternative D
Lacustrine/riverine	Habitat quantity (acres/miles)	No change	No change	No change	No change
Aquatic macroinvertebrates	Habitat quality	Remain stable or improve	Remain stable or improve	Remain stable or improve	Remain stable or improve, potential to decline without restoration
	Species population trend	Remain stable or improve	Remain stable or improve	Remain stable or improve	Remain stable or improve, potential to decline without restoration
	Potential impacts on habitat quality and trend in MIS population	Grazing, recreation expansion (AIS spread), legacy effects from past land uses	Grazing, recreation expansion (AIS spread) less than A, legacy effects from past land uses less than A	Grazing, recreation expansion (AIS spread) more than A, legacy effects from past land uses, all more than A	Grazing, no future restoration, AIS risk more than other Alts., legacy effects from past land uses, catastrophic wildfire
Riparian	Habitat quantity (acres)	No change	No change	No change	No change
Yellow Warbler	Habitat quality	Remain stable or improve	Remain stable or improve	Remain stable or improve	Remain stable or improve, potential to decline without restoration
	Species population trend	Current local trend unknown, potential for positive trend with restoration	Current local trend unknown, potential for positive trend with restoration	Current local trend unknown, potential for positive trend with restoration	Remain stable or improve, potential to decline without restoration

Habitat or Ecosystem Component and MIS	Metric	Trend Alternative A	Trend Alternatives B and E	Trend Alternative C	Trend Alternative D
Riparian Yellow Warbler	Potential impacts on habitat quality and trend in MIS population	Grazing, DBH limits for conifer removal, recreation expansion	Grazing, recreation expansion less than A	Grazing, increased access, recreation expansion more than A	Grazing, no future restoration, legacy effects from past land uses, implementation limitations (fire and DBH), risk of shifted unmanaged recreation use
Wet meadow	Habitat quantity (acres)	Unknown – potential to increase with restoration or decrease (loss of acres) in meadows not restored	Unknown – potential to increase with restoration (particularly B, C, E) or decrease (loss of acres) in meadows not restored	Unknown – potential to increase with restoration (particularly B, C, E) or decrease (loss of acres) in meadows not restored	Unknown - potential for decline without restoration
Pacific tree frog	Habitat quality	Improve	Improve more than A	Improve more than A	Improve with restoration and fire, potential to decline without future restoration
	Species population trend	Current local trend unknown, potential for positive trend with restoration	Current local trend unknown, potential for positive trend with restoration (especially under B and E)	Current local trend unknown, potential for positive trend with restoration (especially under B and E)	Current local trend unknown, potential for positive trend with restoration
	Potential impacts on habitat quality and trend in MIS population	Recreation expansion, grazing, legacy impacts from past land uses on meadows not selected for restoration	Recreation expansion less than A, grazing, legacy impacts from past land uses on meadows not selected for restoration	Recreation expansion more than A, grazing, legacy impacts from past land uses on meadows not selected for restoration	Lack of restoration beyond currently planned projects, implementation limitations (dbh and fire)

Habitat or Ecosystem Component and MIS	Metric	Trend Alternative A	Trend Alternatives B and E	Trend Alternative C	Trend Alternative D
Early and Mid-Seral Coniferous Forest	Habitat quantity (acres for all forest types combined)	Moderate decrease (early and mid closed), substantial decrease (mid open)	Slight decrease (early), moderate decrease (mid seral closed) and no change (mid seral open)	No change (early), moderate decrease (mid seral closed), slight increase (mid seral open)	Slight decrease (early), moderate decrease (mid closed and open)
Mountain quail	Habitat quality	Decline	Improve in treated areas, decline in other areas	Improve more than A and B	Decline
	Species population trend	Current local trend unknown, potential for declining trend more than other Alts.	Current local trend unknown, potential for positive trend with treatment	Current local trend unknown, potential for positive trend	Current local trend unknown, potential for declining trend less than A
	Potential impacts on habitat quality and trend in MIS species	Recreation expansion and ski area expansion, habitat loss from vegetation treatments that move forest to later seral stages	Recreation and ski area expansion less than A, creation that can't keep pace with loss to later seral stages	Recreation and ski area expansion more than A, increased roads and trails, creation that can't keep pace with loss to later seral stages but less than A and B	Habitat loss from vegetation treatments that move forest to later seral stages
Late seral open canopy coniferous forest	Habitat quantity (acres for all forest types combined)	Moderate increase	Substantial increase	Moderate Increase	Substantial Increase
Sooty blue grouse	Habitat quality	Improve	Improve	Improve	Improve
	Species population trend	Current local trend unknown, potential for positive trend	Current local trend unknown, potential for positive trend	Current local trend unknown, potential for positive trend	Current local trend unknown, potential for positive trend (most under D)
Late seral open canopy coniferous forest Sooty blue grouse	Potential impacts on habitat quality and trend in MIS species population	Recreation and ski area expansion, increased access to NFS lands	Recreation and ski area expansion less than A	Recreation and ski area expansion more than A, increased access to NFS lands more than A	Limitations on use of prescribed fire and managed wildfire to maintain habitat

Habitat or Ecosystem Component and MIS	Metric	Trend Alternative A	Trend Alternatives B and E	Trend Alternative C	Trend Alternative D
Late seral closed canopy coniferous forest California spotted owl Pacific marten Northern flying squirrel	Habitat quantity (acres for all forest types combined)	Moderate increase	No change	Slight decrease	Slight increase
	Habitat quality	Decline	Improve	Improve	Decrease
	Trend in MIS species	Current local trend unknown, potential for positive trend	Current local trend unknown, potential for positive trend	Current local trend unknown, potential for positive trend	Current local trend unknown, potential for positive trend
	Potential impacts on habitat quality and trend in MIS population	Increasingly dense stands, risk of stand-replacing event, decrease in CWHR 6, recreation and ski area expansion, limited recreation LOPs	Short term implementation impacts, decrease in CWHR 6, recreation and ski area expansion (less than A and C)	Short term implementation impacts and recreation expansion more than other Alts, ski are expansion less than A, decrease in CWHR 6	Increasingly dense stands, risk of stand-replacing event, decrease in CWHR 6
Snags in green forest Hairy woodpecker	Habitat quantity (acres for all forest types combined)	Increase	Increase at rate less than A	Increase at rate less than A and B	Increase at rate more than other Alts
	Habitat quality	Possible decline	Improve	Improve	Possible decline
Snags in green forest Hairy woodpecker	Species population trend	Current local trend unknown, potential for positive trend	Current local trend unknown, potential for positive trend	Current local trend unknown, potential for positive trend	Current local trend unknown, potential for positive trend
	Potential impacts on habitat quality and trend in MIS population	DBH limitation on tree removal can lead to overly dense conditions not preferred by MIS species	None identified	Possible slow rate of snag recruitment	DBH limitation on tree removal can lead to overly dense conditions not preferred by MIS species

Habitat or Ecosystem Component and MIS	Metric	Trend Alternative A	Trend Alternatives B and E	Trend Alternative C	Trend Alternative D
Snags in burned forest Black-backed woodpecker	Habitat quantity (acres for all forest types combined)	No change	Increase more than A	Increase more than A and same or more than B	Increase more than other Alts
	Habitat quality	No change	No change	No change	No change
	Species population trend	Remain stable with potential to improve	Remain stable with potential to improve	Remain stable with potential to improve	Remain stable with potential to improve
	Potential impacts on habitat quality and trend in MIS population	Snag removal	Snag removal but Alt E has greater potential than B for snag retention	Snag removal	None identified

3.4.15. Minerals

3.4.15.1. Introduction

The minerals program includes locatable minerals under the general mining laws, leasable minerals under the mineral leasing laws, and common variety minerals which can be sold or leased. Many of the National Forest System lands in the Lake Tahoe Basin are open to the filing of mining claims for locatable minerals, mostly metallic minerals, under the general mining laws. Under the mineral leasing laws, leases can be issued for energy development, although the only potential resource for energy development in the Basin is geothermal. In addition, mineral sales can authorize the extraction of common variety minerals such as sand, gravel or stone for landscaping or building.

This section evaluates and discloses the potential environmental consequences on the minerals program that may result from the adoption of Alternative A, B, C, D, or E.

Methodology

No statistical or analytical models were utilized. Current mining claim status is from the Bureau of Land Management Mining Claim Geographical Index Report for Dec. 13, 2012.

3.4.15.2. Assumptions

In the analysis for this resource, the following assumptions have been made:

- The location and filing of mining claims under the general mining laws through the BLM on National Forest System Lands that are open to mineral entry is not a discretionary action.
- Most of the NFS land on the LTBMU is not withdrawn, and does not have Weeks Law Status, so is open to the filing of mining claims.
- The issuance of mineral leases under the minerals leasing laws and the sale of common variety minerals are discretionary actions.
- The TRPA Regulatory Code, Chapter 18, and TRPA's Plan Area Statements and Community Plans, do not list mining or mineral extraction as an allowable use anywhere in the Lake Tahoe Basin. Therefore, such activities will not be permitted by TRPA.

3.4.15.3. Overview of the Affected Environment

Locatable minerals under the general mining laws include gold, silver, copper, uranium and rare earth elements, but can also include unique or special varieties of otherwise common variety minerals such as building stone or even pumice. Locatable minerals are appropriated by the filing of mining claims through the BLM, which give the claim holder the right to develop the claim to extract the valuable minerals located on it. A mining claim owner can retain their claim by filing annual assessment fees or paying mining claim maintenance fees to the BLM. Under the 1872 General Mining Law if they can prove a valuable, economically viable mineral deposit, they can file for patent which when granted, puts the claim under private ownership although there has been a budgetary moratorium on BLM accepting and processing new mining claim patent applications since October 1994 and BLM will not accept patent applications until the moratorium is lifted.

The Lake Tahoe Basin, which is located between the Mother Lode of the Sierra foothills in CA, and the Comstock Lode around Virginia City, NV, has had a low level of historic mining activity. Even though several thousand acres have been identified as having a high probability for the occurrence of metallic minerals, and about 30,000 acres have been identified with a low to moderate probability, there are only

10 known historic mining sites in the LTBMU. Even with the recent record high prices for gold, no new claims were filed on the LTBMU. Of the historic mining sites, all four mines with high safety hazards were fully decommissioned as of 2010, and the remaining sites are classified as low safety hazards.

All NFS lands within the LTBMU with federal minerals that are not withdrawn or have Weeks Law acquired land status are open to entry for prospecting and the filing of mining claims. On the LTBMU, 31,816 acres are withdrawn from entry under the mining laws: 23,886 acres of wilderness areas and 7,930 acres for recreation and administration site and water projects. The amount of land with Weeks Law status is unknown, but is probably less than a thousand acres. In addition, on another approximate 10,000 acres of acquired land, the minerals were outstanding and are under private ownership, and thus are not available for mining claims, but could be developed by the owners of the mineral estate.

There are currently eight active mining claims on the LTBMU. Five claims are located adjacent to the Mount Rose Wilderness above Incline Village, NV, and three are located around Lake Louise above the Homewood Ski Area in Placer County, CA. None of the claim holders have filed any notice or plan of operations for development of their claims. If these claimants or holders of any future claims filed suitable plans of operations, with adequate mitigation to protect water quality and other resource values and existing uses, and adequate reclamation bonds, the Forest Service would approve the plans. However, since TRPA would not permit the mining activity, the holders could not obtain the required state and county permits to actually start operations, and therefore mining is essentially precluded in the Lake Tahoe Basin.

Leasable minerals include oil, natural gas, coal, sodium, potassium and phosphate. There are no known occurrences of these minerals in the Lake Tahoe Basin and there have not been any requests to the BLM to offer leases in the Basin for these minerals. In addition to leasable minerals, geothermal energy is subject to leasing. There is some potential for low temperature geothermal energy suitable for direct heating on the North Shore, but no geothermal development has occurred, nor have any requests for geothermal leases been submitted. Leasable mineral development is a low priority for the LTBMU, and the LTBMU would probably object to any proposals by the BLM to offer leases for mineral or non-renewable energy development on the LTBMU except for small scale geothermal projects, due to conflicts with water quality and other resource and management objectives.

Common variety minerals include sand, gravel and cinders for construction or road use, and building stone, river cobbles and granite boulders for landscaping or building. Use of these materials can be authorized through mineral material sales, or small volume collecting permits. The current policy on the LTBMU is not to authorize removal of common variety minerals through sale or permit. This policy was implemented to meet water quality standards by preventing soil disturbance, to protect other resource values including scenic, recreational and wildlife and aquatic values, and to comply with TRPA's regulations. Currently the only mineral materials used by the LTBMU within the Basin are rock and soil extracted and used within a project area, and granite boulders removed from project areas to allow construction. The boulders are stockpiled for use as barriers to control off-road parking and driving. All other mineral materials for FS projects in the Lake Tahoe Basin are brought in from sources outside the Basin. The current policy will continue.

The only other existing mineral removal activity on the LTBMU is unauthorized mining of quartz crystals. There are deposits of very large smoky quartz crystals on the LTBMU. These are very popular and much of this activity is probably commercial, with the crystals appearing in rock shops adjacent to the Basin. This unauthorized activity causes resource damage and significant public safety concerns as well as safety issues for those digging for the crystals. Several of these mines have been vertical pits up to thirty feet deep. One was located immediately adjacent to the Tahoe Rim Trail, and another was found within a ski area last year. Two of the largest mines were decommissioned in 2010, and three more will be decommissioned this year.

3.4.15.4. Environmental Consequences

Mineral extraction activities are a low priority for the use of the National Forest System lands in the Lake Tahoe Basin as they are likely to conflict with the goals of protecting water quality and the outstanding scenic, recreational and natural resource values of the Lake Tahoe Basin. In addition, most mineral extraction activities are precluded by TRPA regulations. However, much of the LTBMU is open to the filing of mining claims and the submittal of Plans of Operation to develop any claims. All mining proposals under the mining laws would be thoroughly evaluated and mitigated through review and NEPA preparation for any Plans of Operation submitted, even though TRPA would not permit the activity. This objective will be consistently applied for all five alternatives and will not change by alternative.

The only potential impact of the alternatives to the mineral program will be that Alternatives C and D could result in less land available for the filing of mining claims if the additional roadless area designations resulted in additional wilderness area designations, which would withdraw the areas from the filing of mining claims. There are no existing mining claims in either roadless area.

Alternatives A, B and E would have no effect on the acreage available for the filing of mining claims. Alternative C could result in the Dardanelles Roadless Area being withdrawn from mining if it becomes designated wilderness. Alternative D could result in the most acreage withdrawn if both the Dardanelles and Freel Roadless Areas are eventually designated as wilderness. These potential environmental consequences are of minimal concern as no known minerals or interest in developing them have occurred in the roadless areas, and development would be precluded by TRPA.

Comparison of Consequences by Alternative

There are no programmatic differences between the alternatives, except that Alternatives C and D could result in withdrawal of land from mining because of potential wilderness designation.

How the Alternatives Maintain or Achieve the Desired Conditions

There would be no difference between the alternatives in how desired conditions are maintained or achieved.

3.4.16. Natural Hazards

3.4.16.1. Introduction

This section evaluates the environmental consequences of the alternatives as it relates to natural hazards, primarily in terms of geologic hazards. Geologic hazards include a litany of processes such as landslides (i.e., rockfall, landslides, debris flows and torrents), snow avalanches, seismic activity, lake tsunamis (i.e., seiches), and volcanic activity.

Methodology

Estimation of natural hazard risk potential based on the Natural Hazard Study for the Lake Tahoe Basin Management Unit (Kohler, 2008).

3.4.16.2. Overview of the Affected Environment

The Lake Tahoe area, including the LTBMU, is geologically active with the potential for a variety of geologic hazards to occur, however the risk is relatively low.

Currently the risk from geological hazards and floods to existing roads, houses and other infrastructure is relatively low in the Tahoe Basin, because these features are not located in areas of high geologic hazards (ie. steep slopes and avalanche paths). For future development, the current Terrestrial Ecological Unit Inventory information provides a starting point for land use planning and permitting by both the USFS and the Tahoe Regional Planning Agency.

The available information provided and cited in the Natural Hazards Study (Kohler, 2008) should be considered in evaluating the potential impacts of geohazards to projects and the potential impacts that the projects may have on underlying or adjacent geohazard-prone areas.

3.4.16.3. Environmental Consequences

Hazard and risk are not synonyms in the risk management sciences. In a geologic risk analysis the hazards are evaluated for the likelihood (i.e., chance or probability) that the geologic process will occur. The next step in the risk analysis is to predict what the consequences will be for a particular hazard likelihood.

We determined the likelihood by using two approaches in this project. In the first approach, for landslides and snow avalanches, we used the steepness of the hill slope. In the second approach, for seismic activity, seiches and volcanic activity, we used the geologic history of the Lake Tahoe Basin. In the first approach we know from the scientific literature as well as empirical studies on the adjacent Eldorado National Forest, that the hill slopes with gradients of 60% or greater are more likely to have landslide movement than the gentle slopes of 59% or less. Therefore the hill slope gradient of 60% was used as a "threshold value" for assigning a high likelihood of landslide movement. For the gentle slopes the hazard was assigned lower likelihoods.

In the second approach we know from the geologic history of the Basin that volcanism last occurred sometime between several thousand years ago to a few million years ago. Therefore, in the next ten to fifty years it is unlikely that a volcanic event will occur (if it last occurred several thousand years ago it is unlikely that it will occur again soon). And in a similar vein we did the same with lake tsunamis (seiches). Although seiches do occur on Lake Tahoe, they are not known to occur with any regularity and the most recent is estimated to have occurred several hundred years ago. Therefore seiches were assigned lower probabilities for occurring than for the landslides. Table 3-53 displays the estimated geologic hazards, consequences and risks within the LTBMU.

Table 3 53. Estimated geologic hazards, consequences and risks within the LTBMU

Delineation between slopes with greater than 60% and those with 60% or less is based on a shear strength study by Prellwitz and Koler (2003).

Hazard	GIS Geo-morphic Map Unit	Estimated Hazard Rating		Possible Consequences	Estimated Risk Rating	Possible Mitigation Options	
> 60% Hill Slope Gradient		**≤ 60% Hill Slope Gradient**		**> 60% Hill Slope Gradient**		**≤ 60% Hill Slope Gradient**	
Snow Avalanche Chutes	GE[1]	Possible to Almost Certain	Rare	Some damage to Highway 50 (Minor to Medium)	Low to High	Very Low to Low	Caltrans currently provides mitigation for minimizing avalanche hazards from occurring
Rockfall	MW[2] MW/GE and MW/GD[3]	Unlikely to Almost Certain	Rare	Medium to Catastrophic	Low to Very High	Very Low to Moderate	Warning systems, deflection walls, and nets
Landslides	MW[4]	Unlikely to Almost Certain	Rare to Possible	Medium to Catastrophic	Low to Very High	Very Low to High	Warning systems, retaining structures, dewatering of landslide mass
Debris Flows and Torrents	MW	Possible to Almost Certain	Rare to Possible	Medium to Catastrophic	Moderate to Very High	Very Low to High	Warning systems and deflection structures
Seismic	----	Rare to Almost Certain		Minor to Catastrophic	Very Low to Very High	All structures meet seismic design criteria under the Unified Building Code	
Seiches	----	Rare to Possible		Minor to Catastrophic	Very Low to High	Warning systems	
Volcanic	----	Rare		Minor to Catastrophic	Very Low to Moderate	----	

1 Although there are no avalanche chutes mapped within the LTMBU GIS geomorphic layer, they are included as inclusions within the glacial erosional map unit (GE).

2 MW represents mass-wasting which not only includes rockfall but also landslides and debris flows.

3 MW/GD represents mass-wasting within glacial deposits (GD).

3 MW may also include secondary geomorphic processes such as fluvial (F), glacial erosional and depositional processes (GE and GD). For the polygons that have a fluvial dominate process with mass-wasting as a secondary process (F/MW), the mass-wasting is usually stream bank failure or the materials through which the stream is cutting its course may be mass-wasting deposits.

3.4.16.4. Analytical Conclusions

Comparison of Consequences by Alternative

There is no difference in environmental consequences between any of the alternatives as it relates to natural hazards. Projects would include site-specific hazard evaluation. Risks would be mitigated through project design, either through use of BMPs or through avoidance of the hazardous areas.

How the Alternatives Maintain or Achieve the Desired Conditions

Under all the alternatives standards and guidelines and the available information provided and cited in the Natural Hazards Study (Kohler, 2008) will be considered in evaluating the potential impacts of geohazards to projects and the potential impacts that the projects may have on underlying or adjacent geohazard-prone areas. There would be no difference between the alternatives in how desired conditions are maintained or achieved.

3.4.17. Noise

3.4.17.1. Introduction

Noise by definition, is "unwanted sound," and is a subjective reaction to acoustical energy or sound levels. It was identified in the 1988 Forest Plan as a resource environment concern within the National Forest. The LTBMU adopted the TRPA (Tahoe Regional Planning Agency) noise thresholds for the Tahoe Basin for the NFS lands within the Lake Tahoe Basin. The LTBMU Forest Plan FEIS identifies noise as a potential environmental consequence that needs to be addressed.

Visitors and residents have expressed concerns about the level of noise they've encountered from such sources as off-highway vehicles, on-highway traffic, over-snow vehicles, chainsaws, watercraft, aircraft, and occasionally from other forest visitors. While noise levels within the LTBMU lands have been generally stable since the 1988 Forest Plan, increasing urbanization and visitation have contributed to some increases. In recent years, management of noise has become a growing concern in the Tahoe Basin and on lands administered by the Forest Service. A Monitoring Plan was identified in the 1988 Forest Plan to determine if activities on NFS lands are within human and animal tolerance levels. The Plan also stated that the Forest Service would cooperate with the TRPA and other agencies in the reading of single and cumulative noise event levels at selected locations. Noise monitoring was intended to occur annually, however noise monitoring on the LTBMU has been limited to random monitoring of snowmobiles and off-highway vehicles.

The Plan also contained a summary of noise environmental thresholds, which were developed by the TRPA and adopted by the LTBMU. The TRPA as recently as 2013, has been conducting a noise monitoring program, sampling noise levels around the basin (Community Noise Equivalent Levels or CNELs, and single noise events). In 2010 their noise monitoring focused on watercraft generated noise around the basin. Monitoring reflects there is a general compliance with established noise thresholds, however there are exceptions.

Research needs were also identified in the Forest Plan to determine the natural background levels for noise in the environment, especially in the wilderness, and for habitat of wildlife indicator species, along with a determination of the level of change that can be tolerated by wildlife. To date, research has been limited, inconclusive or non-existent regarding the impacts of noise on indicator wildlife in the Lake Tahoe Basin. Effects of noise on wildlife are discussed in the wildlife sections of this document.

Methodology

Monitoring Noise

Noise monitoring has been conducted throughout the Lake Tahoe Basin by the TRPA, using calibrated sound level meters. Monitoring is conducted to evaluate compliance with single event noise (e.g., aircraft, watercraft, motor vehicles, off-road vehicles, snowmobiles), and community noise standards. Noise monitoring systems use sound level meters meeting ANSI Type 1 and IEC Class 1 technical specifications. TRPA has established a noise standard for various land use categories ranging from wilderness areas to industrial areas. In addition, LTBMU law enforcement officers occasionally monitor noise levels of individual off-highway vehicles and or snowmobiles using A-weighted sound meters, and tested using established protocols as adopted by the Society of Automotive Engineers (SAE) under Standard J-1287 as applicable.

Monitoring Noise in the Lake Tahoe Basin

Noise monitoring has been focused on specific sources and areas. The sources and areas where the Forest Service monitors include:

- Off-Highway Vehicles are monitored for noise. The noise threshold for off-highway vehicles is 72 dB at a speed of less than or equal to 35 mph and a standard of 86 dB at 50 feet at speeds over 35 mph. TRPA OHV standards are both more and less restrictive than the California Vehicle Code standards, which are not speed dependent (limit is 82 dB at 50 feet). The California standards are applied to the sale of a new OHV. There is also a standard that requires in-use OHVs be equipped with a silencer to meet a standard of 96 dB at a distance of 20 inches, using techniques established by the Society of Automotive Engineers (SAE J-1287). This is the same standard enforced by the Forest Service under the Federal Code of Regulations that requires the USFS to apply established state standards (Nevada has no such standard).
- Over-Snow Vehicles (e.g., snowmobiles) are monitored for noise. Environmental Threshold for over-snow-vehicles (OSVs): 82 dB at 50 feet at less than 35 mph. TRPA monitoring has reflected that most OSVs are in compliance. The Forest Service also monitors stationary OSV noise to determine if applicable standards developed by the Society of Automotive Engineers (as adopted by the State of California) are being met. LTBMU monitoring also has reflected that most OSVs have been in compliance.

Most noise sources are outside of the Forest Service's authority to regulate (e.g., transportation, aircraft, urban noise sources, boats, on-highway motorcycles). However, the Forest Service does have some regulatory authority over general noise sources that occur on NFS lands within the Lake Tahoe Basin.

Assumptions

In the analysis for this resource, the following assumptions have been made:

- Noise monitoring will continue, with potential changes in the noise thresholds and standards as established by the TRPA. Much of the sound level monitoring and noise compliance monitoring will continue to be conducted by the TRPA within the Tahoe Basin, The LTBMU will continue to check compliance with CFR and State of California regulations respective to noise issues, through occasional random monitoring. Monitoring will follow established acoustical procedural methodology or appropriate SAE standards.
- Noise generated by recreation activities such as events, and over-snow vehicle uses may receive more attention because of public concerns.
- Prior to the issuance of a special use permit for an event or a new activity on NFS lands, compliance with existing noise standards are considered.

3.4.17.2. Overview of the Affected Environment

Existing Condition

Noise monitoring has been conducted around the Lake Tahoe Basin for over 20 years. In some areas, noise levels have increased, while in other situations, noise levels have been stable and occasionally decreasing. As stated in the 1988 Forest Plan: “noise is becoming a major concern in administering the National Forest. There are occasional complaints about chain saws, OHV and low-flying aircraft over Desolation Wilderness. As noise measurements are taken in the future, actions may be necessary to meet single event and cumulative event noise standards that have been established for the area. Monitoring Plan directions at the time were to “cooperate with TRPA and other agencies in the reading of single and cumulative noise event levels at selected locations.” Since that time, the LTBMU has cooperated with TRPA and other agencies to conduct noise monitoring.

TRPA has conducted a focused review of Basin noise standards and thresholds as part of the Regional Plan Update, and staff forwarded a number of recommendations that have yet to be adopted. The goal is to develop the necessary noise monitoring strategies needed to preserve community serenity and also provide abundant quiet recreation areas.

Overall, the Existing Condition for noise remains the same as identified in the 1988 Forest Plan for the LTBMU: noise remains an issue within the LTBMU, and the Forest Service has limited noise enforcement authority or responsibility, however to meet the Desired Conditions, the LTBMU addresses single noise event issues respective to recreation events, motorized vehicles (including snowmobiles), and noise generated by either resource management and/or recreation activities on the National Forest. The LTBMU will continue to encourage use of the best available technology to minimize noise levels in excess of acceptable quantities, along with operating practices that minimize noise levels.

3.4.17.3. Environmental Consequences

Noise is not a resource condition that is “desired,” as by its definition is “unwanted sound.” Noise can be an intrusion on the recreational experience of forest visitors, and negatively impact the tranquility of neighborhoods. Noise can also be impacting on wildlife, though more research on this is needed.

Noise is partially subjective, as tolerance does vary according to such factors as its intensity, time of occurrence, duration, proximity to the source and individual sensitivity based upon factors such as individual expectations and values.

Noise will be generated from various activities including:

- Access and Travel Management,
- Recreation Development,
- Dispersed Recreation (Summer and Winter Motorized)
- Watershed restoration,
- Vegetation and Fuels Treatment,

Most of the noise generated from these activities is of short term duration: From hours, days, to several months or a year.

Other actions generated from other resource management activities are not considered in this analysis as they are not anticipated to affect the character of the existing general noise settings and they are not monitored by the TRPA for single or cumulative noise events. For example resource management or activities that would not be monitored include:

- Aquatic and terrestrial invasive species management.
- Managing wildlife.
- Dispersed summer and winter non-motorized recreation activities.
- Wilderness Recommendations.

Consequences Related to Noise

Access and Travel Management

Much of the noise generated from Access and Travel Management activities from the construction and decommissioning of roads, trails and parking areas generates noise from asphalt grinding and the grading of roads and parking areas with heavy equipment, and the use of chainsaws and other mechanical devices in both developed and rural settings. As mentioned above, much of the impacts generated from these activities are primarily the intensity, time of occurrence, duration, proximity to the source and individual sensitivity based upon factors such as individual expectations and values. Generally stated, more noise will be generated from the construction and maintenance of the higher condition class roads and trails (Classes 4 and 5) than from the lower condition class roads and trails (Classes 1-3). It is also anticipated that noise will increase as roads are upgraded and road speed and traffic volumes increase.

As stated in the access section of this FEIS (3.4.1), there will be more road and parking improvement projects in Alternative C than the other alternatives. Alternative C would tend to shift the most automobiles towards higher condition class roads, consolidated access routes and parking facilities. More class 2 and 3 roads open to high clearance vehicles and OHV will be available in alternative D and more Trails open to OHV will be in Alternative C (See Table 2-1 in Chapter 2).

In Alternatives A, B, C, and E where roadside parking is reduced or eliminated outside of developed recreation sites, some of the parking demand would be absorbed within managed recreation sites or by expanding associated parking facilities. There is less potential for noise generating activates in Alternative D, because the reduction in overall developed recreation sites could result in reduced construction and maintenance of parking facilities.

Recreation Development

The degree of modification to recreation infrastructure will vary as each alternative provides more or less supply by expanding or reducing developed infrastructure in response to future recreation demand. In general, noise will be generated by activities such as: initial site construction (grading of sites for roads, campsites and parking spurs), clearing of vegetation (tree removal), grading of sites, asphalt and concrete installation (non-permeable surfaces such as roads, parking lots, and structures), and trenching for utilities.

As measured by the metrics of overnight accommodations and day use parking spaces, Alternatives A (10%) and C (15%) will have the most potential to generate noise due to the retrofitting of existing facilities or building new ones. Alternative B will allow up to a 5% increase in new or expanded facilities. Similar to Alternative B, Alternative E will allow a 5% increase in dayuse parking opportunities, and a 10% increase in overnight accommodations. There will be fewer short term noise impacts in Alternative D than in the other alternatives since there will be fewer construction projects although Alternative D will have some short term increases in noise generation where developed recreation infrastructure is lost to the noise generating activities of resource restoration.

Dispersed Recreation (Summer and Winter Motorized)

Summer Motorized – Summer motorized vehicles (passenger cars, high clearance vehicles and OHVs) and the noise they generate are monitored by the TRPA, and Forest Service law enforcement officers randomly monitor OHVs for single event noise standards. Historically, the large majority of these vehicles are in compliance with adopted standards. The TRPA standards for noise are described in the Affected Environment section above.

As stated in the Access and Travel Management section (FEIS, 3.4.1), there is more potential for noise generated from OHV use on remote roads in Alternative D, because there are more road miles available for that use than in the other Alternatives. Conversely, there are fewer OHV opportunities on trails in Alternative D and thus less potential noise. Alternative C offers the most miles of trail available for OHV use and thus more potential for noise in remote areas from this activity.

Winter Motorized –The TRPA and the Forest Service monitor OSVs (over-snow vehicles) for single event noise standards. Monitoring has reflected that most OSVs have been in compliance with adopted noise standards. Alternatives A, B, C, and E all maintain the same level of access for OSVs on NFS lands. Dardanelles recommendation for Wilderness designation would have minimal effect on noise levels since the area is already non-motorized (summer and winter). Designation of the Freel Wilderness area would contribute to a “quieter” noise environment with lower overall sound level due to the elimination of OSV use.

Watershed (Stream Channel and Habitat) Restoration

Watershed restoration projects would create short term noise impacts (1 month to 1 year) from stream channel restoration on developed recreation resources results from the use of heavy equipment (excavators, dozers, dump trucks) and from restoration activities such as sod borrowing, stock piling materials, and de-watering streams. Meadow restoration activities such as mechanical thinning also generate short term impacts. These restoration activities are generally transitory in nature but would affect nearby visitors and residents by the creation of noise, for the life of the project. The public may be temporarily inconvenienced by these activities.

Under all of the alternatives, currently planned stream channel and habitat restoration projects are expected to be accomplished. Short term noise from these activities on the public are more likely under Alternatives A, B, C, and E, as they will be continuing planning for implementation of both large and small scale restoration projects. In Alternative D, the strategy for watershed restoration will be to rely primarily on natural processes for recovery and would not have short term noise impacts from these activities beyond the currently planned projects.

Vegetation and Fuels Treatment

Noise from vegetation and fuel treatments generally include noise generated from: hand and mechanical thinning, masticators, aerial tree removal with helicopter or small mobile yarding, and temporary road construction and rehabilitation. Temporary roads are often constructed as a part of vegetation management projects to access areas not accessible from the permanent road system. Although these roads are temporary and closed to vehicle traffic from the general public, they are often used by hikers, equestrians, and mountain bikers. These short-term impacts generally range from 1 day to 1 month. Noise generated by these activities would mostly be heard from those recreating nearby, recreation sites and neighborhoods situated close to Wildland Urban Interface (WUI) zones.

People who recreate in WUIs or live near them will experience more potential noise impacts in Alternatives C and D as they would treat 300 more acres per year than Alternatives A, B and E. Alternatives A, B, and E will treat 3,800 acres per year and Alternative C and D would treat 4,100 acres/year.

For those who recreate in Backcountry, General Conservation, and on Santini-Burton/Urban Forest Parcel Management Areas, Alternatives A, B, and E propose 750 acres of fuels and vegetation treatments. Alternative C would propose to treat 1,500 acres/year (double the acreage in Alternatives A, B, and E), therefore resulting in more short-term noise impacts to dispersed recreation resources. Noise impacts from forest thinning would be lesser under Alternative D, which proposes the least amount of forest vegetation treatment at 450 acres.

3.4.17.4. Analytical Conclusions

Noise levels are expected to increase because of projected increases in visitation and population levels over the coming years. Noise management will be dependent upon a number of factors, including the ability to monitor and enforce regulated noise sources, of which the Forest Service has limited authority (being dependent upon multiple agencies and enforcement authorities as identified in the “relevant laws, regulations, and policy” section). The LTBMU will continue to consider any “significant” noise impacts that might be the result of a resource management decision. Since noise is partially a “social” issue and a “quantitative” issue, it has been identified as a “resource” issue, with many sources that will remain as a “challenging” issue on the LTBMU.

Comparison of Consequences by Alternative

Within each alterative noise mitigation actions can be considered at the project level, such as allowed uses, time of day those activities are allowed (i.e., noise generated during daylight hours is not weighted (penalized) as noise that occurs during evening and overnight hours because of the intrusive nature of noise during those periods). Management could also include such mitigations as overall decibel levels allowed in a single event, seasonal closure periods or hours for noisy events or activities.

It is anticipated that Alternatives A, B, C and E will generate noise increases to varying degrees as roads are upgraded and road speed and volume will likely increase, as will any expansion of recreation access or facilities. Resource restoration activities would likely generate some short-term noise (especially when mechanical forest vegetation treatment is involved), and effects on any adjacent urban areas would need to be evaluated prior to field operations. Alternative C would likely generate the highest noise levels of the alternatives because it proposes more of these noise generating activities. The inclusion of the Dardanelles recommendation for Wilderness designation in Alternative C would have minimal effect on noise levels since the area is already non-motorized (summer and winter).Alternative D will most likely result in the lowest overall noise being generated in that it reduces or constrains public uses and resource activities more than the other alternatives. An indirect effect of a Freel Wilderness designation would be the elimination of winter OSV use and the noise generated from that activity.

How the Alternatives Maintain or Achieve the Desired Conditions

Respective to noise, the Desired Condition is to control noise to maintain community and neighborhood serenity, provide abundant quiet recreation, and protect wildlife. The presented alternatives do not specifically address noise levels or potential noise mitigation measures. Alternative D would most effectively meet the Desired Conditions; Alternatives A, B, C, and E would adequately meet the Desired Conditions, but less than Alternative D.

3.4.18. Range Resources

3.4.18.1. Introduction

Grazing on NFS lands in the LTBMU takes place under two types of permits, term-grazing permits and special use permits. Term grazing permits are issued for ten-year periods and are defined legally as "licenses in real property". They convey to the permittee "privileges" to graze, not "rights". Grazing permits are always issued for a specific area, specific time, and specific number and kind of livestock. The actual date livestock enter and leave an allotment will vary each year with weather and resource conditions. In addition to term grazing permits, temporary permits may be issued on a yearly basis. Grazing is included in a special-use permit rather than a grazing permit, when grazing is a secondary use of an area or the permittee does not qualify for a term-grazing permit.

Methodology

The purpose of this section is to evaluate effects on Range resources from Alternatives A, B, C, D, and E. The Forest Plan includes unit-wide land management direction for the following program and sub-program areas, which could affect Range resources:

- Watershed and Aquatic Habitat Restoration
- Biological Resources
    - General/Native Species Conservation
    - Critical Aquatic Refuges (CARs)/Species Refuge Areas
    - Protected Activity Centers (PACs) and Home Range Core Areas (HRCAs)
    - Aquatic and Terrestrial Invasive Species
- Forest Vegetation
    - Wildland Urban Interface (WUI)
    - General Forest (Non-WUI)
    - Managed Wildfire
- Recreation
    - Developed
    - Dispersed
    - Wilderness
    - Backcountry
- Access to NFS Roads and Trails
- Permitted Land Uses

Assumptions

In addition to universal assumptions (see Section 3.3), the following Range resource specific assumptions have been made:

- Any changes to current range management (term grazing permit or special use permits) would be analyzed under project specific NEPA and would include a capability and suitability analysis.

- Range management activities would comply with all management direction (Standards and Guidelines) applied to invasive species and biological resources.

3.4.18.2. Overview of the Affected Environment

The LTBMU currently has three vacant allotments (Meiss, Cold Creek, and Trout Creek), one closed allotment (Baldwin), and one special-use pasture (Fredricks Pasture).

The Baldwin Allotment was closed in 2008 and included the 232 acres (20 acres private) allotment located in the Tallac Watershed. The ten year term grazing permit for 45 horses and mules from July 1 through October 15 expired 12/31/2006. A Notice of Violation due to inability to meet water quality standards was issued in 1999 from the Lahontan Water Quality Board. A capability and suitability analysis was completed as well as an Environmental Assessment in 2008 to determine if grazing should continue on the allotment. The determination and decision made by the Forest Supervisor in 2009 was to close the Baldwin allotment to future grazing (USFS LTBMU 2009).

The Meiss Allotment is an 11,275 acres allotment located in the headwaters of the Upper Truckee River Watershed. This allotment is in vacant status. The previous term-grazing permit for 200 cow-calf pairs was not reissued in 2002 due to resource concerns and inability to meet resource protection standards. A capability and suitability analysis as well as NEPA analysis would be needed prior to issuing another term-grazing permit.

The Cold Creek Allotment is a 5,026 acre allotment located in the headwaters of Cold Creek within Trout Creek Watershed. The term grazing permit for this allotment was canceled in 2003 as part of the High Meadows Land Acquisition and has remained in vacant status. A capability and suitability analysis as well as NEPA analysis would be needed prior to issuing another term-grazing permit.

The Trout Creek Allotment is 15,032 acres and located in the headwaters of the Trout Creek Watershed. Within the allotment boundary is a 160 acre private in-holding. The ten year term grazing permit expired 12/31/2011. Another permit was not requested and, therefore, this permit was canceled leaving the allotment in vacant status. A capability and suitability analysis as well as NEPA analysis would be needed prior to issuing another term-grazing permit.

The Fredericks Pastures are adjacent to Fallen Leaf Lake and total 145 acres. These pastures were historically associated with a Special Use Permit for Camp Richardson Corral. The grazing portion of this permit was not reissued in 2005. A capability and suitability analysis as well as NEPA analysis would be required prior to issuing another Special Use Permit.

A forest-wide capability and suitability analysis was completed for the 1988 Forest Plan. Capability and suitability would be re-analyzed on a site specific basis if any future grazing permits are requested.

3.4.18.3. Environmental Consequences

Watershed and Aquatic Habitat Restoration

Under Alternative A, B, C, and E, range resources would stay in current condition or improve as restoration activities in vacant range allotments are implemented. Where restoration activities restore stream and floodplain conditions or where riparian conditions (e.g., conifer removal) are enhanced, range resources will improve as herbaceous vegetation increases in abundance and vigor. Season of use could be shortened due to more frequent flooding following restoration activities.

Under Alternative D, range resources will stay in current condition or improve where active restoration improves stream and floodplain condition and riparian habitat. Where passive restoration is implemented,

there could be a loss of riparian or open meadow habitat, which would reduce availability of forage for livestock as meadow habitat shift to more upland species composition.

Biological Resources

Under Alternative A, B, C, D and E, range resources would stay in baseline condition. Where TESPC species are detected, LOPs may be enforced, limiting grazing opportunities in terms of both grazing season and, perhaps livestock numbers.

Grazing opportunities could be limited in terms of grazing season and livestock numbers if western bumble bees are detected within allotment boundaries. This mitigation may be required because heavy grazing and high forage utilization reduces flowering plants that provide necessary nectar and pollen.

Forest Vegetation

Under Alternative A, B, C and E the potential impacts to range resources would not vary. Where vegetation restoration activities restore areas outside the WUI and in active grazing allotment, herbaceous vegetation is expected to improve, which could provide more and higher quality forage for livestock.

Under Alternative D, there is an increased risk of unplanned, catastrophic wildfire that could cause mortality of livestock as well as impacts to herbaceous vegetation and woody shrubs. Additionally, some areas, due to passive management direction, could shift from riparian to more upland habitat, further reducing forage availability.

Recreation

Under Alternative A, B, and E, range resources would stay in baseline conditions or improve through management actions. Where visitor use increases, specifically dispersed use, there could be an increase in user conflicts.

Under Alternative C and D, if grazing were designated as a nonconforming use in the designation of wilderness, there would be no impacts to grazing resources through the designation of wilderness. Visitor use could increase if additional wilderness were designated. Range resources could be impacted through increased user conflicts such as domestic animal conflicts, fence tampering or unclosed gates.

Access to NFS Roads and Trails

Under all alternatives, range resources would stay in baseline conditions or decrease as trail and increased visitor use could increase conflict between domestic animals and livestock. Additionally, gates could be left open, impacting pasture maintenance and allowing animals to move into unauthorized portions of the landscape.

3.4.18.4. Analytical Conclusions

The overall condition of range resources across the LTBMU is expected to improve, stay at current baseline levels or adjust with the on-set of climate change in relation to management direction from all alternatives (Table 3-54). Management direction in Alternatives B, C, and E more clearly and contemporarily outlines restoration and enhancement of watershed and aquatic habitat specific to the Lake Tahoe basin. The restoration of watershed and aquatic habitat will indirectly affect range resources by increasing forage availability and vigor. Additionally, forest vegetation management direction in Alternatives B, C, and E would provide the greatest benefits to range resources through removal of conifers within meadows and/or meadow edges; increasing meadow habitat. Increased recreation, and road and trail use in all alternatives could potentially increase conflicts between livestock, recreationist, and/or domestic animals. This potential would be prevalent in all alternatives, but could be greatest in

Alternative C and D where areas are proposed for wilderness designation, which could increase visitor use.

Comparison of Consequences by Alternative

Table 3 54. Range Resources Impact Summary

Alternative A	Alternative B	Alternative C	Alternative D	Alternative E
Range resources would a) improve as result of restoration and enhancement or areas treated in forest vegetation actions near vacant allotment boundaries or b) decrease where impacted by land uses, especially where expansion of dispersed recreation increases potential user conflicts.	Range resources would a) improve as result of restoration and enhancement or areas treated in forest vegetation actions near vacant allotment boundaries or b) decrease where impacted by land uses, especially where expansion of dispersed recreation increases potential user conflicts. Impacts on Range resources are same as Alt. A.	Range resources would a) improve as result of restoration and enhancement or areas treated in forest vegetation actions near vacant allotment boundaries or b) decrease where impacted by land uses, especially where expansion (wilderness) of dispersed recreation increases potential user conflicts. Impacts on Range resources are greater than Alt. A.	Range resources would: a) improve as a result of currently planned restoration and enhancement b) decrease where restoration (including forest vegetation treatments) or enhancement is needed but not permitted, c) decrease where impacted by land uses, especially where expansion of dispersed recreation (wilderness) increases potential user conflicts. Impacts on Range resources greater than A, B, C, and E	Range resources would a) improve as result of restoration and enhancement or areas treated in forest vegetation actions near vacant allotment boundaries or b) decrease where impacted by land uses, especially where expansion of dispersed recreation increases potential user conflicts. Impacts on Range resources are same as Alt. A.

How the Alternatives Maintain or Achieve the Desired Conditions

The desired conditions for Range Resources will be met through the implementation of management direction set forth by multiple program areas, such as water quality, soil quality, SEZs, and biological resources (including botanical resources and terrestrial invasives). Resource protection measures proposed under Alternatives B, C, D, and E address contemporary desired conditions tied to species life history, habitat needs, and overall community-level management in the LTBMU. Specifically, the biological resources protection measures provide clear and proactive management direction for special-status species protection and habitat restoration.

If a permit were requested for an existing vacant allotment, the analysis to determine what level, if any, of grazing was appropriate would need to show that the proposed use is consistent with the Forest Plan, as described in the Forest Plan Consistency section of the Plan Introduction.

3.4.19. Recreation

3.4.19.1. Introduction

This section establishes the affected environment and discloses the potential environmental consequences on recreation resources that may result with the adoption of a revised land management plan. It examines, in detail, five different alternatives for revising the 1988 Lake Tahoe Basin Management Unit Land and Resource Management Plan as amended (LTBMU 1988).

Methodology

The National Visitor Use Monitoring surveys (NVUM 2000, 2005, and 2010) and the National Survey on Recreation and the Environment (NSRE 2005) are two valuable studies used to help characterize recreation use on the Basin by measuring quality trends in recreation demand and visitor satisfaction. Effects will be assessed by analyzing the following management activities that influence the quality and quantity of recreation resources:

- Modification of developed recreation facilities;
- Access and travel management;
- Watershed (stream channel and habitat) restoration;
- Vegetation and fuels management;
- Aquatic invasive species management; and
- Species recovery habitat restoration.
- Wilderness recommendations;
- Changes in recreation opportunity spectrum; and
- Ongoing dispersed recreation.

For purposes of analysis, recreation resources are generally characterized as:

Recreation Opportunities

- Recreation Opportunity Spectrum
  - ♦ Public Access -Dispersed Recreation
- Visitor Access –Summer
  - ♦ Non-Motorized and Mechanized
  - ♦ Motorized
- Visitor Access – Winter
  - ♦ Non-Motorized
  - ♦ Motorized

Recreation Development

- Developed Recreation
  - ♦ Ski Areas and Slopes
- Climate Change

Recreation Issues and Indicators

Issues

Public participation and collaboration identified several key issues as discussed in Chapter 1, Recreation Issues. They include:

Recreation Opportunities - Having a continued range of desired recreation opportunities and settings.

Public Access - Providing recreation access to public lands and shorelines**.**

Recreation Development - Maintaining recreation development to respond to recreation demand and enhance economic opportunities.

Indicators

Measurement indicators respond to the Issues and allow for analysis of the recreation resource by alternative. These recreation indicators are depicted in detail below and in Chapter 2 (Table 2-1).

1. **Recreation Settings –** Acres of Recreation Opportunity Spectrum (ROS) classes are used to measure the existing supply of recreation settings. The degree that alternatives increase, decrease, or change the various ROS classes will be used to compare the impact of alternatives.

2. **Public Access to Dispersed Recreation –** Miles of roads and trails and number of trailheads available to the public that reflects accessibility to dispersed recreation opportunities (see Table 2-1).

3. **Developed Recreation –** Acres of developed recreation sites, often under special use permit, are used as a measure of existing recreation opportunities. The degree to which alternatives respond to demand by increasing or decreasing the available developed recreation acres will be used to compare the impacts of alternatives.

4. **Developed Overnight –** Overnight accommodation units are an indicator of the number of cabins, lodges, and campsites available to the visiting public. The degree to which alternatives increase or decrease overnight accommodations reflects our ability to accommodate overnight recreation demand and will be used to compare the impacts of alternatives.

5. **Developed Day Use –** The number of day use parking spaces is a function of the public ability to access developed day use recreation opportunities. The degree to which alternatives increase or decrease day use parking spaces reflects our ability to accommodate recreation demand and will be used to compare the impacts of alternatives.

6. **Ski Area Operational Boundary –** The acres within a ski area and ski slope permit boundaries that are used for development (e.g., runs, lifts, and structures).

Metrics

The following metrics were used to quantify the above mentioned measurement indicators. These include:

1. **Recreation Site Acres –**Recreation site acres on National Forest System lands.

2. **Overnight Accommodations –** Lodging and campsite units on National Forest System lands.

3. **Day Use Parking Spaces –** Parking spaces available for day use located at developed recreation sites on National Forest System lands.

Assumptions

Recreation Demand – Recreation demand is expected to grow in all alternatives for the life of the plan. While the Forest Service strives to respond to growing user demands, it recognizes that meeting all user demand remains unfeasible. The Agency cannot sustainably—environmentally, economically, or socially— provide for all recreation demand in the Lake Tahoe Basin. Demand will continue to exceed capacity at some recreation sites during peak seasons in all alternatives.

Recreation Conflict Strategy– The strategy to manage recreation conflicts will consistent for all alternatives as stated in the Revised Forest Plan: "Recognizing and accepting that some conflict between user groups in natural, the LTBMU will manage user interaction by using a variety of methods, including educating visitors on shared and multiple use concepts (e.g., signage, information kiosks, interpretive programs), managing visitor expectations, and recreation setting design."

Special Use Permits – Special use authorizations for management and operation of resorts, ski areas, and recreation sites (campgrounds and day use areas) will continue under all alternatives.

Recreation Infrastructure – Recreation infrastructure will continue to be upgraded, retrofitted, relocated, or decommissioned in order to reduce deferred maintenance, facilitate recreation demand, and protect natural resources in all alternatives. Examples of these activities include:

- Implementing BMPs and universal accessibility upgrades at recreation sites.
- Updating existing lodging and support facilities at resorts and recreation sites to provide quality recreation experiences.
- Replacing or repairing existing restrooms at recreation sites (includes adding showers at campgrounds)
- Decommissioning sites that are not in use or are economically infeasible to maintain.
- "Hardening" sites - in order to protect natural resources and to allow recreation use to continue into the future, developed recreation sites are made more sustainable through design and construction principles that increase a site's ability to withstand use without facility or natural resource deterioration.

Recreation Expansion

Under all alternatives, the LTBMU recreation program will work towards the sustainable integration of environmental, social, and economic conditions. This is achieved in part by adapting to changing user demands, trends, and preferences, including modifying existing sites and infrastructure to improve natural resource conditions and recreation settings. During the Forest Plan scoping and public comment process, infrastructure expansion and permanent development of general forest areas were identified as an issue of concern. The Forest Service undertakes recreation expansion to address socioeconomic challenges, improve management of existing developed sites, and mitigate adverse effects to natural resources resulting from recreation activities.

The EIS describes this issue as 'recreation expansion' and defines it as an increase of infrastructure in support of additional recreation opportunities over the Lake Tahoe Basin Management Unit landscape. Each alternative describes a range of recreation expansion by percentage. Alternatives A, B, and C would allow for expansion up to 10%, 5%, 15%, respectively, whereas Alternative D would allow up to a 15% reduction. Alternative E would allow a 5% increase in developed site acres, day use parking, and ski area operational footprint acres, and a 10% increase in overnight accommodation units. These percentages correspond to the following measurement indicators: recreation site acres, overnight accommodation units, and day use parking spaces.

Management activities that are, and are not considered as recreation expansion are discussed in section *3.3.1 Recreation Expansion under all Alternatives*.

3.4.19.2. Overview of the Affected Environment

Current Conditions

Recreation Setting

The Lake Tahoe Basin is a world-renown tourism destination providing year-round outdoor-recreation opportunities nestled in a scenic, high-alpine setting. The Lake Tahoe area offers diverse outdoor recreation activities ranging from the highly challenging, thrill-seeking experiences sought in popular resort settings to the tranquility of remote areas where visitors can find solitude and spiritual renewal. People live in Lake Tahoe to enjoy the quality of life benefits associated with a mountain environment; people visit Lake Tahoe to test their outdoor skills, escape the stresses of day-to-day life, and take advantage of the restorative opportunities the area provides.

Lake Tahoe is commonly known as the "Jewel of the Sierra"—its' social, economic, and environmental value cannot be overstated. The deep azure lake is the region's central iconic feature and draws well over 5.7 million visitors annually – the highest concentration of visitor use among national forests. The challenge is to sustain Lake Tahoe's intrinsic character, while providing high-quality recreation settings and opportunities that contribute to a thriving economic base.

The Lake Tahoe Basin Management Unit (LTBMU) is 154,850 acres in size and spans two states. Elevations range from 6,225 feet at Lake Tahoe's shoreline to 10,891 feet at the rounded top of Freel Peak. Much of the LTBMU's landscapes remain natural appearing and provide the beautiful visual backdrop that draws visitors from around the world. The area's seasonal changes are dramatic, with snowy winters, vibrant fall colors, and mild spring and summer periods. With the exception of periods of inclement weather, the skies are clear, providing a picturesque contrast to the verdant mountains that rim the basin. There are cultural and historic sites representing many periods of the LTBMU's history.

The LTBMU has four resorts that provide world-class downhill skiing opportunities. There are 337 miles of non-motorized trails that provide day use and overnight opportunities for hiking, biking, horseback riding and camping into remote areas of the National Forest. The Pacific Crest Trail traverses the Basin

on its western boundary. There are 12 developed campgrounds (three are operated by resorts) and eight day use sites for picnic and scenic viewing. There are six designated swimming beaches that are included in approximately 14 miles of publicly accessible shoreline that provide opportunities for water play and other water-related activities. The LTBMU provides 84 miles of passenger-vehicle roads that are outstanding for viewing the region’s natural features; and 115 miles for more rugged backcountry motorized touring for high clearance vehicles. Over 64% of the LTBMU is classified as being in a “semi-primitive” condition as defined by ROS classes, with 24,670 acres of the area currently designated as wilderness.

Sustainable Recreation

The aim of sustainable recreation management is to integrate recreation program activities with landscape processes, social values, and economic consideration to provide high quality recreation opportunities can be perpetuated through the long term.

Sustainable recreation is a systems-based approach to managing recreation within the larger context of landscape values, services, and processes. The three themes encompassed by sustainability are social (recreation opportunities), economic (built environment), and environmental (natural setting). No one theme is prescriptive of sustainability in and of itself; all three must successfully be integrated in the landscape in order to achieve sustainable recreation. By addressing facilities issues in concert with resource protection, sustainable recreation management increases the longevity and quality of developed and dispersed recreation opportunities on the Lake Tahoe Basin Management Unit.

Recreation Visitation

Based upon the National Visitor Use Monitoring (NVUM) survey that monitors visitor use every 5 years, the LTBMU receives visitors primarily from California and Nevada (76%). This constitutes the LTBMU’s primary market area. The ethnic and racial make-up of the primary visitors are more than 90% white, which does not reflect the general composition of these counties (See Appendix F – Social and Economic Assessment for more information regarding the demographic profile of visitors). The remaining 24% of visitors come from other parts of the United States and abroad.

More specifically, these surveys found that 52% of visitors to the Lake Tahoe basin come from a distance of 200 miles for recreation opportunities. Supporting data from the National Survey on Recreation and the Environment (NSRE) indicates that the larger visitor market for the LTBMU includes the majority of California, southern Oregon, and western and southern Nevada.

Based upon the NVUM data there were an estimated 5.7 million national forest visits to the Lake Tahoe Basin Management Unit in 2010 (USDA Forest Service 2012). This figure is higher than what was projected in the 1988 Forest Plan. The increase in visitation has resulted in increased demands for site access during peak seasons, related transportation congestion, and a perception of crowding in some recreation areas. Table 3-55 provides annual visitation estimates.

Table 3 55. National Forest Visits to the LTBMU *(1988 Forest Plan, NVUM 2000/05/10)*

Forest Visits§	**1988#**	**2000***	**2005***	**2010***
Total Estimated National Forest Visits	1,081,000 (Under reported)	3,105,000	4,391,000	5,786,000

§ A National Forest Visit is defined as the entry of one person upon 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.

1988 Land and Resource Management Plan

*Actual NVUM values. These individual values are estimates with a 90% confidence level based on NVUM surveys, for example if the visitation estimate is 100 +/-5%, one would say "at the 90% confidence level visitation is between 95 and 105 visits.

As discussed in the 2006 Comprehensive Evaluation Report, the annual number of basin visitors has been higher than was projected in the 1988 Forest Plan. As visitation has increased, the LTBMU has not expanded its capacity, but has strived to maintain and improve the quality and level of services through recreation site improvements, special use authorizations and partnerships.

Recreation Visitor Demand

As shown in the table above, the demand for national forest recreation opportunities and services in the Lake Tahoe Basin has grown since 1988. Most developed facilities however, have not increased in design capacity and at peak periods these facilities often reach vehicle site capacity. Assuming this trend persists, recreation managers anticipate rising demand will continue to place additional pressure on existing sites, services, and facilities. In addition, managers anticipate areas that currently receive relatively less use (based on previous NVUM statistics as well as anecdotal observations) might experience increased pressure from displaced visitors. Demand will continue to outstrip supply during peak periods at popular areas.

Similar impacts are expected to occur in dispersed recreation areas as more users share the same general forest or trail system, which could result in a rise in user conflicts between motorized and non-motorized users. Agency managers will face increasingly difficult decisions about recreation management and resource protection conflicts as the demand for recreation opportunities grows.

Currently, visitors to the LTBMU participate in a broad spectrum of recreation opportunities. Table 3-56 provides a snapshot of the order of popularity of the primary activities reported in the 2010 National Visitor Use Monitoring survey.

Table 3 56. 2010 Recreation Activity Participation on LTBMU

Activity	% Participation*	% Main Activity‡	Average Hours Doing Main Activity
Relaxing	65.5	11.2	9.2
Downhill Skiing	62.5	55.9	8.9
Viewing Natural Features	56.3	5.6	4.3
Hiking / Walking	47.0	8.8	3.5
Viewing Wildlife	43.2	1.5	3.6
Driving for Pleasure	31.8	2.1	3.5
Visiting Historic Sites	15.1	0.4	2.1
Other Non-motorized	14.9	2.8	3.7
Nature Center Activities	13.2	0	2.0
Bicycling	11.0	3.1	3.0
Resort Use	10.7	0.2	59.4
Cross-country Skiing	9.8	1.5	4.1
Nature Study	9.6	0.1	3.6
Picnicking	9.5	0.6	4.5
Non-motorized Water Activities	6.9	1.7	2.4
Motorized Water Activities	6.8	0.9	3.0
Snowmobiling	6.2	1.0	2.0
Fishing	5.6	0.4	3.3
Some Other Activity	5.3	1.6	3.0
Developed Camping	5.2	0.4	68.5
Gathering Forest Products	4.7	0	0
Backpacking	4.4	0.2	48.2
Primitive Camping	2.4	0.1	1.0
Horseback Riding	2.0	0	1.0
OHV Use	1.7	0.4	3.3
Motorized Trail Activity	1.4	0	0
Other Motorized Activity	1.3	0	0
Hunting	0.1	0	0
No Activity Reported	0	0	0

* Survey respondents could select multiple activities so this column may total more than 100%.

‡ Survey respondents were asked to select just one of their activities as their main reason for the forest visit. Some respondents selected more than one, so this column may total more than 100%.

It is expected that popular short-term day-use recreation activities will continue to be the primary activities as opposed to extended-duration activities such as staying at resorts and camping.

Recreation Visitor Satisfaction

An important element of the outdoor recreation program delivery is evaluating customer satisfaction with the supply of recreation settings, facilities, and services provided. Satisfaction is a core piece of data for national and forest level performance measures. Satisfaction information helps managers decide where to invest in resources and how to allocate resources more efficiently toward improving customer satisfaction.

Based upon NVUM data, the overall LTBMU recreation visitor satisfaction results are very high; 98% of visitors gave a rating of very satisfied or somewhat satisfied for their overall recreation experience. The agency's national target for this measure is 85%. Visitors are generally satisfied when there is an ample supply of facilities for lodging, camping, picnicking, beach use, skiing, trailheads, visitor information and the like, to support the demand. Table 3-57 depicts overall satisfaction ratings for visitor experiences in the Lake Tahoe Basin Management Unit in 2005 and 2010.

Table 3 57. NVUM overall satisfaction ratings 2005 and 2010

Satisfaction Rating	Percent Satisfied 2005	Percent Satisfied 2010
Very Satisfied	85.0%	89.8%
Somewhat Satisfied	13.1%	8.8%
Neither Satisfied nor Dissatisfied	1.8%	0.7%
Somewhat Dissatisfied	0.1%	0.3%
Very Dissatisfied	0.1%	0.4%

Satisfaction ratings are expected to remain high during the planning period if the Forest Service continues its ability to maintain a supply of high quality developed facilities and services, provide suitable access, and continue providing a feeling of safety.

Recreation Opportunities

Recreation Opportunity Spectrum

For planning purposes, recreation supply is defined as the opportunity for recreationists to participate in a desired recreation activity in a preferred setting to realize desired and expected experiences. Recreationists choose a setting and activity to create a desired experience. While the goal of the recreationist is to obtain satisfying experiences, the goal of the recreation resource manager is to provide the opportunities for obtaining these diverse experiences while maintaining the balance of natural resource concerns. Managers provide a supply of recreation opportunities by managing settings, activities, and facilities, which in turn allow visitors to have recreation experiences.

One of the tools that Forest Service managers use to help provide a variety (supply) of appropriate recreation settings is the Recreation Opportunity Spectrum (ROS) (see *FEIS Map 10*). The ROS system (USDA Forest Service 1982) is used as a guide to assign a variety of existing and potential recreation activities and opportunities to NFS lands. The tool identifies the supply of recreation settings on NFS lands by evaluating various levels of access, remoteness, naturalness, facilities, social encounters, visitor impacts, and visitor management. The spectrum employs six classifications: 1) Primitive (P), 2) Semi-primitive Non-motorized (SPNM), 3) Semi-primitive Motorized (SPM), 4) Roaded Natural (RN), 5) Rural (R), and 6) Urban (U). Definitions of these classifications are provided in the Glossary.

ROS Classes on National Forest System lands were remapped in 2011 using updated classification criteria (USDA Forest Service 2003) to include additional National Forest System acreage gained via land acquisitions since completion of the 1988 LRMP. Table 3-58 lists the 2011 ROS Class inventory. Only four of the classifications have been inventoried on the LTBMU. There are no areas on the LTBMU that met the inventory criteria for Primitive. Though there are portions of the three Wilderness Areas in the Basin that are managed as primitive, their proximity to roads and urbanization and the intensity of use, rules out a ROS Primitive designation. There were also no areas on the LTBMU that met the inventory criteria for Urban. Though some undeveloped NFS lands may exist within urban neighborhoods in the form of scattered parcels, they are classified as rural as they offer visual and recreational relief from the adjacent urban development.

Table 3 58. Recreation Opportunity Spectrum (ROS) Classification for NFS lands in the Lake Tahoe Basin (2011)

2011 ROS Class	ROS Class Acres	ROS Class Percent
Primitive (P)	0	0
Semi-Primitive Non-Motorized (SPNM)	78,521	51%
Semi-Primitive Motorized (SPM)	20,370	13%
Roaded Natural (RN)	39,812	26%
Rural (R)	16,081	10%
Urban (U)	0	0
Total	154,784	100%

Today, approximately 64% of LTBMU lands provide a semi-primitive recreation setting while 36% of the NFS lands provide a more developed environment. In general, developed recreation occurs in the RN and R classes. Conversely dispersed recreation activities are more common in the semi-primitive ROS classes (SPM and SPNM).

Applying these classes to all land ownerships, the LTBMU provides the majority of the SPNM (94%), SPM (85%), and RN (77%) opportunities in the basin, and slightly less than half of the R (44%) opportunities. The ROS map (FEIS Map 10) shows the distribution of ROS classes, with relatively undeveloped lands outside the ring of urban and rural settings that surround Lake Tahoe's shoreline.

It is important to note that ROS classifications are a tool that serves to guide management. Management consistent with the ROS class helps to ensure that the desired opportunities are maintained. However, there is no regulatory requirement that all activities be consistent with the ROS class, or that summer and winter uses be managed the same within a given ROS class. OSV designations on the LTBMU are an example – while most of the designated OSV areas are located in a motorized ROS class (SPM, RN, R), some are located in areas that, when free of snow, are managed as SPNM.

Public Access - Dispersed Recreation

Dispersed recreation activities on NFS lands are defined as those activities that occur outside of developed recreation sites. Dispersed activities typically do not require the use of improved facilities other than access points such as trailheads and the roads and trails systems themselves. Dispersed recreation activities are categorized for management purposes as either Dispersed Summer or Dispersed Winter and are further categorized by the mode of Access. Public access is categorized as either:

- **Summer –** Non-Motorized (hiking and equestrian) and Mechanized (mountain bikes) or Motorized (Off Highway Vehicles –OHV).
- **Winter –** Non-Motorized (cross-country skiing, backcountry skiing, snowshoeing etc.) and Motorized (over snow vehicles).

Much of the outdoor recreation occurring in the Lake Tahoe Basin is dispersed recreation that occurs at more remote locations. Some of the more popular areas include Desolation Wilderness, Meiss Country, and East Shore Beaches. There were 1,300,000 dispersed site visits (General Forest visits plus Wilderness visits) to the LTBMU in 2010 or roughly 23% (22.4) of the total forest site visits (USDA Forest Service 2012). Approximately 54% of the main activities reported by forest visitors were dispersed activities. Popular dispersed recreation activities reported by visitors include hiking and walking, relaxing, viewing natural features, driving for pleasure, picnicking, viewing wildlife, and bicycling (Table 3-41). Other popular activities include horseback riding, dispersed camping, rock climbing, and non-motorized water activities (e.g., swimming, paddling, beach, and water play). Winter dispersed recreation activities include cross-country skiing, snowshoeing, snowmobiling, and snow play (e.g., sledding). A large amount of the current use occurs because of the existence of forest, state and county highways that provide access, and local communities which provide visitor services that often happens without any inducement by the Forest Service. In addition, land acquisitions such as High Meadows and the Dreyfus Estate have expanded access opportunities for the public to recreate on NFS lands.

Dispersed Camping - Dispersed Camping is allowed in specific areas on the LTBMU and is categorized as either overnight backpacking or vehicle camping. The LTBMU provides a unique niche for this activity as it provides the majority of the dispersed backcountry camping in the Basin. Overnight backpacking is allowed primarily in wilderness areas such as Desolation, Mt. Rose and Granite Chief, the Dardanelles Inventoried Roadless Area (Meiss Management Area), and along the Pacific Crest Trail and the Tahoe Rim Trail. The Desolation Wilderness is one of the most heavily used wilderness areas in the nation.

Though backpacking in the Lake Tahoe Basin is not a high participation activity as defined by NVUM surveys, less than 1%, it is an activity that visitors are very passionate about and the Forest Service goes to great lengths to assure that high quality opportunities continue to be available. The Desolation Wilderness is managed to very high standards as is reflected by the Chief of the Forest Service awarding Desolation managers the Aldo Leopold National Stewardship Award for Excellence in 2006.

Most areas are patrolled on a regular basis by rangers and volunteers who contact and educate the public on 'Leave No Trace' backcountry ethics and regulate user impacts such as campfires, litter, and sanitation. Camping along the PCT and TRT is only allowed within 300 ft. of the trail corridor to protect sensitive resources.

Dispersed vehicle camping on the LTBMU is unlike that approved in many national forests that allow camping in most General Forest Areas. In the Basin, vehicle camping is limited to a 300 ft. corridor along certain sections of the Genoa Peak Road, Logan House Loop and along the McKinney-Rubicon Road. The intent of this regulation is to continue to allow dispersed camping opportunities while still constraining vehicles primarily to the roadway for resource protection.

Dispersed Permitted Activities - Resorts and outfitter guides currently offer services for snowmobile tours, cross country skiing, horseback riding, and weddings. Numerous requests have been received for outfitter/guide permits to lead tours on NFS lands. New special use permits may be granted for outfitting and guiding based on need assessments or capacity analysis that are used to assure compatibility with public use of the National Forest. Limitations on activities that potentially damage or disrupt sensitive

species and habitat areas are generally included as conditions for permit approval. There are also several annual events under special use permit such as the Lake Tahoe Marathon and the Renaissance Fair.

Dispersed Summer Recreation, Non-Motorized/Mechanized

Summer non-motorized access to more remote areas of the national forest is gained primarily via trails that are shared by hikers, equestrians, and mountain bikers alike. Trails in the Basin, similar to roads, are maintained by miles of trail available primarily to these different user groups. There are currently 337 miles of total trails available in basin, all of which are available for hiking and equestrian and 217 miles available for mechanized use. The Lake Tahoe area is popular as a mountain biking destination, and many trails throughout the Basin are now designed specifically to appeal to different levels of mountain biking abilities. Mountain biking is allowed anywhere in the Basin with the exception of wilderness areas, the Pacific Crest Trail and along sections of the Tahoe Rim Trail.

There are 10 trailheads in the Tahoe Basin that receive significant use by hikers that provide developed parking and accessory facilities. The rest of the trailheads are dirt turnouts on the shoulders of roads. Soil erosion, adverse visual quality impacts, and highway safety problems are often associated with these undeveloped trailheads.

Nationally recognized trails within the Tahoe Basin include the Pacific Crest National Scenic Trail and National Recreation Trails including the Hawley Grade Trail and portions of the Tahoe Rim Trail. From 1999 to 2002, the entire trail network on LTBMU managed lands was inventoried and cataloged. (Please see Access Section for a more comprehensive discussion of trails, trailheads, and general access.)

Dispersed Summer Recreation, Motorized

The LTBMU has managed OHV routes as a designated system since the 1976 Off-Highway Vehicle Plan was completed (1976 Off Highway Vehicle Plan adopted in the 1988 LRMP ROD). The Plan established policies and provided for procedures that helped to ensure that the use of off-road vehicles on public lands would be controlled and directed in order to protect the resources, promote the safety of all users of the public lands, and to minimize conflicts among the various users of these lands. The majority of the managed road system has been upgraded as a result of the Road Access and Travel Management Plan that was completed in 1999. Designated road systems are now depicted on the resulting Motor Vehicle Use Map (MVUM).

Roads and trails in the Basin are generally maintained to different class levels available to different user groups: Passenger cars, high clearance vehicles and OHV. Generally speaking, the higher the class of road and trail the more improved it is. Class 5 and 4 roads are accessible to passenger cars and serve those visitors who enjoy driving for pleasure and witnessing forest settings from a high quality road in the comfort of their passenger cars. Class 3 roads generally allow use by high clearance 4x4 vehicles for those visitors who have the equipment to travel those more rugged roads that lead to more remote locations in the forest. Class 2 roads and trails are open to unlicensed OHV operators who appreciate the challenges and rewards of navigating very rough terrain.

The 1976 Off-Highway Vehicle Plan adopted a restrictive policy towards the management of summer OHV activity on NFS lands. This was due to the emphasis placed on protecting the water quality of Lake Tahoe and concerns for minimizing the social conflicts between area residents and OHV users. This policy recognized OHV activities as a legitimate use of the national forest, but permitted them only on designated routes or areas. This recreational activity is not permitted or encouraged where urban areas interface the National Forest, in environmentally sensitive areas, or within administratively closed areas of the Basin. In general, OHV routes have not expanded since adoption of the 1988 Forest Plan.

The LTBMU has designated OHV summer routes/sites and areas throughout the basin while closing those existing routes/areas where these activities are not considered as either compatible or suitable with the

environment or other uses. Route designation requires environmental analysis and public review. Designated routes and areas are shown on readily available maps and signed so that recreationists will know where they can legally operate vehicles. Providing adequate signage is a management challenge and users are sometimes not aware that they are using closed roads and trails.

Enforcement of OHV regulations remains a challenge because of limited Forest Service funding. Even though OHV use still remains a source of controversy, particularly where use is occurring near residential areas, progress has been made since 1980. Many areas have been successfully closed to use, signing has been installed, education programs have helped change behavior, and steps have been taken toward the designation of routes. OHV user groups have volunteered to correct damage and to implement OHV management. Much of the recent success has resulted from the availability of "Green Sticker" OHV funds from the State of California.

Dispersed Winter Recreation, Non-Motorized

The LTBMU offers many winter recreation opportunities such as cross-country skiing, snowshoeing, backcountry skiing, snow play, sledding, and snow camping, though parking and access are often limited. The majority of NFS lands in the Basin are available for non-motorized winter pursuits. Groomed cross-country ski trails are popular and are provided on NFS lands by resorts, private businesses and local municipalities. Some of these trails on NFS lands are under permit and others are not. Backcountry skiing and snowshoeing have become popular alternatives for adventure seekers who would otherwise ski at resorts. While there are many high quality backcountry ski routes within the Tahoe Basin, few have established winter parking.

State and county highway departments plow mostly roadways and a few emergency turnouts. The California State Sno-park program plows and maintains some of the most popular parking areas for dispersed winter sports. There are many areas that are not accessible even after snow removal has been completed, depending upon county ordinances for winter parking. Specifically many county snow removal and winter parking ordinances do not allow for roadside parking when snow is present which has eliminated many winter dispersed recreation opportunities such as backcountry skiing, and snowshoeing.

The current trend of growth in dispersed winter recreation on the LTBMU is associated with increased competition for parking, crowding, and conflict between non-motorized and motorized recreationists. Areas that have traditionally been enjoyed by cross-country skiers are now also accessed by OSV users and vice versa, which is resulting in some user conflicts. Noise from OSV use in certain areas may negatively affect some cross-country skiers' experiences. In addition, the combination of motorized and non-motorized uses may lead to potential safety concerns. Areas that are designated open and closed to motorized winter use are currently shown on the LTBMU Snowmobile Guide map and differences in opinion persist within the OSV and cross-country skier communities as to what areas should be available to OSV's. Use of the map allows non-motorized users options in choosing locations that provide the experience they are seeking. (See the Dispersed Winter Recreation Motorized section below and 2.5.3 Revise the Over-Snow Vehicle Use Designations for more discussion of winter access).

Dispersed Winter Recreation Motorized

Over snow vehicles have become more popular since the LTBMU published the 1988 Forest Plan. OSV use is managed in accordance with the OSV designations defined by the 1988 Forest Plan and enforced through a Forest Order. The criteria used to determine areas either open or closed were based on combination of jurisdictional boundary's (e.g., State Parks and wilderness designations), species protection areas, and urban buffers. Buffered areas were implemented to minimize conflicts between user groups with differing recreation values. In general, riding areas for OSVs have been stable since the 1988 Forest Plan.

Recreation Development

Developed Recreation

The LTBMU provides a wide variety of developed recreation sites that offer different levels of user comfort and convenience. Developed recreation facilities have been constructed to offer sustainable recreation opportunities, protect resources, and otherwise manage visitor activities in different outdoor settings. Developed recreation sites typically represent a significant investment in facilities and management, and include downhill ski areas, resorts, campgrounds, picnic areas, swimming beaches, interpretive sites, visitor centers, historic sites, and trailheads (Table 3-59 – Inventory of Developed Recreation Sites). Often site amenities such as restrooms and footbridges are provided for the protection of resources. In some locations, developed recreation sites are "built out," and expansion is unlikely or limited due adjacent sensitive resources. Fees may be charged at developed recreation sites under a variety of authorities.

In general, as visitation has increased, the LTBMU has focused primarily on eliminating deferred maintenance, modernization, meeting universal accessibility standards, and improving the quality of its recreation programs and services to enhance the quality of the visitor's experience. The LTBMU has also strived to improve the quality of services through special use authorizations and partnerships. This trend is likely to continue for the life of the plan.

Improvements in the quality of amenities at developed recreation sites have focused on the redevelopment of existing facilities to meet current building codes and accessibility requirements, and on projects that enhance protection of natural resources. These projects include the redesign of Inspiration Point and Nevada Beach Campground; construction of new restrooms at Kiva Picnic Area, William Kent Beach, Kaspian Beach, Eagle Falls Picnic Area, Bayview Campground, Nevada Beach, Pope Beach, Baldwin Beach, and Fallen Leaf Campground. Refurbishment of the Stream Profile Chamber and Rainbow Interpretive Trail as well as facility upgrades at Camp Richardson, Zephyr Cove, Meeks Bay and Heavenly Mountain Resorts have been ongoing.

During peak periods many popular developed recreation sites reach their design capacity. Resorts and campgrounds are often full from Memorial Day through Labor Day. If this trend continues as expected, accommodating more demand could be satisfied through expansion or redevelopment of existing sites or development of new sites. Any future expansion would need to meet Forest-wide desired conditions and sustainability objectives.

User trends and aging infrastructure demonstrate the need to update existing overnight accommodation units. Travel trailers, tent trailers and recreational vehicles (RV) have become increasingly popular and as a result, utilities are now provided at a number of campgrounds and resorts.

Table 3 59. Inventory of Developed Recreation Sites

Developed Recreation Site Type*	Number of Sites	Managed by Forest Service	Managed by Permit Holder
Resorts	8	0	8
Campgrounds	12	3	9
Swimming Beaches	8	0	8
Day Use Sites	8	6	2
Interpretive Sites	9	6	2
Organization Camps/Clubs	4	0	4
Recreation Residences	594	594	0
Trailheads	29	27	2

*Excluding Ski Areas and Slopes, discussed below

Resorts - The resorts on the LTBMU under special use permit are Camp Richardson Resort, Meeks Bay Resort, Zephyr Cove Resort, Round Hill Pines Resort, Angora Resort, Echo Chalet, Valhalla and the Camp Richardson Corral. Several resorts not only offer overnight lodging, but overnight camping, day use sites and swimming beaches as well. Many of the resorts were developed under private ownership from 1900-1950 before being acquired by the Government. (Ski resorts are discussed in more detail below in the Winter Sports Section.)

Campgrounds - Campgrounds on the LTBMU are managed by the Forest Service and special use permit holders. Those campgrounds managed by the Forest Service include, Luther Pass, Blackwood Canyon and Watson Lake. Campgrounds managed under special use permit include William Kent, Kaspian, Meeks Bay, Bayview, Fallen Leaf and Nevada Beach. Three campgrounds are also managed by the Camp Richardson, Meeks Bay, and Zephyr Cove Resorts mentioned above.

Swimming Beaches - Designated swimming beaches managed under special use permit include William Kent, Meeks Bay, Meeks Bay Resort, Baldwin Beach, Pope Beach, Nevada Beach, Camp Richardson Resort, and Zephyr Cove Resort.

Day Use Sites - Day use sites are often picnic sites or viewpoints that are managed by the Forest Service or special use permit holders. Those managed by the Forest Service include 64 Acres Lakeside, Eagle Falls Picnic Area and Trailhead, Kiva Picnic Area, Sawmill Pond, Secret Harbor, and Chimney Beach. Those dayuse sites managed under special use permit include 64 Acres Riverside and Kaspian.

Interpretive Sites - Interpretive services primarily serve visitors to national forest sites. The Taylor Creek Visitor Center and the Tallac Historic Site are the major public points of contact, providing guided and self-guided activities, educational programs, and living history throughout the summer months. Two interagency partnership facilities are located at Meyers Interagency Visitor Center and Explore Tahoe Visitor Center. Minor self-guided interpretive sites include Inspiration Point Overlook, Stateline Lookout Overlook, Angora Lookout, Logan Shoals Vista, and Lam Wa Tah Interpretive Trail.

Organization Camps and Clubs - Organization Camps and clubs are operated under special use permit. They include Camp Concord, Camp Shelly, Berkeley Camp, and the California Alpine Club.

Recreation Residences - The LTBMU administers 594 special use permits for recreation residences within 23 tracts. The largest of these are at Echo Lakes, Echo Summit, Fallen Leaf Lake, Spring Creek, and along the Upper Truckee River. Some recreation residence tracts are adjacent to environmentally sensitive lands. Current management emphasis includes avoiding and mitigating adverse effects through the following: no increase in the existing footprint of structures; consolidation of water systems; and installation of BMPs and erosion control measures.

Trailheads –Trailheads serve as the portals to trail systems that provide access for hiking, mountain biking, and horseback riding opportunities into the more remote regions of the National Forest. Trailheads can range from highly developed sites such as Eagle Falls with amenities like paved parking, restrooms and trash bins, to informal parking on the side of the road offering very few parking opportunities. Most trailheads are managed by the Forest Service. Only the Echo Lake and Moraine Trailheads are maintained by concessionaire.

Recreation Special Uses

Recreation sites and activities under special use permit are often commercial in nature and include a variety of fee-based services. These sites and activities include ski areas, resorts, organization camps, campgrounds, swimming beaches, day-use sites, interpretive sites, marinas, outfitting-guiding services, and recreation events. Recreation special uses include the recreation residence program, which is non-commercial in nature.

There are 640 special use permits issued within the LTBMU, which generates one of the largest land-use fees for recreation special uses in the Pacific Southwest Region of the Forest Service (Region 5), amounting to approximately $4,000,000 annually. Table 3-44 lists the current inventory of developed recreation sites under special use permit on the LTBMU as inventoried by the 2008 Recreation Facility Analysis.

Ski Areas and Slopes

There are five ski areas and slopes addressed by the existing LTBMU Land and Resource Management Plan. These are:

- **Heavenly Mountain Resort –** Operational footprint of 3,066 acres on NFS lands. Does not include acres located on the Humboldt Toiyabe National Forest.
- **Alpine Meadows –** Operational footprint of 377 acres on NFS lands and is administered by the Tahoe National Forest. Does not include acres on the Tahoe National Forest.
- **Diamond Peak Ski Area** – Operational footprint of 350 acres on NFS lands.
- **Homewood Mountain Resort** – Operational footprint of 204 acres on NFS lands.
- **Northstar** – Currently located entirely on private land (potential for expansion onto NFS lands discussed under Alternative A).

Heavenly Mountain Resort

Heavenly Mountain Resort receives the most skier visits and is the largest resort on the LTBMU. Ownership of Heavenly Mountain Resort changed in 2002, and the new owner undertook a review of facilities and operations that resulted in the 2007 Heavenly Master Plan Amendment. The 2007 Heavenly Master Plan Amendment identifies the overall objectives of Heavenly Mountain Resort and the context for on-going capital investment projects. Currently, chairlifts, cleared ski runs, lodges, support facilities, and intensive off-piste tree skiing occurs on an operational footprint of approximately 3,066 acres. This

footprint consists of areas of development and primary use within existing permit boundaries. This includes developed ski runs, lodge, lift operations, maintenance and utility facilities.

At build-out, the accepted 2007 Heavenly Master Plan Amendment projects 17,434 skiers at one time (SAOT). To accommodate these skiers, sufficient interconnection of facilities and ski trails are proposed, in addition to an expanded system of ski trails.

Beginning in the 2004-2005 ski season, the Forest Service approved placement of backcountry gates within Heavenly Mountain Resort to better manage out-of-bounds skiing. The backcountry gates provide the only legal means by which paid guests may leave the ski area boundary. Prior to the backcountry gates, “rope-ducking” occurred at random locations along the ski area boundary and resulted in skiers more frequently becoming lost.

Summer activities are currently provided at Heavenly Mountain Resort in the form of hiking, scenic chairlift and gondola rides, food and beverage sales, and tubing. It is anticipated that the variety of summer activities at Heavenly Mountain Resort will increase in the future as authorized by the Ski Area Recreational Opportunity Enhancement Act of 2011.

Alpine Meadows

Alpine Meadows is predominately on the Tahoe National Forest, which also administers the special use permit. However, 377 acres of the resort’s operational footprint, including the Lakeview Chairlift and developed ski runs, occur on the LTBMU. Alpine Meadows’ 2007 Master Development Plan Update indicates the potential for additional parking in the Deer Park area of the resort, including NFS lands managed by the LTBMU. However, the 2007 Master Development Plan Update indicates the concept needs additional analysis in a separate master plan update.

Diamond Peak Ski Area

Diamond Peak Ski Area is predominantly on private lands. However, 350 acres of the ski area’s operational footprint are included on NFS lands managed by the LTBMU under special use permit. This also includes portions of the developed ski runs known as The Great Flume; Golden Eagle Bowl; and off-piste skiing provided in Solitude Canyon. Authorized activities include grooming and snow making. Infrastructure on NFS lands includes signage, snow-fencing, and snow making lines. There are no existing proposals to additionally develop Diamond Peak Ski Area on NFS lands.

Homewood Mountain Resort

Homewood Mountain Resort is predominately on private lands. However, 204 acres of the resort’s operational footprint include NFS lands managed by the LTBMU. This includes portions of the developed ski runs known as Main Cirque, 55 Chutes, Wally’s Folly, The Shoulder, Third Creek, and Nooncester Traverse. Authorized activities include avalanche control and grooming. Infrastructure on NFS lands includes signage and snow fencing. There are no existing proposals to expand Homewood Mountain Resort on NFS lands.

Northstar

Currently, Northstar is located entirely on private land. The existing 1988 Forest Plan allows for expansion of the ski area on approximately 300 acres of NFS lands south and east of Mt. Pluto. However, there are no existing proposals to expand Northstar on NFS lands.

Climate Change

As stated in Appendix D: LTBMU Climate Change Trend Assessment, mean annual temperatures in the LTBMU planning area have risen by about 2 degrees Fahrenheit over the last century, with most of the change occurring in nighttime temperatures. The average number of days in a year on which the average air temperature remains below freezing has dropped by 27 days since 1910. Also, the average annual precipitation during the last 100 years is increasing, but inter-annual variability is also increasing. While average annual precipitation is increasing, the amount falling as snow is decreasing, as well as average winter snow pack. Further, spring thaw is occurring 5-30 days earlier than several decades ago.

These observed trends are already affecting recreation resources in a variety of ways, but it is most evident with the wide swings in yearly precipitation rates. Currently, ski areas are experiencing more pronounced differences in snow pack from year to year. The winter of 2011 was a record breaking snow year that has been followed by one of the lowest precipitation years on record in 2012. More snow making occurs in the early season in drought years to provide skiable snow packs. In addition, campgrounds and recreation sites that rely on snow melt and springs for water supplies are running out of water during low water years.

3.4.19.3. Environmental Consequences

Recreation

Recreation resources that may experience consequences from other forest management actions include: Recreation Opportunities, Access (Dispersed Recreation), Recreation Development, and Ski Areas.

The effects of the following major categories of activities and uses on recreation resources will be discussed for each alternative when applicable:

- **Recreation Opportunity Spectrum Classes –** Changes in ROS classes could change the balance of the existing recreation opportunities and setting currently available in the Basin (e.g., Shifting Semi-Primitive Motorized acres to Semi-Primitive Non-motorized acres would reduce the number of miles of roads available for those recreationists who enjoy driving for pleasure or OHV opportunities).
- **Recommended Wilderness –** Increased acres of lands managed as wilderness will change recreation opportunities (e.g., recommended wilderness status may enhance hiking, equestrian and back country camping opportunities in wilderness settings, while reducing miles of trails currently used by mountain bikers and areas open to OSV use).
- **Modifying Developed Recreation Facilities –** Actions generated from the modification of developed recreation facilities that may increase or decrease recreation capacity and change opportunities (e.g., increasing the size of a campground to accommodate increased future demand).
- **Dispersed Recreation Management –** Actions that may result in changes to existing dispersed recreation opportunities (e.g., improvements or elimination of existing trailheads or the construction of new trailheads).
- **Access and Travel Management –** The elimination or construction of new roads and trails or changes to the maintenance levels of existing roads may impact various recreation opportunities (e.g., improving the maintenance levels of an existing road from Level 2 to Level 4 would allow more passenger vehicles to utilize the road and may enhance a visitor's experience who enjoys driving for pleasure).
- **Watershed (Stream Channel and Habitat) Restoration –** Watershed restoration actions that would potentially remove or modify existing recreation infrastructure or change existing recreation opportunities (e.g., removal of recreation parking from stream environment zones for resource restoration).

- **Fuels Reduction And Vegetation Restoration –** Actions generated from vegetation restoration that may impact recreation opportunities (e.g., a fuel treatment project may encourage off road/trail incursions and damage resources).
- **Aquatic Invasive Species –** Actions initiated for the control of aquatic invasive species that may affect recreation opportunities (e.g., temporary closures of stream access while treatments for eradicating non-native species are occurring). Similarly, recreation activities that may affect aquatic invasive species populations and distribution.
- **Species Recovery Habitat Restoration –** Actions that may protect a species of concern may reduce acres available for recreation activities (e.g., protecting Tahoe yellow cress via fence enclosures may reduce the acres of available sandy beach for recreation activities).

Consequences Related to Recreation Opportunities

Recreation Opportunity Spectrum

Those management activities that could have the most effect on Recreation Opportunity Spectrum class resources are:

- Recommended Wilderness
- Recommended Backcountry

Other actions generated from other resource management activities are not anticipated to affect the character of the existing ROS general settings enough to merit a change in an ROS class. As a general statement, no changes in ROS classes in specific areas indicate that land uses affecting recreation in the Lake Tahoe Basin are becoming relatively stable.

Recommended Wilderness

There are no recommendations for additional Wilderness designations in Alternatives A, B, and E and no changes to the ROS classifications. Both alternatives will maintain the existing 24,664 Wilderness acres managed in the basin between the Desolation, Granite Chief, and Mt. Rose Wildernesses.

Recommendations for additional Wilderness have been proposed in both Alternatives C and D. The Dardanelles Inventoried Roadless Area is recommended for designation as Wilderness in Alternative C, and both Dardanelles and Freel Inventoried Roadless Areas are recommended for Wilderness designation in Alternative D. Wilderness destinations would not change the ROS classifications from Semi-primitive Non-motorized (SPNM). The proximity of the recommended wilderness areas to roads and urbanization negates a Primitive ROS classification.

The relationship graphic below depicts the balance of the alternatives between the ROS classes and how Alternative D includes more SPNM than the other alternatives.

Gradation within Recreation (least to most intensive)			
Recreation Opportunity Setting Classes			
← Semi-Primitive Non-Motorized	**Semi-Primitive Motorized Roaded**	**Natural Roaded**	**Rural →**
⇧ Alt. D	🡅 Alt. A,B,C, **E**		

Recommended Backcountry

The ROS classifications reflect the overall theme and character expressed by the settings maintained for various forest management and recreation activities. As a general characterization, more dispersed recreation activities occur in the semi-primitive ROS classes, while conversely; developed recreation occurs in the Roaded Natural (RN) and Rural (R) classes.

Proposals in the land management plan revision to allocate areas of the LTBMU to different land use zones will not largely affect existing ROS classifications, and will have a minimal effect on recreation visitation and use in each alternative. There is little variation between the overall themes and recreation character represented between the Management Areas and the ROS classifications and each classification varies minimally between the alternatives. Comparisons of Management Areas to ROS classifications are presented in Table 3-60 below:

Table 3 60. Management Areas Comparison to Recreation Opportunity Spectrum

Land Use Zone	Recreation Opportunity Spectrum
Wilderness Management Area	Semi Primitive Non-Motorized *
Backcountry Management Area	Semi Primitive Non-Motorized, Semi Primitive Motorized
General Conservation Management Area	Semi-Primitive Motorized, Roaded Natural, and Rural
Santini-Burton / Urban Forest Parcels Management Area	Santini-Burton - Semi Primitive Non-Motorized, Semi Primitive Motorized, Rural Urban Parcels - Rural

*Note: Though wilderness areas on the LTBMU are classified as Semi Primitive Non-Motorized, they are in fact managed to Primitive standards.

Acreages of ROS classifications by alternative are shown in Table 3-61. Alternatives A, B, C, and E will continue the current mix of settings and activities with approximately 64% of the NFS lands providing a semi-primitive environment (SPM and SPNM) and 36% providing a more developed environment (RN and R).

Alternative C is similar to A, B, and E in its general mix of settings however up to 174 more acres of general improvements to developed recreation facilities may occur within the existing Rural settings. Visitors will continue to enjoy the current balanced mix of recreational opportunities throughout the Basin in these alternatives.

Alternative D would shift the mix by 4% to SPNM with a 7,410 acre increase. The majority of these acres come from the Inventoried Roadless Areas. Both SPM and RN acres would decrease by 3% resulting in less improved roads being available for those users who enjoy driving for pleasure in their passenger cars.

Alternative E ROS classifications are the same as Alternatives A, B, and C. Though Alternative E has more acres of NFS lands managed as Backcountry with the addition of approximately 5,000 acres in the Stanford Rock area, these additional backcountry management acres do not change the existing ROS classification of SPNM that are present in Alternatives A, B, and C.

Table 3 61. Recreation Opportunity Spectrum (ROS) Classification by Alternative

ROS Class	1988 Land Status	Existing Acres*	Alternatives A, B, & C (No Change from Existing)	Alternative D	Alternatives E (No Change from Existing)
Semi-Primitive Non-Motorized	53,500	78,521	78,521 51%	85,931 56%	78,521 51%
Semi-Primitive Motorized	17,600	20,370	20,370 13%	16,457 11%	20,370 13%
Roaded Natural	55,700	39,812	39,812 26%	36,430 23%	39,812 26%
Rural	11,900	16,081	16,081 10%	15,966 10%	16,081 10%
Urban	0	0	0	0	0
Total	138,700	154,784	154,784	154,784	154,784

* Includes acres acquired via land acquisitions since 1988.

Consequences Related to Public Access - Dispersed Recreation

Dispersed Recreation Overview – Dispersed recreation on NFS lands is defined as those activities that occur outside of developed recreation sites in more remote areas of NFS lands. Impacts to resources are generated by visitors as they access remote areas and participate in their chosen activities. The types of impacts will be similar for all alternatives but the intensity can vary with increased visitation. Each alternative provides differing amounts of access as measured by miles of roads and trails.

More access will create more opportunities for dispersed activities while potentially reducing crowding and user conflicts. This may result in improved visitor satisfaction based on increased opportunities and access. Simultaneously, more access may increase demands on management and enforcement efforts to assure that the integrity of the environment is maintained and not degraded.

Often dispersed recreation activities are concentrated into small geographical areas, such as streams, meadows, riparian, and other sensitive areas. Common impacts generated from dispersed recreation activities can include: off-route hiking and mountain biking that creates user routes and potentially tramples plants and disrupts wildlife; littering, which is not only unsightly but can be harmful to wildlife; improper disposal of human waste; and user-created campsites that may disturb or destroy habitat. More access to remote areas may increase impacts to natural resources. Some areas traditionally used for dispersed recreation could be closed in the future due to potential future development of recreation facilities and ski areas. These potential expansions are unknown at this time.

Conflicts may occur among users as popular trails and areas become more crowded, where incompatible uses are not separated, or where desired opportunities are not available. Because of the diverse desires for outdoor recreation activities, experiences may be affected by behavior or mode of travel by other recreational users in the same area. Examples of potential conflicting activities include; horseback riding and mountain biking; off-highway vehicles and hiking or nature watching; alpine skiing and snowboarding, and OSV's and cross country skiers.

Recognizing and accepting that some conflict between user groups is natural, visitor behavior may be modified by managing expectations through interpretive and conservation education. Also facilities and trails may be designed, built, and maintained to better allow for shared uses. The strategy for managing recreation conflict was introduced in the Assumptions section above.

Those management strategies and activities that may have the most effect on Dispersed Recreation resources are:

- Recreation Opportunity Spectrum Classes
- Recommended Wilderness
- Access and Travel Management
- Vegetation and Fuels Management
- Aquatic Invasive Species Management
- Species Recovery Habitat Restoration

Recreation Opportunity Spectrum Classes - As mentioned in the ROS section above, Alternatives A, B, C, and E would continue the current mix of settings and activities. Alternative D would shift the mix by 4% to SPNM (Table 3-46). The majority of these acres come from the Inventoried Roadless Areas. The increase in SPNM acres would result in a 3% decrease in both SPM and RN acres. This would result in less improved roads being available for those users who enjoy driving for pleasure in their passenger cars.

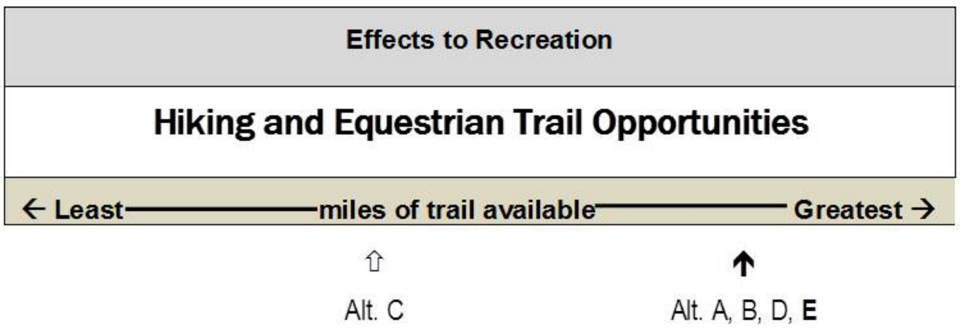
Recommended Wilderness - Alternatives A, B, and E are unchanged from existing conditions. The proposed wilderness designations in Alternatives C and D would affect both summer and winter dispersed recreation activities as discussed in the Access and Travel Management sections below. (Please see the Wilderness and ROS discussions for further evaluations.

Dispersed Summer Recreation Non-Motorized and Mechanized Access - Availability of summer dispersed recreation activities are affected primarily by the type of access to public lands that are needed to allow that activity to happen. For the purposes of this analysis, access is categorized by the quantity of miles of trails open to hiking and equestrian use and trails open to mechanized use. Table 2-1 displays the miles of trails available for both uses by alternative.

Miles of Hiking and Equestrian Trails

Hikers and equestrians will find satisfying experiences under all alternatives though the experience will vary by alternative. More miles of trails are available in Alternatives A, B, D, and E, where (pending future environmental analysis) approximately 30 miles of unauthorized trails eligible for adoption would be added to the existing inventory of 337 miles for a total of approximately 367 miles of trails.

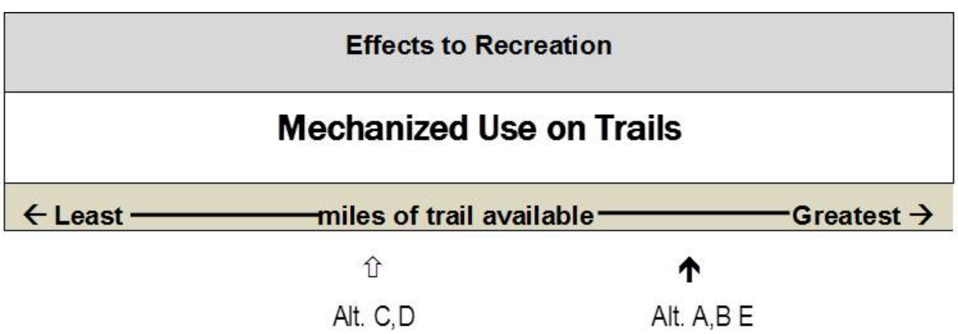
Alternatives C and D however would offer increasingly more primitive experiences due to potential wilderness designations. More opportunities would be available to hike in a wilderness setting without exposure to mountain bikes. Alternative C would have fewer miles available for hiking only trails than the other alternatives with a total of 360 miles of trails open to hiking. Under this alternative fewer hiking trails would be available with the designations of use specific trails for mountain bike only trails or motorcycle only trails.



Miles of Trails Open to Mechanized Use

Mountain bikers would have more riding opportunities and potentially be more satisfied with Alternatives A, B, and E as more miles of trails are available and popular routes in the Dardanelles and Freel areas will remain open. The additional Backcountry Management acres proposed in Alternative E will not change the experience to mountain bikers as there are few roads or trails in this area that are currently open to motorized use.

The relationship graphic on the next page depicts the general class levels by alternative.



Alternatives C and D offer fewer total miles for mechanized use, however 20 miles of additional trails will be upgraded for mechanized use. Some of these trails would be shared with motorized and non-motorized uses outside of wilderness areas and include fully or highly developed trails and bike paths. In Alternative C and D however, some popular mountain biking trails would become off limits if the proposed Dardanelles and Freel Peak wilderness recommendations are adopted by Congress. Wilderness designation would also preclude the construction of additional mountain bike routes in those areas.

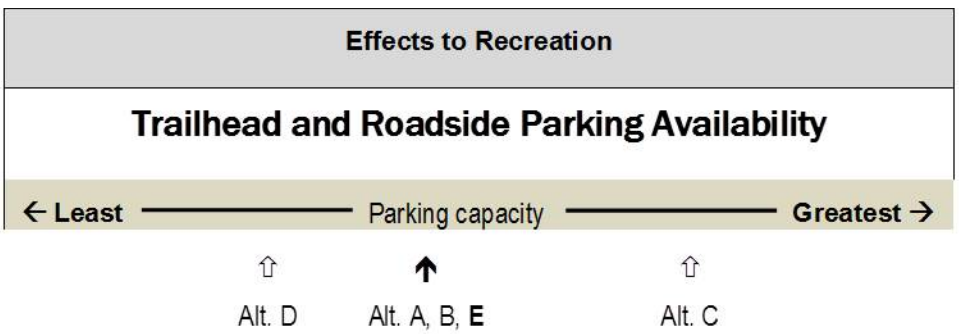
In Alternative C, a Dardanelles Wilderness designation would prohibit mechanized use on approximately 12 miles of trails including the trail from Big Meadow through Round Lake to the Pacific Crest Trail, the Dardanelles Trail, and the Lake Valley Trail.

In addition to the prohibitions in Alternative C, a Wilderness designation in Alternative D would also prohibit mechanized use on 21 miles of trails in the Freel Area including popular rides such as Saxon Creek, Armstrong Pass, portions of the Tahoe Rim Trail, Star Lake and Monument trails. In Alternative D with both the Dardanelles and Freel areas recommended for Wilderness designation, approximately 33 total miles would be excluded from mountain bike use upon designation. (See *Wilderness Section 3.4.27* for further discussion).

The additional Backcountry Management acres proposed in Alternative E would not significantly change the experience to mountain bikers as there are few roads or trails in this area that are currently open to motorized use.

Trailheads

Trailheads serve as the portals to trail systems throughout the Basin. Trailheads can range from highly developed sites such as Eagle Falls with amenities like paved parking, restrooms and trash bins, to informal parking on the side of the road offering very few parking opportunities. The relationship graphic below depicts parking availability by alternative.



Regardless of their development scale, trailheads provide access for trails leading into the more remote regions of the general forest where visitors participate in dispersed recreation activities (See Access and Trail Management Section). The following is a general summary of parking available by alternative:

- Alternatives A, B and E- Maintain current parking capacity by converting unmanaged parking to managed parking.
- Alternative C –Increase current parking capacity by increasing managed parking areas and converting unmanaged parking to managed parking.
- Alternative D –Reduce current parking capacity by converting less unmanaged parking to managed parking.

In all alternatives roadside parking would be reduced where parking congestion, safety and resource impacts are determined to be unacceptable.

Dispersed Summer Recreation -Motorized Access - Existing regulations regarding operation of vehicles on non-paved forest roads and trails would not change significantly in any alternative. Vehicles will continue to be restricted to designated roads and trails in all alternatives. Emphasis on the length and

maintenance levels of designated routes available for differing user groups will vary in each alternative. Enforcement, user education, and signing will be effected by alternative.

Satisfaction levels for off-highway vehicle users will vary by the miles available to each of the different user groups: passenger cars, high-clearance vehicles and OHVs. Generally the upgrading of existing roads will reduce the quality of recreation opportunities for motorcycles, all-terrain vehicles and 4x4 vehicles because of the loss of challenge. At the same time those seeking easier access to remote locations will benefit from the relative comfort and ease of access over new or reconstructed roads.

Summer OHV users seeking challenging routes will be influenced most by the length of road and trail systems, the location of designated routes and the quality of the riding experience. For these users difficult routes would be preferred over improved routes. Table 2-1 describes the mile of roads and trails available for each user group by alternative.

The following is a general summary of roads available for the different levels of desired dispersed recreation experiences by alternative:

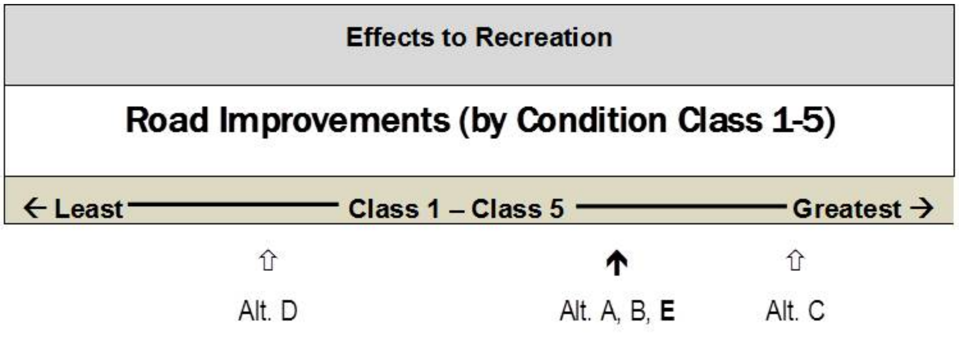
Miles of Roads: Passenger Vehicles - Scenic driving is a popular recreational activity on NFS lands in the basin. Satisfaction is tied to the number and length of routes along with the location and scenic qualities of the routes. In general, visitors who enjoy driving for pleasure in their passenger cars will find the most satisfaction in Alternative C with approximately 22 more miles (+26%) of upgraded roads from existing for access to both dispersed and developed recreation sites.

In Alternative A, the current level of passenger car roads would be maintained with minimal changes. In Alternatives B and E, approximately 5 more miles (+6%) would be upgraded to passenger car roads for access to both dispersed and developed recreation sites than in Alternative A. Alternative D would offer approximately 7 fewer miles than in Alternative A for visitors driving passenger vehicles on forest roads.

Miles of Roads open to High Clearance Vehicles and OHV - High clearance vehicle and OHV road users would have more options under Alternative D with 130 miles (+13%) of roads maintained at these more challenging levels as maintenance levels of other roads decline. In Alternatives A, B, C and E the current level of roads open to OHVs (115 miles) would be maintained with minimal changes.

Miles of Trails Open to OHV - Alternative C offers the most (20 miles) trails for OHV users, which is 25% more than Alternatives A, B and E with 15 miles and 50% more than Alternative D at 10 miles. Under Alternative D, approximately 5 miles of trail currently open to motorized use would be closed to motorized use within the Freel Peak wilderness destinations. Alternative D would result in a reduction in road maintenance levels resulting in increasing the mileage of roads open to non-licensed OHV's and decreasing access for passenger car vehicles.

The relationship graphic below depicts the general class levels by alternative.



Dispersed Winter Recreation Non-Motorized - Non-motorized (quiet) dispersed winter recreation such as cross-country skiing, snowshoeing, and snow play is a growing part of the total use of NFS lands. While there are many high quality opportunities for these activities around the basin, few have established winter parking. Due to this situation, increased competition for parking, localized crowding, and potential conflict between recreationists is the anticipated future condition for all alternatives. The following is a general summary of dispersed winter parking available by alternative:

The relationship graphic below depicts opportunities for winter parking by alternative.

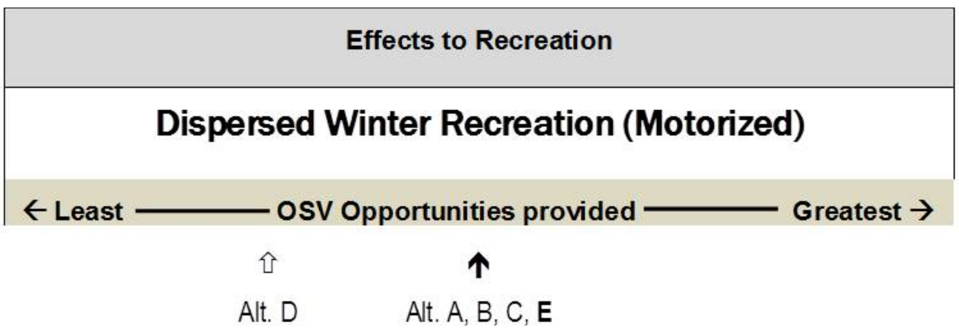
- Alternatives A and D- Maintain existing winter parking capacity. Some sites may be eligible in the future for additional winter parking to support existing winter recreation opportunities.
- Alternatives B, E and C - Additional winter parking sites would be added to increase access to dispersed recreation activities.
- In addition, opportunities for quite non-motorized winter recreation would remain the same in Alternatives A, B, C, and E and would increase in Alternative D with a Freel Wilderness designation and the closure of this area for over snow vehicle use.

Dispersed Winter Recreation Motorized - Over snow vehicle (OSV) users currently have access to approximately one half of the total National Forest System acres in the basin (52%) open to OSV use vs. (48%) closed). Regulations regarding operation of OSVs as identified in existing Forest Orders will continue until revised or superseded. Over snow vehicle use is most affected by area-wide closures such as those resulting from species protection, urban buffers, and wilderness designations.

In Alternatives A, B, C, and E, opportunities for OSV use are not anticipated to change largely from existing conditions as depicted in current LTBMU OSV guidance. Some areas traditionally used for OSV use could be closed in these alternatives in the future due to potential future development of recreation facilities and ski areas. These potential expansions are unknown at this time. In Alternative C, the designation of the Dardanelles Roadless area as new wilderness would not change areas currently open or closed to OSVs, as that area is already closed for OSV use.

OSV users would be displaced in Alternative D if the 15,341-acre Freel Roadless area were recommended and subsequently designated as Wilderness. Though the Freel area is designated as semi-primitive non-motorized and is closed to motorized use during the summer, 59% or 9,084 acres are currently open to winter motorized use. OSV use in the Freel area is currently popular with visitors and residents alike. The area provides approximately 6% of the terrain available to over snow vehicle use in the Lake Tahoe Basin.

Many users of this area are residents who gain access to open terrain via their backyards. Users displaced by the area closure will have to find other areas to participate in this activity, most likely in nearby Hope Valley on the Humboldt-Toiyabe National Forest. Users from adjacent neighborhoods will have to trailer their machines to other open areas. The relationship graphic below depicts the acres available to OSV opportunities by alternative.



Vegetation and Fuels Management on Public Access - Vegetation and fuel management strategies generally result in a more stable forest condition, which is more resistant to catastrophic wildfires and insect infestations. These activities overall have a positive effect on recreation activities as a healthy environment is what most visitors to forest lands would like to experience. Vegetation treatments often improve scenic conditions by opening views of the Sierra Nevada Mountains and Lake Tahoe. Vegetation and fuels management treatments have short-term impacts generated from actual project activities that generally range from one day to one month. Long-term visual impacts resulting from treatments can affect recreation experience and are described in Section 3.4.20.

The primary activities generated from vegetation and fuels management generally include: prescribed fire (under burning and pile burning), managed wildfire, hand and mechanical thinning, aerial tree removal with helicopter or small mobile yarding, and temporary road construction and rehabilitation. Managed wildfire is defined as the management of naturally ignited fires to achieve resource desired conditions and objectives where fire is a major component of the ecosystem (see Fire and Fuels Section (3.4.10) of this document and the Resource Overlays in the Forest Plan).

These activities may result in short-term consequences to recreation resources from temporary closures; noise and dust that are created in the preparation stages of the treatments and from helicopter yarding; slash piles that remain on the landscape for several years in order to cure; temporary smoke generated from the burning process itself; and the end result of a blackened landscape that may persist for several years.

The degree of impact to recreation resources from thinning projects and prescribed/managed fire is primarily short-term and largely a function of proximity (i.e., how close these activities occur to where people recreate or live). The further these processes occur from these activity centers, the less impact they will have.

Other than in wilderness areas, fuels treatments can occur throughout the forest including the wildland urban interface (WUI). If treatments occur close to roads and trails or other areas where people recreate and live, they may affect the experiences of those users and satisfaction levels may be lower. For example, if burn piles are left close to trails for several years to cure, hikers will be exposed to the unnatural character of the piles, and once burned they will see the fire scar until it is cover by needles and vegetation is reestablished. If areas are temporarily closed and access is denied, users may have to momentarily adjust their expectations and find other places to recreate.

Seeing and breathing smoke from prescribed burns and managed fires have a larger zone of influence than other fuels treatment activities and is one of the unfortunate side effects that may affect visitor and residence experience and lessen satisfaction ratings. Also helicopter yarding can also be heard from greater distances than other mechanical operations and therefore impact a larger number of forest visitors.

Temporary roads are often constructed as a part of vegetation management projects to access areas not accessible from the permanent road system. Although these roads are temporary and closed to vehicle traffic by the general public, they are often used by hikers, equestrians, and mountain bikers. This unregulated use is not problematic until resource damage occurs (such as off road incursions into open forest areas) and then management actions are needed to regulate the activity.

Alternatives A, B, D, and E propose 4,550 acres/year in all categories of fuels and vegetation treatments, while Alternative C would propose to treat a total of 5,600 acres/year.

For treatments in the WUI, Alternatives A, B, and E will treat 3,800 acres per year and Alternative C and D would treat 4,100 acres/year or 300 more acres than Alternatives A, B, and E. People who recreate in WUIs or live near them will experience more impacts in Alternatives C and D.

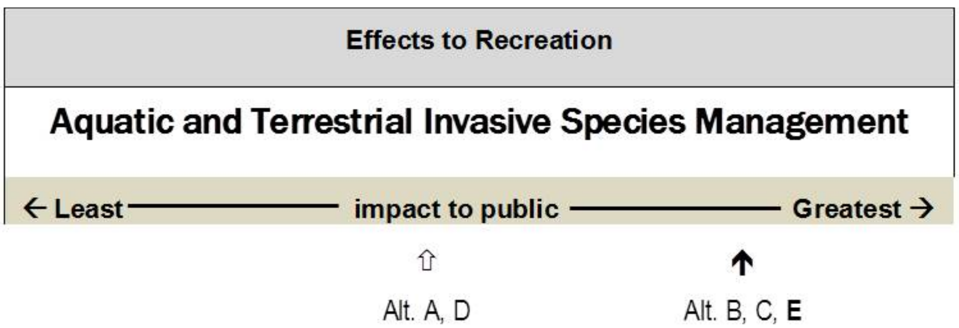
For those who recreate in Backcountry, General Conservation, and on Santini-Burton/Urban Forest Parcel Management Areas, Alternatives A, B, and E propose 750 acres of fuels and vegetation treatments. Alternative C would propose to treat 1,500 acres/year (double the acreage in Alternatives A, B, and E), therefore resulting in more short-term impacts to dispersed recreation resources. Impacts from forest thinning would be lesser under Alternative D, which proposes the least amount of forest vegetation treatment at 450 acres.

Managed wildfire is allowed in some areas in all alternatives. Alternative A is the least likely to allow managed wildfire. In Alternative C there is a moderate likelihood and Alternatives B, D, E are most likely. Alternative A allows it in only the Desolation Wilderness, Alternatives A, D, and E allow it everywhere except the WUI defense zone (roughly, ¼ mile outside of communities). Alternative C allows it everywhere except WUI (defense and threat zones). If this restoration tool is used, there may be impacts to recreation activities such as smoke, and or area closures. The LTBMU is largely a WUI forest and this is most likely not going to be a commonly used tool because of the proximity to communities from any point in the Basin, However, should this option be exercised, alternatives with the greatest area available will have the highest likelihood of causing the listed effects to recreations.

Aquatic and Terrestrial Invasive Species Management - The prevention of the spread of aquatic and terrestrial invasive species remains a high priority for the LTBMU recreation program. Prevention methods for dispersed recreation include improved signage at popular access points as well as education and outreach efforts that communicate the importance of managing invasive species in the Lake Tahoe Basin.

As mentioned in more detail in the Developed Recreation section, activities generated from aquatic and terrestrial species management include prevention, control, and eradication techniques. These strategies include manual removal using electro-shockers, gill nets and traps, and chemical-based methods. Terrestrial control and eradication strategies include removing weeds by hand or with tools, using herbicides, and thermal methods such as torching among others. These methods are used on a project by project basis and are not used if they present any danger to visitors.

Most aquatic and terrestrial species management actions are considered to be short-term in nature as they do not generate long-term closures or modifications to recreation areas. Short-term closures of up to several months may occur at lakes or streams as treatments are applied and for up the several days for terrestrial species treatments.



Effects to recreation resources from aquatic species management activities are most likely in Alternatives B, C, and E as there will be from 0.5 to 1 mile of streams treated. Alternatives A and D will have fewer effects as there will be from 0 to 0.5 miles treated respectively.

Effects to recreation resources from terrestrial invasive species management are most likely in Alternatives B, C, and E as there will be from 5 to 40 acres eradicated. Alternatives A and D will have fewer effects as there will be from 0 to 5 acres treated respectively.

Species Recovery and Habitat Restoration - Impacts to dispersed recreation activities from species recovery and habitat restoration can occur when areas are closed to recreation activities for varying periods of time or when activities are prohibited or displaced.

Short-term impacts (from several hours to several days depending on the species and type of treatments) may arise from management strategies such as the reintroduction of the Lahontan cutthroat trout (LCT) into local streams and rivers. This is often accomplished by eliminating the current populations of non-native rainbow, brown, or brook trout so that new populations of LCT can be established. Fishing patterns may be disrupted for periods of time as treatments are applied and new LCT populations are introduced and become stable enough to reintroduce fishing.

Long-term impacts from aquatic species management may occur when existing recreation opportunities are changed or eliminated. An example of a long-term impact may include loss of fishing opportunities in some alpine lakes as a result of eliminating non-native brook trout populations to enhance habitat for Sierra Nevada yellow-legged frogs. In this case, outdoor enthusiasts who enjoy fishing for brook trout may be disappointed if fishing in those particular lakes was their favorite activity. Displaced fisherman may then move on to other lakes, possibly resulting in increased impacts at these alternate locations.

Long-term impacts to winter motorized activities from species recovery habitat restoration actions could be generated if access to terrain is limited or closed to OSVs. All alternatives propose to maintain one

Sierra Nevada yellow-legged frog sub-population and to restore four. These actions may close terrain that is currently accessible to OSVs.

Consequences Related to Recreation Development

Developed Recreation

Developed Recreation Overview - The quality and quantity of developed recreation opportunities would vary in all alternatives depending on the level of recreation expansion allowed. Recreationists may be adversely affected as future demand outpaces supply and crowding increases at popular recreation sites during peak visitation periods. Those alternatives that allow for expansion would provide greater flexibility in meeting existing and anticipated use levels.

The following management activities will have an effect on developed recreation resources:

- Modification of developed recreation facilities;
- Access and travel management;
- Watershed (stream channel and habitat) restoration;
- Vegetation and fuels management;
- Aquatic invasive species management; and
- Species recovery habitat restoration.

In all alternatives, the Forest Service recognizes that it cannot meet all user demands and that visitors will continue to be displaced during peak use periods from popular recreation sites. Moreover, the duration of peak periods may increase with the projected rise in visitation. Generally, those areas adjacent to popular developed recreation sites will serve as alternative destinations for displaced visitors. Unmanaged recreation at these locations may result in an increase in adverse effects. Construction of additional infrastructure and expansion and/or modification (hardening) of existing recreation sites may help alleviate crowding as well as mitigate the potential for resource impacts associated with displaced visitors.

The following management actions will not significantly affect developed recreation resources:

- Wilderness recommendations;
- Changes in recreation opportunity spectrum; and
- Ongoing dispersed recreation.

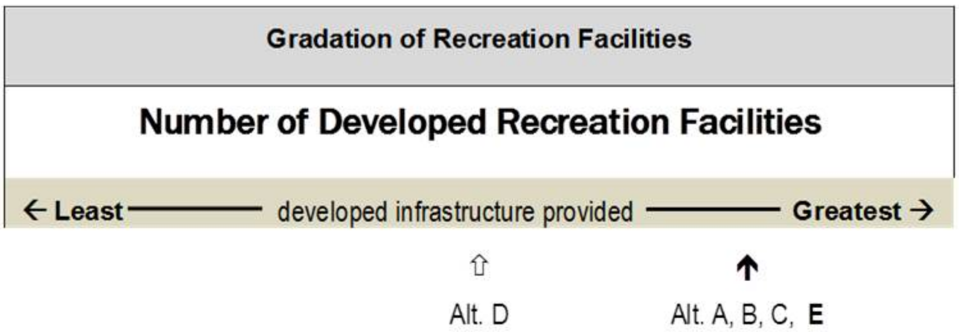
Some minor impacts may result from resource management activities that are ongoing and not considered in this analysis. For example, it is understood that some seasonal closures or restrictions may be placed on recreation uses in key wildlife habitat areas during the nesting or wintering season for certain species. Also it is understood that a broad spectrum of dispersed recreation opportunities will encourage more visitation to the Basin and result in positive economic benefits to permit holders and to the local community. Visitor use is not anticipated to be influenced by general resource management activities as recreation demand is not driven by forest management practices. In summary, recreation visitation and use will increase in all alternatives: however the location, type, rate and intensity will vary by alternative.

Modifying Developed Recreation Facilities - Recreation visitation and resulting demand and use is anticipated to increase in all alternatives and none of the alternatives are anticipated to accommodate all the projected demand during the peak season from July 4th thru Labor Day. At a minimum, all alternatives will focus on deferred maintenance or modification of existing facilities to help achieve accessibility and sustainability of recreation opportunities.

Recreation infrastructure will vary as each alternative provides more or less supply by expanding or reducing developed infrastructure in response to future recreation demand. As depicted in Table 2.1

using recreation site acres, overnight accommodations and day use parking spaces, Alternatives A (10%) and C (15%) will have the most potential to respond to increased public demand by retrofitting existing facilities or building new ones. Alternative B will allow up to a 5% increase in new or expanded facilities. Similar to Alternative B, Alternative E will allow a 5% increase in permit acres and day use parking opportunities, and a 10% increase in overnight accommodations. The greatest effects from unmet demand will come from Alternative D as it will have the least ability to respond to demand as 15% of the developed recreation infrastructure may potentially be lost to resource restoration.

The availability of developed recreation facilities to meet demand per alternative is depicted on the relationship graphic below:

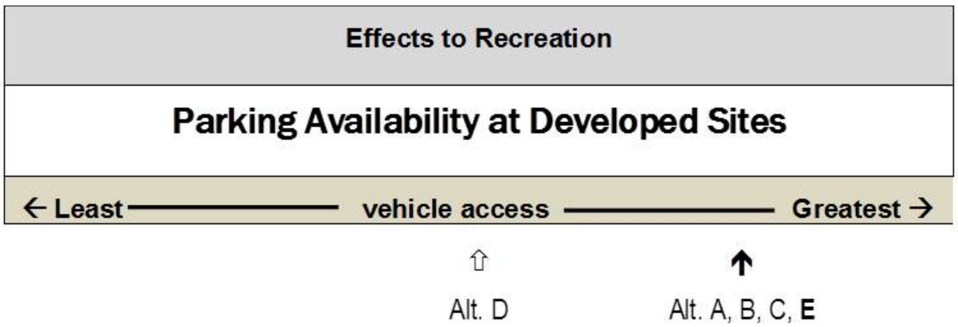


Alternative E will be similar to Alternative B in its ability to provide expansion opportunities in recreation site acres and day use parking spaces; however it provides more overnight accommodations to respond to visitor demands. Assuming maximum build out in Alternative E as described in Table 2-1, visitors will have more opportunities during peak summer periods to obtain overnight accommodations than in Alternative B. Visitors who desire more developed recreation infrastructures for their activities could expect a more satisfying experience in Alternatives A, B C and E, so long as the maintenance and construction of facilities occur at a sufficient rate to support most of the demand. Alternative C has the most opportunity to provide more developed infrastructure to meet increased future demands. In Alternative D, as demand exceeds available services due to the loss of developed facilities, recreationists will be adversely affected as prices and crowding increase and their sense of satisfaction lessens. Conversely, Alternative D may suit those visitors who prefer dispersed recreation activities such as hiking/walking that rely less on constructed infrastructure.

Accessibility improvements will continue in all alternatives. Effects from accessibility improvements include a greater satisfaction for users of all abilities as more sites become accessible. Families of all ages and ability levels can share the same facilities and site furnishing, and visitors with accessibility needs will find their choices have broadened in selecting campsites, picnic sites and other types of developed recreation sites.

There will be more short term construction impacts (1 month to 1 year) in Alternative C than in the other alternatives since there is the potential for more retrofitting or expansion of developed facilities. In general these impact will include: initial site construction (grading of sites for roads, campsites and parking spurs), clearing of vegetation (tree removal), grading of sites, asphalt and concrete installation (non-permeable surfaces such as roads, parking lots, and structures), and trenching for utilities. These impacts may generate short term detours or closures in recreation sites, and some inconveniences to visitors from construction related noise and dust. Some short term impacts may be substantial if recreation sites are closed for improvements during the peak season and visitors are displaced to other locations. These impacts must be weighed in relation to the long term gain of the approved project. There will be fewer short term construction impacts in Alternative D than in the other alternatives since there will be fewer construction projects.

Access and Travel Management - As stated in the access section of this EIS, general access to developed recreation sites for all alternatives, would tend to shift towards consolidated access routes and parking facilities that would incorporate mode transfer to promote use of transit or bike path systems over the private automobile. In Alternatives A, B, C, and E where roadside parking is reduced or eliminated outside of developed recreation sites, some of the parking demand would be absorbed within managed recreation sites or by expanding associated parking facilities. In all alternatives, a strategy of shifting use toward transit and bike path systems will be followed. In Alternative D, a reduction in overall developed recreation sites could result in reduced parking facilities and vehicle access to sites that are removed creating addition demand for alternative transportation and other parking options. The relationship graphic below depicts the general class levels by alternative.



Watershed (Stream Channel and Habitat) Restoration - Stream Channel and Habitat Restoration activities would result in short term impacts of limited extent and net long term gains as stream zones in developed recreation sites are stabilized. Generally speaking, a resource action that protects and enhances the overall environmental health and integrity of the Lake Tahoe Basin is beneficial to recreation interests if they do not reduce recreation opportunities or restrict access. A healthy environment is a primary reason that recreationist enjoy the Lake Tahoe Basin.

Short term impacts (1month to 1 year) from stream channel restoration on developed recreation resources results from the use of heavy equipment (excavators, dozers, dump trucks) and from restoration activities such as sod borrowing, stock piling materials, de-watering streams, and short term closures. Meadow restoration activities such as broadcast burning, hand thinning, and mechanical thinning also generate short term impacts. These restoration activities are generally transitory in nature but will effect nearby developed recreation facilities by the creation of noise, dust, smoke from broadcast burning, and potential closures for the life of the project. The recreating public may be temporarily inconvenienced by these activities.

There are some potential long term detrimental effects from restoration actions to existing recreation infrastructure that could potentially affect quality (modification), quantity (removal), and access (road closures or decommissioning) of existing recreation resources. Actions that affect recreation management's effort to meet demand by reducing supply will change the overall recreation experience from existing. For example if restoration activities remove a recreation amenity from a stream environment zone for resource enhancement, visitors accustomed to using that facility may be disappointed if they are unable to enjoy that specific location. Displaced visitors may not be able to duplicate their desired experience at newly provided locations or may experience crowding if there is an overall loss of capacity. New visitors looking for a less developed environment may enjoy the restoration result. The number and type of those recreationists served in each instance may be very different.

The relationship graphic below depicts the general class levels by alternative.

Effects to Recreation

Watershed Restoration (Stream Channel and Habitat)

← **Least** ——— miles/acres restored ——— **Greatest** →

⇧ Alt. D

🡅 Alt. A, B, C, **E**

The proposed watershed restoration actions for each of these activities does not differ between the Alternatives A, B, C, and E. In Alternative D, currently planned watershed restoration projects will continue until completed, and then the strategy for watershed management will be to rely primarily on natural processes for recovery. Effects from these activities on developed recreation resources are more likely under Alternatives A, B C, and E, as they will be restoring the most miles/acres and have the most potential to remove or relocate existing developed recreation features from sensitive resource areas. The direct effects from these actions would be analyzed on a project by project basis.

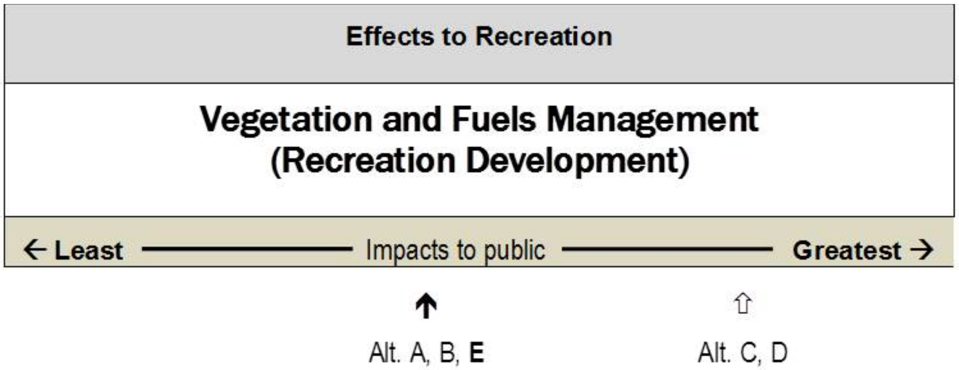
Vegetation and Fuels Management (Recreation Development) - Please see the Vegetation and Fuels Management in the Public Access - Dispersed Recreation section. Impacts from vegetation and fuels management are similar for both dispersed and developed recreation activities.

As previously stated, vegetation and fuel management strategies generally result in a more stable forest condition which is more resistant to catastrophic wildfires and insect infestations. These activities overall have a positive effect on recreation activities as a healthy environment is what most visitors to NFS lands would like to experience. Vegetation treatments often improve scenic conditions by opening views of the Sierra Nevada Mountains and Lake Tahoe. Vegetation and fuels management treatments have short-term impacts generated from actual project activities that generally range from 1 day to 1 month, and long term visual impacts resulting from treatments (Section 3.4.20).

Impacts to developed recreation resources from vegetation and fuels management will primarily be generated by treatments within the Wildland Urban Interface (WUI) where most developed recreation sites exist. The degree of impacts to developed recreation resources from treatments that include thinning projects and prescribed fire is largely a function of proximity or how close they occur to where people recreate. The further these processes occur from recreation activity centers, the less impact they will have. If these activities occur close to resorts, campgrounds, or day use areas, they may affect the experiences of those users and satisfaction levels may be lower.

Seeing and breathing smoke from prescribed burns has a larger zone of influence than other activities and is one of the unfortunate side effects of prescribed burns that may affect visitor's experiences and lessen satisfaction ratings. Helicopter yarding can also be heard from larger distances than other mechanical operations and can impact a larger range of forest visitors. There is also the potential for removal of vegetation from developed recreation sites that previously screened development. An example would be the removal of young trees in campgrounds to reduce their density, that currently provide screening and privacy from other campsites or from nearby roadways.

Longer-term impacts may result from fuel treatments and may be evident for some time. For example, the blackened landscape left after broadcast burning may take several years to recover and affect visual experiences (Section 3.4.20).



For treatments in the WUI, Alternatives C and D would treat 300 more acres than Alternatives A, B and E. Visitors in developed recreation sites near WUI treatments would experience more impacts in Alternatives C and D.

Aquatic and Terrestrial Invasive Species Management - The prevention of the spread of aquatic and terrestrial invasive species remains a high priority for the LTBMU recreation program. Prevention methods for developed recreation include improved signage at developed recreation sites, additional terms and conditions on special use permits, education and outreach efforts communicating the importance of managing invasive species in the Lake Tahoe Basin, and watercraft screening, inspection, and washing stations. Please see the “Aquatic Wildlife Habitat and Species” and “Botanical Terrestrial Invasive Species” sections in Chapter 3 for a more in-depth description of affected environment and environmental consequences related to aquatic and terrestrial invasive species.

Aquatic control and eradication strategies at developed recreation sites include manual removal using electro-shockers, gill nets and traps, and chemical-based methods. Terrestrial control and eradication strategies include removing weeds by hand or with tools, using herbicides, and thermal methods such as torching among others. These methods are used on a project by project basis and are not used if they present any danger to visitors.

Species Recovery and Habitat Restoration - Impacts from species recovery habitat restoration will be the same in all alternatives. Restoration activities may reduce the availability of recreation settings if areas closed to public access. Impacts related to recreation activities are expected to be minimal in all alternatives depending on the location and scale of the closures. An example would the potential loss of available sandy beach for recreation activities by protecting Tahoe Yellow Cress via fence enclosures. The current enclosures are usually less than ¼ acre and do not represent a large percentage decrease of available sandy beach acres. There are currently 8 enclosures at various beaches around the Basin however the number and locations of the enclosures are not static, nor dependent on alternative.

Ski Areas

Ski areas on the LTBMU provide a major economic and recreation benefit to the region. Under all alternatives, the operation and maintenance of existing ski areas will continue but may also include summer activities consistent with laws, regulations, and Forest Service policy.

For the purposes of this analysis, the operational footprint of existing ski areas and ski slopes was used to measure environmental consequences of the proposed action and alternatives. The operational footprint consists of areas of development and primary use within existing permit boundaries. This includes developed ski runs, lodge, lift operations, maintenance and utility facilities. The operational footprint also represents the area from where recreation expansion is most likely to occur in the future.

Management activities that may affect ski areas and ski slopes include:

- Modifying Developed Recreation Facilities
- Vegetation and Fuels Management
- Species Recovery Habitat Restoration

Modifying Developed Recreation Facilities - In all alternatives, in order to maintain a high quality experience, emphasis will include the need to balance chairlift and terrain capacity. Generally, alternatives that allow for the greatest expansion and modification will best support ski areas in meeting socioeconomic challenges and changing user preferences. For example, in response to changing climate conditions, a ski area may propose additional development outside the existing footprint on terrain with a more favorable aspect for snowpack retention. Additionally, to provide better connectivity for summer uses, a ski area may propose construction of new trails outside the existing operational footprint. Alternatives B and E have the same expansion potential.

Alternative A

Heavenly Mountain Resort – Alternative A would confine most ski area development to approximately 4,200 acres within the 7,700-acre special use permit boundary. This is due to existing LRMP direction that applies to a large portion of lands within the special use permit boundary.

The emphasis for these areas is to serve as a scenic backdrop to Lake Tahoe, left in a nearly natural condition but does not preclude ski opportunities. This includes the steep northwest facing slope of East Peak. Alternative A may allow glading and off-piste terrain/vegetation modification within this area if those activities comply with visual quality and watershed objectives.

Alternative A allows for new ski run construction and widening within the “Alpine Skiing Management Prescription.” Alternative A allows for the development of additional support facilities and lodges. As a result, this alternative provides for a greater diversity of recreation experiences for both winter and summer users.

Alpine Meadows - Alternative A allows for expansion of the existing ski area, including portions of NFS lands currently not under special use permit. Alternative A maintains the “Alpine Skiing Management Prescription” on approximately 2,605 acres in the Ward Management Area. Alternative A allows for the greatest level of expansion, providing for development of additional support facilities, lodges, and ski runs within the LTBMU. As a result, this alternative provides for a greater diversity of recreation experiences for both winter and summer users.

Diamond Peak Ski Area - Ski area expansion may not occur beyond the existing special use permit boundary because the “Alpine Skiing Management Prescription” is identical to the special use permit boundary. However, Alternative A allows for more intensive development than other alternatives within the existing special use permit boundary.

Homewood Mountain Resort - Alternative A allows for expansion of the existing ski area, including portions of NFS lands currently not under special use permit. Alternative A maintains the “Alpine Skiing Management Prescription” on approximately 760 acres in the McKinney Management Area. Alternative A allows for the greatest level of expansion, providing for development of additional support facilities, lodges, and ski runs within the LTBMU. As a result, this alternative provides for a greater diversity of recreation experiences for both winter and summer users than other alternatives.

Northstar – Currently, Northstar is located entirely on private land. Alternative A allows for expansion of the ski area onto NFS lands south and east of Mt. Pluto. Alternative A maintains the “Alpine Skiing Management Prescription on approximately 300 acres in the Watson Management Area. Alternative A allows for the greatest level of expansion, providing for development of additional support facilities,

lodges, and ski runs within the LTBMU. As a result, this alternative provides for a greater diversity of recreation experiences for both winter and summer users than other alternatives.

Alternatives B and E

Heavenly Mountain Resort – Alternative B and E remove the "Maintenance Management Area" and "Alpine Skiing Management Area" prescriptions and would allow up to 5% expansion beyond the existing operational footprint. Ski area development in Alternatives B and E may occur in lands previously designated as "Maintenance Management Area." Expansion is suitable in general conservation management areas, and plans for future expansion would be evaluated on a project by project basis.

Alpine Meadows – Alternatives B and E removes the "Alpine Skiing Management Area" prescription and would allow up to 5% expansion. Expansion is suitable in general conservation management areas, and plans for future expansion would be evaluated on a project by project basis.

Diamond Peak Ski Area – Alternatives B and E removes the "Alpine Skiing Management Area" prescription. Expansion of up to 5% under Alternatives B and E would be limited to general conservation management areas. Plans for future expansion would be evaluated on a project by project basis.

Homewood Mountain Resort – Alternatives B and E removes the "Alpine Skiing Management Area" prescription. Expansion of up to 5% under Alternatives B and E would be limited to general conservation management areas. Plans for future expansion would be evaluated on a project by project basis.

Northstar -Northstar is entirely on private land. Expansion is suitable in general conservation management areas and plans for future expansion would be evaluated on a project by project basis.

Alternative C

Heavenly Mountain Resort – Alternative C removes the "Maintenance Management Area" and "Alpine Skiing Management Area" prescriptions and would allow up to 15% expansion beyond the existing operational footprint within general conservation management areas. Expansion is suitable in general conservation management areas and plans for future expansion would be evaluated on a project by project basis. Under this alternative, the ski area would have the greatest flexibility to respond to user demand as well as accommodate summer uses as ski seasons become more variable due to climate change.

Alpine Meadows – Alternative C removes the "Alpine Skiing Management Area" prescription. Expansion of up to 5% under Alternatives B and E would be limited to general conservation management areas. Plans for future expansion would be evaluated on a project by project basis. Under this alternative, the ski area would have the greatest flexibility to respond to user demand as well as accommodate summer uses as ski seasons become more variable due to climate change.

Diamond Peak Ski Area – Alternative C removes the "Alpine Skiing Management Area" prescription. Expansion of up to 5% under Alternatives B and E would be limited to general conservation management areas. Plans for future expansion would be evaluated on a project by project basis. Under this alternative, the ski area would have the greatest flexibility to respond to user demand.

Homewood Mountain Resort – Alternative C removes the "Alpine Skiing Management Area" prescription. Expansion of up to 5% under Alternatives B and E would be limited to general conservation management areas. Plans for future expansion would be evaluated on a project by project basis. Under this alternative, the ski area would have the greatest flexibility to respond to user demand.

Northstar - Northstar is located entirely on private land. Expansion is suitable in general conservation management areas and plans for future expansion would be evaluated on a project by project basis. Under this alternative, the ski area would have the greatest flexibility to respond to user demand.

Alternative D

This alternative may result in a 15% reduction of the existing operational footprint to meet ecosystem restoration objectives. Alternative D restricts all ski areas to their existing operational footprint with no opportunity to expand. Alternative D allows for the replacement of existing improvements such as lodges and chairlifts and new ski runs could be constructed within the reduce footprint. National Forest System lands not developed may be removed from future special use permits when reissued.

Alternative D mostly affects Heavenly Mountain Resort and would eliminate some projects identified in the accepted 2007 Master Plan Amendment.

The relationship graphic below depicts availability of winter ski opportunities by alternative.

Table 3-62 displays the existing ski area acreage and maximum ski area acreage in each alternative.

Table 3 62. Maximum ski area operational footprint acreage on NFS lands in Lake Tahoe Basin

Ski Area	Existing Operational Footprint (NFS Lands)	Alternative A[1]	Alternative B[2]	Alternative C[3]	Alternative D[4]	Alternative E
Heavenly Mountain Resort	3,066*	4,200	3,219	3,526	2,606	3,219
Alpine Meadows	377*	2,605	396	434	320	396
Diamond Peak Ski Area	350	350	368	403	298	368
Homewood Mountain Resort	204	760	214	235	173	214
Northstar[5.]	0	300	0[5.]	0[5.]	0	0[5.]
All Ski Areas	3997	7,915	4,197	4,598	3,397	4,197

*Does not include acres located on the Humboldt-Toiyabe (Heavenly Mountain Resort) or Tahoe National Forest (Alpine Meadows).

1 Existing special use permit boundary and/or Alpine Skiing Management Prescription adjacent to existing special use permit.

2 Existing special use operational footprint acreage on National Forest System lands + 5%.

3 Existing special use operational footprint acreage on National Forest System lands +15%.

4 Existing special use operational footprint – 15%.

5. Expansion is suitable in general conservation management areas and plans for future expansion will be evaluated on a project by project basis.

Vegetation and Fuels Management - Generally, vegetation management activities enhance downhill skiing by allowing better utilization of skiable terrain. For example, Solitude Canyon at Diamond Peak Ski Area provides excellent off-piste skiing opportunities. In recent years, the timber stand and ground vegetation has grown increasingly thick making skiing more difficult. Timber stand thinning and ground vegetation treatments would clear existing slopes and improve visibility, thus enhancing downhill skiing.

Some vegetation management projects may have a detrimental short-term impact on ski terrain access due specific disposal techniques. For example, pile burning adjacent to or within ski area boundaries may pose a short-term hazard due to the placement of piles on skiable terrain.

Some long-term impacts may occur if large downed trees are not treated. Specifically, large downed trees create greater distance between the ground and the skiable surface. This results in the need for greater snow depth to avoid hitting obstacles. In all alternatives, the “Easy Street Run Prescription” is the preferred method by which downed trees and woody material are treated within developed ski runs. However, the Easy Street Run Prescription may not be implemented when it conflicts with specific resource objectives.

The term "Easy Street Run Prescription" originated from implementation of the vegetation management strategy on the Easy Street ski run at Heavenly Mountain Resort. The Easy Street Run Prescription includes the following vegetation management actions:

- Existing native shrubs within or adjacent to developed ski runs are identified and avoided.
- Noxious weeds are flagged and identified for removal.
- Felled trees and woody debris less than 10 inches are chipped, and the resulting mulch evenly distributed to an average depth of 3 inches.
- Felled trees and logs larger than 10 inches are removed to a sufficient distance from the developed ski run (e.g., adjacent tree island).
- Existing tree stumps are ground down.
- Boulders will be moved or shortened to a height between 12 and 18 inches from the ground.

While the Easy Street Run Prescription is the current preferred prescription for how ski runs are implemented, this prescription may be adjusted and improved through monitoring and adaptive management in the future.

Potentially, vegetation management may increase solar gain on the snowpack or affect wind-related snow loading at site-specific locations. However, such potential effects are not ecologically significant at the Forest Plan level.

Though no specific fuels treatments are prescribed for ski areas, ski areas are primarily in the Backcountry and General Conservation Areas on NFS lands where treatments will occur. Alternatives A, B, and E propose similar acres of fuels and vegetation treatments in those management areas. Alternative C proposes to treat double the acres of Alternatives A, B and E therefore have more short term impacts to ski areas. Impacts from forest thinning would be lowest under Alternative D, which proposes the least amount of forest vegetation treatment.

Species Recovery and Habitat Restoration - Impacts to ski areas from species recovery habitat restoration activities would be minor in most cases for all alternatives. Generally, a habitat restoration activity that enhances the overall environmental health and integrity of the Lake Tahoe Basin is beneficial to ski area interests. However, there is potential for some restoration activities to affect winter sports opportunities. For example, area closures may eliminate skiable terrain, causing crowding on adjacent terrain or a loss of opportunity. In any alternative that resource actions affect recreation management's effort to meet demand, the overall recreation experience will be changed from existing.

Consequences Related to Climate Change

The uncertainty related to climate change over the life of the plan requires recreation managers remain flexible in the delivery of recreation opportunities and services. More boom and bust cycles will likely occur for various recreation opportunities. Though sustainable recreation goals will be considered on a project by project basis for the life of the plan, unpredictable climate changes may make mitigative actions less effective than intended and may even have unforeseen consequences. Over time, the public will have to modify their expectations for the types of recreation experiences they are seeking.

All alternatives provide for adaptation and modification of recreation infrastructure and opportunities in response to climate change. Alternatives A, B, C, and E would allow for varying degrees of flexibility in modification (expansion) of recreation infrastructure to meet the environmental and socioeconomic challenges associated with climate change (see Chapter 3.3, Climate Change). These challenges include decreased snowfall, shorter ski seasons, longer summer seasons, and shifts in economic patterns. Alternative C would afford the LTBMU the greatest ability to respond to these challenges by allowing for up to 15% expansion in recreation infrastructure (e.g., development of summer use opportunities at ski areas). In contrast, Alternative D, which would result in up to a 15% reduction in recreation

infrastructure, would provide the least flexibility to adapt recreation opportunities to meet the challenges associated with climate change.

Throughout the life of the plan, climate change may affect recreation resources in many ways including the ways people recreate, patterns of use, and available recreation opportunities. Examples of the potential effects of climate change on specific recreation resources are summarized as follows:

Extended Summer Seasons – During warmer cycles, the opportunities for experiencing summer recreation activities could be extended. This may extend the time that summer dispersed recreation activities are obtainable and also allow permit holders more economic opportunities to provide services to the public.

Skiing – Wider yearly swings in precipitation rates creates more boom and bust seasons in the skiing industry. Drier years can have a huge impact on the economic viability of ski areas not to mention the missed skiing opportunities by the public. Drier years create more reliance on water resources and colder temperatures for snow making capabilities. On the other hand, more precipitation during the winter can create ideal skiing conditions. Variable conditions may led to more pressure to provide year round recreation opportunities in ski areas

Winter Dispersed Activities –Both motorized and non-motorized winter recreation activities will be affected by changing precipitation patterns. Decreased snowfall and a reduced snowpack may change the use practices of Over Snow Vehicle users. A shorter season may increase OSV pressure on available resources as users strive to maximize their activities. Conversely, a shorter season may reduce the demand for OSV opportunities as users determine that the cost of purchasing and maintaining expensive OSVs are not worth the effort for shorter periods of time on the snow. They may decide that expendable dollars may be better spent on other warm weather activities. Non-motorized winter activities will also be affected by less snowpack in much the same ways downhill skiers are impact as discussed above. Boom and bust snow seasons will impact those who enjoy snow play and cross country skiing activities and they will have to modify their expectations as seasons become more variable.

Water Play and Fishing – Also affected by precipitation rates are those activities that rely on dependable stream flows and lake levels such as water play and fishing. Already noticeable in the Tahoe area are seasons when the lower Truckee River is barely flowing during drought periods and very popular rafting activities come to a near halt. Conversely, in high water years Lake Tahoe is recharged and rivers run strong to the benefit of river runners. This can create more crowding as visitors vie for beach space, which becomes less available as the lake level rises.

Water Supplies –Water supplies for recreation sites that depend on springs, stream runoff and high water tables can be less reliable during drier years. Water supplies for campgrounds, day use sites, and even recreation residences can go dry. The public's anticipation of a high quality recreation experience can be challenged when there is little or no water.

Effects To Recreation From Wildlife Resources Changes – Changing climate patterns can create shifts in migratory populations and may affect bird watching, wildlife enthusiasts, and hunters.

3.4.19.4. Analytical Conclusions

Comparison of Consequences by Alternative

Recreation Opportunity Spectrum

The ROS classifications reflect the overall theme and character expressed by the settings maintained for various forest management and recreation activities.

- Alternatives A, B, C, and E would continue the current mix of settings and activities with approximately 64% of the NFS lands providing a semi-primitive environment (SPM and SPNM) and 36% providing a more developed environment (RN and R). Alternative C is similar to A, B, and E in its general mix of settings; however, up 174 more acres of general improvements to developed recreation facilities may occur in the already developed settings of RN and R. Visitors would continue to enjoy the current balanced mix of recreational opportunities throughout the Basin in these alternatives.
- Alternative D would shift the mix by 5% to Semi-Primitive Non-Motorized. The increase in SPNM acres would result in a 3% decrease in both SPM and RN acres. This would result in fewer miles of improved roads being available for those users who enjoy driving for pleasure in their passenger cars.

Access -Dispersed Recreation

Dispersed Summer Recreation – Non-Motorized/Mechanized. Availability of summer dispersed recreation activities are affected primarily by the type of access to public lands that are needed to allow that activity to happen. Satisfaction ratings are generally improved by meeting demand by providing more access via roads, trails, and trailheads. More access will create more opportunities for dispersed activities to occur and potentially reduce crowding and reduce conflicts.

- There are more miles of hiking trail access opportunities under Alternatives A, B, D, and E than in Alternatives C. New wilderness designations in Alternatives C and D would enhance hiking and equestrian experiences by managing the areas for high wilderness standards of solitude and primitive characteristics and would remove interactions with mechanized use as mountain bikes are not allowed in wilderness areas. Alternative C would increase the acres available for wilderness recreation by 60% and Alternative D would number of acres available for wilderness recreation by 123%.

- Alternatives A, B, and E are unchanged from existing conditions. Wilderness designations in Alternatives C and D would increase the availability of more primitive wilderness experiences, but would change the character of mountain biking experiences in the Basin by prohibiting use on well-used trails such as Big Meadows and Christmas Valley in Alternative C, and Saxon Creek, Armstrong, and the Tahoe Rim Trail among others in Alternative D. Mountain bike trail opportunities will be decreased by 12.3 miles in Alternative C due to a Dardanelles wilderness designation. Mountain bike trail opportunities will be decreased by an additional 25.6 miles for a total of 37.9 miles in Alternative D with Dardanelles and Freel wilderness designations. Wilderness designation would also preclude opportunities for future mountain bike trails in these areas. Alternatives B and E would maintain the existing mix of trail uses and preserve the previously mentioned popular mountain biking opportunities. Dispersed camping opportunities in the Basin would increase with the Freel Peak Wilderness designation under Alternative D.

Dispersed Summer Recreation – Motorized. Vehicles will continue to be restricted to designated roads and trails in all alternatives. Satisfaction levels for off-highway vehicle users will vary in each alternative

by the miles available to each of the different user groups: Passenger cars, High clearance Vehicles and OHV.

- Visitors who enjoy driving for pleasure in their passenger cars would find the most satisfaction in Alternative C with 76 miles of upgraded road for access to both dispersed and developed recreation sites and in support of scenic driving as a recreational activity. Alternatives B and E offer 7 miles less than C. Alternatives A and D maintain the existing 64 miles.
- High-clearance vehicles and OHV road users have more options under Alternative D with 130 miles of roads maintained at these more challenging levels as maintenance levels of other roads decline. The current levels of roads open to OHVs (115 miles) would be maintained with minimal changes in Alternatives A, B, C, and E. Alternative C offers 20 potential miles of trails for OHV users which is 25% more that Alternatives A B, and E and 50% more that Alternative D at 10 miles of trails. Under Alternative D, approximately 5 miles of trail currently open to motorized use would be closed to motorized use with the Freel Peak wilderness designation.

Dispersed Winter Recreation – Non-Motorized. Non-motorized dispersed winter recreation such as cross-country skiing, snowshoeing, and snow play are growing part of the total winter use of forest lands. While there are many high quality opportunities for these activities around the basin, few have established winter parking. The following is a general summary of dispersed winter trailheads/parking available for the different levels of desired winter recreation experiences by alternative:

Alternatives B, C, and E allow for additional winter parking sites to be added to increase access to both dispersed and developed recreation activities. Alternatives A and D would maintain existing winter parking capacity. Some sites may be eligible in the future for additional winter parking to support winter recreation opportunities.

Opportunities for non-motorized winter recreation would remain the same in Alternatives A, B, C, and E and would increase in Alternative D with a Freel Wilderness designation and OSV opportunities are eliminated.

D**ispersed Winter Recreation –Motorized.** Over Snow Vehicle (OSV) users currently have access to approximately one half of the NFS lands in the basin with about 52% open vs. 48% closed).

Opportunities for OSV use would not change from existing conditions as depicted in the current Snowmobile Use Guide for Alternatives A, B, C, and E as new wilderness designations would not change areas currently open or closed. OSV use would not change in Alternative C even with the Dardanelles Wilderness designation as that area is already closed for OSV use. OSV users would be displaced by the designation of the Freel Wilderness area in Alternative D. Though the Freel area is designated as semi-primitive non-motorized and is closed to motorized use during the summer, it is currently open to motorized use in the winter. Users displaced by the area closure would have to find other areas to participate in this activity, most likely in the nearby Hope Valley in the Humboldt-Toiyabe National Forest. Users from nearby neighborhoods would need to trailer their machines to other open areas.

Recreation Development

Developed Recreation - Recreation visitation and resulting demand is anticipated to increase in all alternatives for the life of the plan. None of the alternatives, however, are anticipated to accommodate all the projected demand at popular resorts, campgrounds, and day use areas during the peak seasons. Increasing the supply of amenities such as overnight accommodations and day use parking spaces are not only strategies to respond to the existing and future demand but also ways of meeting visitors' expectations and raising satisfaction levels.

- Alternative C would have the most potential to respond to increased public demand on developed recreation by retrofitting existing facilities or building new ones. Alternatives A, B, and E could also potentially increase supply but not to the same levels as C. Alternative E allows more overnight accommodations than Alternative B but not as much as Alternative C. The greatest negative effects from unmet demand will come from Alternative D as it would have the least ability to respond to demand as developed recreation infrastructure is potentially lost and not replaced due to environmental restoration. In Alternative D, should demand exceed available services due to the loss of developed facilities, recreationists would be adversely affected as prices and crowding increase, and their sense of satisfaction would lessen.
- Effects to Developed Recreation from other management activities on the forest are generated by proposed actions that could relocate or remove existing recreation opportunities. These actions are most likely with Watershed Restoration. Effects from these activities on developed recreation resources are more likely under Alternatives A, B, C and E as they will be restoring the most miles/acres and have the most potential to remove or relocate existing developed recreation features from sensitive resource areas. The direct effects from these actions would be analyzed on a project by project basis. In Alternative D, currently planned watershed restoration projects will continue until completed, and then the strategy for watershed management will be to rely on natural processes for recovery.
- All alternatives will promote transit opportunities where feasible. Parking access at recreation sites would be greatest under Alternative C as it would provide an overall increase in parking. Alternatives A, B, and E would move unmanaged parking to managed parking with no increase in the amount of parking for private automobiles. Alternative D would convert less unmanaged parking to managed parking than the other alternatives.

Winter Sports (Alpine Skiing) - Privately developed downhill skiing on the LTBMU provides a major economic and recreation benefit to the Region. In all alternatives, the operation and maintenance of the existing developed ski areas continues including summertime use that is consistent with laws, regulations, and Forest Service policy pertaining to that use.

- Alternative A offers the most flexibility in responding to increased future skiing demand should it occur. The 1988 plan allows for large scale expansions from the existing operational footprints especially for the Alpine Meadows ski area with a large area of Ward Canyon identified for ski area development.

- Alternatives B, C, and E also allow for expansion of the operational footprint areas but at a much smaller scale. Alternative C allows for more expansion opportunities than Alternatives B and E.

- Alternative D limits ski areas to the existing operational footprint and ski amenities lost to resource restoration activities would not be replaced.

Climate Change

Throughout the life of the plan, climate change may affect recreation resources in many ways including the ways people recreate, patterns of use, and available recreation opportunities. The uncertainties related to climate change will require recreation managers remain flexible in the delivery of recreation opportunities and services and the public will have to modify their expectations for the types of recreation experiences they are seeking.

All alternatives provide for adaptation and modification of recreation infrastructure and opportunities in response to climate change. Alternatives A, B, C, and E would allow for varying degrees of flexibility in modification (expansion) of recreation infrastructure to meet the environmental and socioeconomic challenges associated with climate change (see Chapter 3.3, Climate Change). These challenges include

decreased snowfall, shorter ski seasons, longer summer seasons, and shifts in economic patterns. Alternative C would afford the LTBMU the greatest ability to respond to these challenges by allowing for up to 15% expansion in recreation infrastructure (e.g., development of summer use opportunities at ski areas). In contrast, Alternative D, which would result in up to a 15% reduction in recreation infrastructure, would provide the least flexibility to adapt recreation opportunities to meet the challenges associated with climate change.

How the Alternatives Maintain or Achieve the Desired Conditions

Sustainable recreation management endeavors to provide high-quality recreational activities while minimizing impacts to natural resources, cultural integrity, and socioeconomics. Providing sustainable recreation opportunities in the future is the overarching goal of the desired condition on the LTBMU. The desired conditions focus on providing a broad spectrum of recreation opportunities, providing public access to public lands, continuing infrastructure restoration, maintaining the integrity of the natural resources, and using recreation special uses to leverage the LTBMU's ability to provide recreation services. Alternatives A, B and C all strive to achieve the desired conditions by allowing different degrees of modification and expansion of developed facilities in meeting the predicted increase in future recreation demands. There would be less flexibility in Alternative D to meet future demands.

- Overall, Alternative E provides the best opportunity to meet the desired conditions by continuing to provide a broad mix of recreation opportunities and by having flexibility in responding to future growth by allowing more opportunities to expand overnight accommodations than Alternative B. Though not as aggressive as Alternatives C and A, and still provides managers the ability to be responsive to current and anticipated user demands. This alternative preserves some of the most popular mountain biking opportunities in basin. Very high satisfaction ratings as reported by NVUM surveys support the notion that the current mix of recreation opportunities are generally in balance with the public's expectations.
- Alternative A includes future expansion of recreation infrastructure, and development of new sites by up to 10% is described in the 1988 Plan. As in Alternatives B and E, it does maintain the current mix of recreation opportunities. Future winter demand for ski areas is best addressed in Alternative A where large areas for future expansion have been identified.
- Alternative C provides the most ability to respond to public demand in providing a broad range of opportunities using and increased supply of developed infrastructure as the indicating criteria. Alternative C has off –setting benefits however as there are fewer miles of trail available to dispersed summer non-motorized/mechanized users. The designation of the Dardanelles as Wilderness would result in a shift in user patterns away from mountain biking opportunities toward hiking and equestrian opportunities in a more primitive wilderness setting. Alternative D offers the least flexibility to respond to future demands as recreation infrastructure is potentially lost due to resource restoration projects. Increasing the overall wilderness acres managed would shift the current recreation use patterns in the Dardanelles and Freel IRA's away from the mechanized mountain bike use now popular in both areas, to the more primitive recreation experiences available in a wilderness setting. Wilderness designation of the Freel IRA would also expand the overall acreage available for dispersed overnight camping opportunities in the Basin.

3.4.20. Scenic Resources

3.4.20.1. Introduction

This section evaluates and discloses the potential environmental consequences on the Scenic resources that may result from alternatives A, B, C, D, and E.

Methodology

The public has expressed a strong desire to maintain the outstanding scenic quality of the Lake Tahoe Basin, while accommodating the desire for ecological restoration, hazardous fuels treatment, and development all of which may cause scenic impacts. Public participation and collaboration identified several key valued scenic attributes including:

- The scenic integrity of the natural environment
- Scenic views of and from Lake Tahoe
- Dark sky night views, and
- Built environment character consistent with the alpine setting.

The Forest Service manages scenic resources utilizing the Scenery Management System (SMS). This system replaces the previous Visual Management System (VMS). Two indicators are used to assess current scenic conditions and the potential impacts under the alternatives.

Scenic Integrity

Scenic Integrity Levels are used as a measure of existing scenic condition. They measure the degree of deviation in the landscape from the valued scenic character. These levels are also used to compare the impacts of alternatives. Scenic Integrity uses a graduated rating scale of six levels from "Very High Integrity" to "No Integrity".

Scenic Class is a measure of an area's relative scenic value. Scenic Class considers an area's distinctiveness along with the distance from which it is typically viewed and the relative level of concern regarding those views. Scenic Class ranges from Class 1, "Very High scenic value" to Class 6, "No scenic value".

Scenic Stability

Scenic Stability is an indicator of the ecological sustainability of the valued scenic attributes. Scenic Stability does not measure or evaluate the entire ecological condition. Rather, it addresses how ecosystem dynamics will affect the long-term stability of the valued scenery and its attributes. Scenic Stability uses a graduated rating scale of six levels from "Very High Stability" to "No Stability" to identify the degree to which scenery attributes are likely to be perpetuated within the ecosystem context.

Assumptions

In the analysis for this resource, the following assumptions have been made:

- Overall, the precise timing, location, configuration, landscape-level pattern, and individual characteristics of treatments and other management actions will determine the effects of such actions upon scenery (Litton 1984 [cited in USDA Forest Service 1995a).These factors are determined during site-specific planning; thus the cumulative scenic effects of the alternatives cannot be predicted with confidence. Actual effects will vary with the degree of consideration of scenery management during site-specific planning and implementation.
- Wildfire is likely to have the more severe effects on long-term scenic integrity than planned fuels treatments, based on existing condition inventory by scenic class.
- Vegetation components of the landscape are dynamic and will change over time. Rates of recovery post treatment vary by site conditions, and intensity of treatment.
- Vegetation treatments in the WUI defense zone are essentially the same in the first decade across all alternatives. The assumed short term scenic condition (decade 1) from planned treatments is class 3. WUI Defense Zone is assumed to be 44,069 acres.
- Vegetation treatments do not happen all at once. Annual rates of treatment vary slightly between alternatives. Implementing these initial treatments will take at least 2 decades, so the rates of recovery from initial treatments also vary.
- Scenic standards are in place for all alternatives. Adopted Visual Quality Objectives (AVQOs) for Alt A and Minimum Scenic Integrity Objectives (MSIOs) and Minimum Scenic Stability (MSS) for alternative B, C, D, and E.
- As new recreation and facilities projects are built, they will follow the MSIO, the Built Environment Image Guide (BEIG) and Recreation Opportunity Spectrum (ROS) guidelines for all alternatives.
- The population in the LTBMU's surrounding counties in both northern California and Nevada is projected to grow 1.4% percent annually or 21% in the next 15 years according to U.S. 2010 census data. Visitation is predicted to increase at a rate similar to the population rate increase. The projected growth has the potential to increase demand for new services and development.
- Within the Backcountry Management Area, Inventoried Roadless Areas, Grass Lake RNA, and Wilderness areas, no new developed facilities are proposed under any of the alternatives.
- The long term effect of restoring ecosystems and habitats is assumed to benefit scenery.

3.4.20.2. Overview of the Affected Environment

The planning area encompasses extraordinary scenic resources, most notably Lake Tahoe. The lake is designated as an "Outstanding National Resource Water" under the Clean Water Act, primarily due to the extraordinary clarity of its waters, which is a scenic value. The East Shore Drive National Scenic Byway and east shore beaches offer outstanding unobstructed views of the lake and surrounding Sierra Nevada mountains. Emerald Bay is the iconic "post card setting" for the Lake Tahoe Basin. The Pacific Crest National Scenic Trail passes through the planning area as does the Tahoe Rim Trail. A segment of the Upper Truckee Wild River (Recommended), a large part of the Desolation Wilderness, portions of Mt. Rose and Granite Chief Wilderness, and the Freel Peak and Dardanelles Inventoried Roadless Areas all offer relatively un-altered landscapes, characteristic of the high Sierras.

Tourism that is substantially dependent upon maintaining scenery is an economic mainstay of the Lake Tahoe region. People live in area communities, in large part, in order to benefit from high quality scenery and access to outstanding outdoor recreation. Because of its relative small size, network of roads and trails, and close proximity to intertwined communities around the lake, most of the basin is visible in either the foreground (within a quarter to one half mile) or middleground (quarter mile to five miles). Coupled with its inherently attractive landscape character, and viewed by millions of visitors every year, the landscape is very sensitive to management actions. Any changes to the natural landscape character are easily noticed.

The National Survey on Recreation and the Environment for the 2000-2007 period displayed trends looking at the "seventeen fastest-growing activities—that is, those with days of participation growing by more than 10 percent. Of these top seventeen activities, six involve viewing, photographing, identifying, visiting, or otherwise observing elements of nature—flowers, trees, natural scenery, birds, other wildlife, nature exhibits, and wilderness. The growth in viewing and photographing plants and natural scenery has been most rapid at about 78 and 60 percent, respectively" (Cordell 2008). According to the 2010 National Visitor Use Monitoring (NVUM) report, conducted on the LTBMU, viewing natural features was the third most popular activity, with a 56% participation rate. 83% of those surveyed were very satisfied with the 'quality of the scenery'. These numbers suggest that scenery is a very important public value and perception of the condition of the scenery is very high.

Existing Scenic Integrity

The planning area exhibits extraordinary existing scenic conditions as indicated by the 88% of LTBMU lands that are inventoried Scenic Class 1-2. Landscapes with these ratings (Very High and High Integrity) are natural appearing or appear unaltered to the casual observer. The existing conditions are shown in Table 3-63 and reveal little change in the last thirty years. In fact, the overall existing conditions of scenic integrity for LTBMU lands exceed the minimum level expressed by Adopted VQO's in the 1988 Forest Plan.

Some reductions in scenic integrity have occurred since 1988. The increases in class 4 and 5 landscapes are mostly attributable to wildland fire scars. The Angora Fire (3,072 acres), Gondola Fire (643 acres), and Showers Fire (294 acres), account for most of the changes to Existing Scenic Integrity (ESI) in the last 20 years. Additional land acquisitions encumbered with a certain amount of development have lowered some ratings, such as the purchase of High Meadows and the associated power line corridor. Other development activities in previously undeveloped areas have contributed to lowering ESI scores in certain areas, such as the gondola line construction at Heavenly Mountain Resort.

The increase in Class 1 acres represents the designation of Granite Chief and Mt. Rose Wilderness additions since the adoption of the 1988 Forest Plan.

The scenic and vegetation restoration goals are aimed at restoring landscapes that rank below scenic integrity objectives (Class 4, 5, and 6) where possible. Restoration efforts have improved scenic integrity in some areas.

Table 3 63. Existing Scenic Integrity Inventory, NFS Acres & Percent of Total Area

Existing Scenic Integrity	Class 1	Class 2	Class 3	Class 4	Class 5	Class 6	Total Acres
1982 Acres	20,847	115,510	4,067	2,903	406	1,474	145,207
Percent NFS Land	14.4	79.5	2.8	2.0	.03	1.0	100%
2011 Acres	24,660	111,461	5,040	5,818	6,621	1,176	154,776
Percent NFS Land	15.9	72	3.3	3.8	4.3	0.8	100%

Existing Scenic Stability

Scenery is dependent upon a healthy ecosystem. Natural disturbance elements (including fire, flood, landslides, and avalanches) are normal ecosystem processes, and create or perpetuate natural scenic conditions. In particular, wildfire is a disturbance factor that has been profoundly affected by landscape management. The exclusion of fire through an aggressive suppression policy has led to a departure from normal fire return intervals. Most of the LTBMU's forests were logged during the Comstock era and have re-grown during this fire exclusion period. As a result, age class diversity is almost non-existent in certain vegetation types. Certain dominant scenery attributes most at risk are those related to the vegetation component of ecosystems including:

1. The relative large amounts (89%) of NFS Lands that appear natural (Class I) or unaltered (Class 2) but have little age class diversity and have the potential to be dramatically affected by wildfire and disease,

2. Aspen stands, riparian areas and meadows, valued for their visual variety and seasonal color are threatened by conifer encroachment; and

3. Large tree character and open forest canopies of the Jeffrey Pine Mixed Conifer, White Fir Mixed Conifer and Red Fir vegetation types are threatened by fire exclusion and lack of age class diversity.

Other valued scenery attributes include special places such as unencumbered views of Lake Tahoe from Emerald Bay and the east shore beaches; and cultural features such as the Tallac Historic Site and Cave Rock. Those attributes are protected equally across all alternatives with a common set of standards.

Table 3 64. Existing Scenic Stability — NFS Acres and Percent of Total Area

Very High	High	Moderate	Low	Very Low	No Stability	Total NFS Acres
15,038	70,730	58,505	8,492	1,893	140	154,798
10%	46%	38%	5%	1%	0%	100%

3.4.20.3. Environmental Consequences

Scenery is affected by management activities altering the appearance of what is seen in the landscape. Short-term scenic effects are usually considered in terms of degree of visual contrast with existing or

adjacent conditions that result from management activity. The scenic landscape can be changed over the long term or cumulatively by the alteration of the visual character. Management activities, which result in visual alterations inconsistent with the assigned Scenic Integrity Objectives and scenic desired conditions, affect scenery.

Management activities and plan decisions that have the greatest potential for affecting scenery and vary by alternative are:

- Special area designations
- Vegetation management
- Developed recreation
- Ski areas
- Other management activities

Special area designations

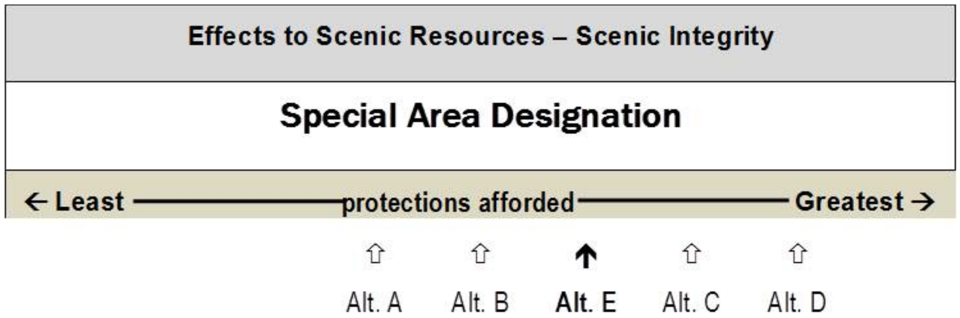
Special Area designation decisions can affect scenic resources by increasing or decreasing the levels of protection. Certain special area designations such as wilderness come with preservation ("Very High" MSIO) scenic objectives. Limits to available management activities such as road building and fuels reduction would reduce effects associated with those activities, while simultaneously limiting the ability to actively restore areas impacted by disturbances such as fire and disease outbreaks.

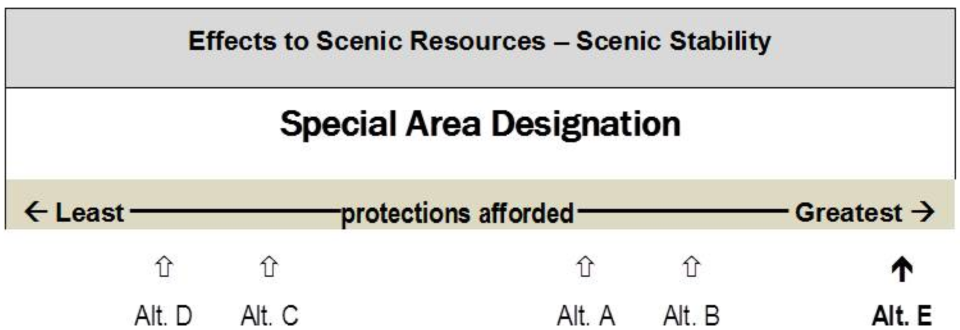
The range of alternatives varies by the amount of proposed wilderness and backcountry management area. The other special areas remain the same between alternatives (Grass Lake RNA, Tallac Historic Site, etc.)

Alternatives

Alternatives A, B, and E are similar in terms of protections afforded to existing wilderness areas with no new areas proposed. Alternative C increases protection by recommending the Dardanelles Roadless Area as wilderness; alternative D provides the most protection for scenic integrity by recommending Dardanelles and Freel Peak Roadless Areas as wilderness. Backcountry management area allocation (See *Table 2-3 Management Areas by Alternative*) is greatest under Alternative E, with Alternatives A and B being the next highest. Alternatives C and D have the least Backcountry management area allocation.

The following relationship graphic displays the gradient of Special Area Designation protections afforded, by EIS alternative:





Although scenic integrity may benefit from additional protections afforded by wilderness allocation, the risk of losing valued scenic attributes may increase due to limitation on the ability to treat disease outbreaks and other management activities that increase forest resilience. Scenic stability may decrease under alternatives C and D.

Vegetation Management

Natural processes can also affect scenery, such as through wildland fires, insect and disease infestations, and the spread of non-native invasive vegetation. The size and intensity of just a few recent fires, Angora, Gondola, and Showers, have had the most impact to the scenic resource in the last 25 years. If the trend to larger fires continues, then the expected impacts to scenic resources will continue. Increasing forest resiliency and lessening fire severity risk should improve scenic stability for all alternatives. All of the alternatives include fuels reduction in the Wildland Urban Interface (WUI). Fuels reduction activities are highly visible in the short term. When combined with the numerous other development activities, utilities, and infrastructure found within the WUI these impacts may reduce the overall scenic integrity. See WUI Treatments described in the Table 2-1 Forest Vegetation Management section (See WUI FEIS Maps 4 and 5 for Zones).

Fuels reduction activities may result in short-term consequences to scenic integrity from cut vegetation resulting in slash piles, disturbed soils from temporary road construction, and the potential to remove vegetation that previously screened development. At the same time, vegetation treatments may improve scenic integrity conditions by opening views of Lake Tahoe and views of the Sierras.

Most of the planned vegetation management activity for the next decade would occur in the WUI defense zone. The defense zone is about a quarter mile from most residences and coincides with foreground viewing distances. Management activities in the foreground are most visible and have the greatest potential effect. The potential for scenic consequences is much higher in the WUI defense than in more remote areas. Since the initial WUI treatment strategy (thinning and fuel reduction) is the same across all alternatives, there is no difference in effects between the alternatives in the first decade. Adherence to design criteria at the project level for foreground thinning (such as low stump cutting) would minimize short-term impacts to scenery.

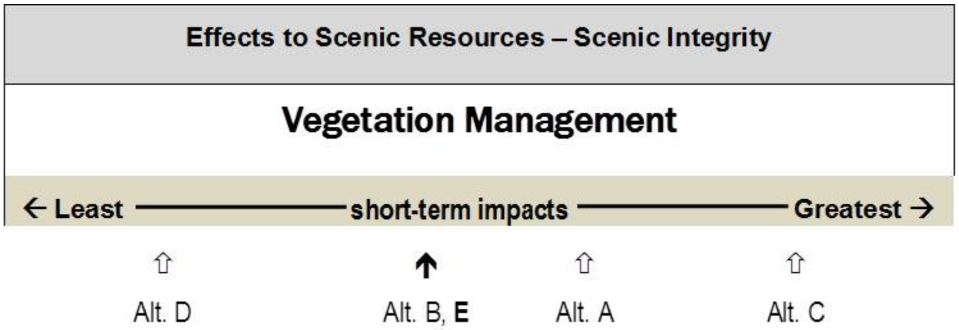
The recovery rate of thinning projects for scenic resources is assumed to be 2-10 years. Given the rate of treatment and recovery approximately 10,000 acres would have visible effects at any one time but should meet scenic class 3 conditions.

Alternatives

Scenic integrity would be negatively affected by natural processes such as wildfire events that reduce the presence of valued scenic attributes. Alternative C proposes to treat slightly more acres through forest structure restoration, forest type conversion and stand resiliency than would the other alternatives; therefore, it would result in more short term impacts to scenic integrity than Alternatives A,B, or E. Impacts would be lowest under Alternative D, which proposes the least amount of forest vegetation treatment.

Forest vegetation and WUI fuels-reduction activities may result in a more stable forest condition, which may be more resilient to wildfires and preserve valued scenic attributes. Without fuels-reduction treatments, wildfires may be more likely to increase in size or severity, negatively affecting valued scenic attributes.

Natural disturbance factors, such as low-intensity wildfire, have the potential to alter the appearance of the planning area. Periodic low-intensity wildfire is a natural disturbance factor that may change short term scenic conditions; however it may improve scenic stability. Generally, low intensity fire (wild or prescribed) may result in long term beneficial consequences to scenic stability by increasing long-term forest resilience.



Alternatives A, B, and E result in the same amount of change from vegetation management and would have similar effects on scenic stability. Alternative C would treat slightly more acres more aggressively than would the other alternatives; therefore it would result in a faster rate of restoration of desired open stand characteristics among alternatives (with the greatest potential for short term negative effects). Aspen stand and meadow restoration is the same across alternatives A, B, C, and E. Alternative D proposes the least amount of active vegetation restoration and may lower scenic stability relative to Alt A.

Developed Recreation

Developed recreation affects scenic integrity as a result of creating visual contrast with the natural environment and varies by the application of design standards consistent with the mountain visual setting and environmental objectives. Addressing the backlog of facility deferred maintenance is common to all alternatives. As facilities are brought up to current codes for design, accessibility, and water quality BMPs, over time most facilities should meet scenic quality desired conditions. The alternatives vary by the amount of developed recreation allowed, however new construction, maintenance and restoration of old facilities, are budget driven. Projecting future budgets is speculative. Since the 1988 Forest Plan was adopted most recreation development management activity has been retrofits of existing facilities rather than expanding capacity or creating new facilities.

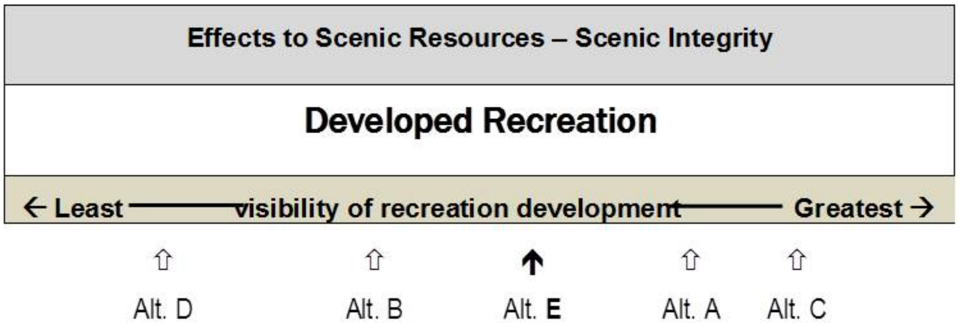
Modeling assumptions for the alternatives seek to satisfy different demand scenarios for developed recreation. In general, the forest plan alternatives address developed recreation areas programmatically, allowing for generalized expansion or contraction to respond to demographic projections, demand scenarios, and the range of issues driving the alternatives.

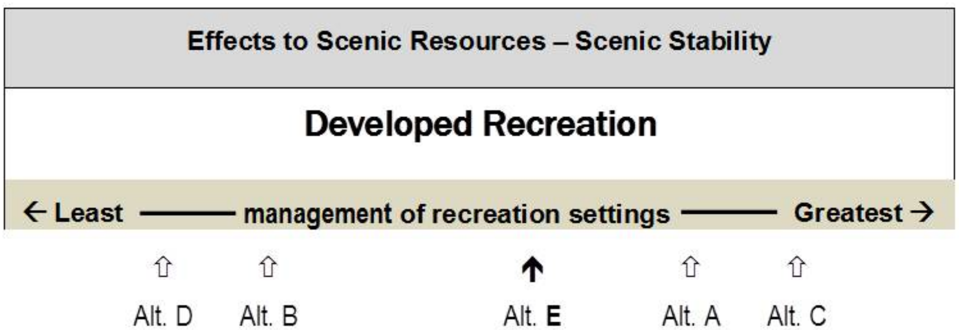
Alternatives

Based on the modeled growth scenarios, scenic integrity would follow the relative pattern displayed below. More growth and recreation development would equal greater effect to scenic resources in terms of degree of contrast from the natural environment. Compared to Alternative A, Alternatives B and E

would allow less expansion, Alternative C more expansion, and Alternative D the least amount of expansion. While the Plan directs developed recreation expansion to incorporate design criteria that visually compliments its visual setting, expansion would have an overall negative effect on scenic integrity in relation to its authorized amount.

Expansion of developed recreation would affect scenic stability in relation to the degree of focused land management surrounding the developed areas; it is assumed that management of the landscape surrounding these developments will receive a high degree of management with the intention of preserving the valued scenic character of the setting.





Ski Areas

The LTBMU manages the Heavenly Mountain Resort under a special use permit and Master Development Plan. A small portion of Homewood Ski Area, Alpine Meadows and Diamond Peak have incidental ski runs on NFS lands and are also managed under special use permit. The impacts to scenic integrity are documented in the SMS inventory update. Generally speaking, the existing vegetation cuts for ski runs and lifts are highly visible throughout the basin and impact valued scenic resources. The site specific direct effects are analyzed and mitigated at the project level. In general the forest plan alternatives seek to address developed recreation and ski areas programmatically, allowing for generalized expansion or contraction to respond to demographic projections, demand scenarios, and the range of issues driving the alternatives

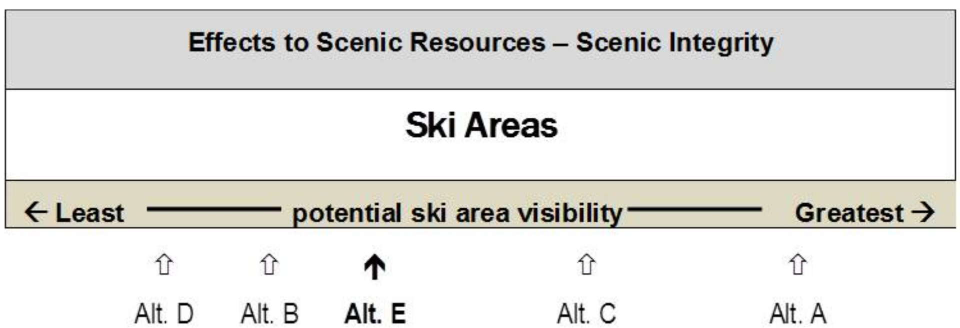
Alternative A reflects the current conditions for allowable development following the most recent Master Plan(s) for ski areas. The consequences related to existing ski area operations and development are expected to continue over the planning period allowing for some modest growth and expansion. The effects on scenic integrity are expected to continue. The visible change from lifts and runs will continue along with efforts to mitigate these effects.

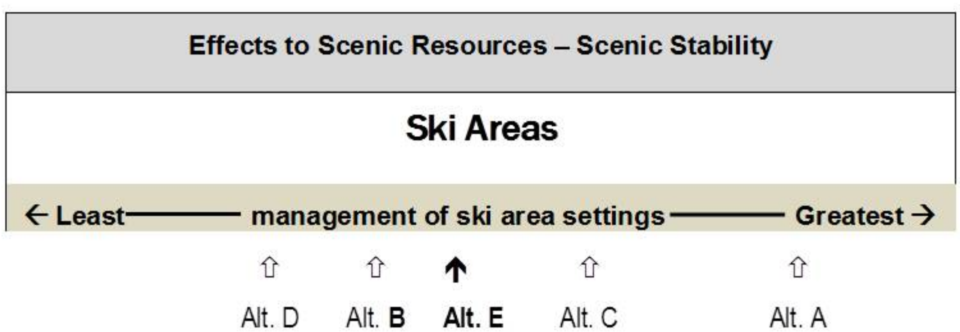
Minimum Scenic Integrity Objectives (MSIO) are common for Alternatives B, C, and D. MSIO are slightly different for Alternative E. The total acres within each MSIO level are similar among all alternatives; however areas within ski area development boundaries are assigned a “Moderate” MSIO in Alternative E compared to a matrix of “High” and “Moderate” under Alternatives B, C, and D.

Alternatives

Alternative A allows for the greatest amount of expansion, and Alternative D the greatest reduction. Alternatives B and E allow for a slight increase compared to current conditions, and Alternative C allows for slightly greater increase than Alternatives B and E. The degree of ski area expansion proportionally affects scenic integrity.

Ski areas are generally managed for developed recreation. The impacts from concentrated use and development on the stability of the vegetation component may lead to unstable forest conditions, making these areas more susceptible to insect, disease and fire outbreaks, resulting in less scenic stability. As ski resorts move to more all season operations the effects are felt year round. More development pressure and increased human caused fire ignitions does increase fire risk and vegetation loss. The presence of roads, trails, and water reservoirs may improve fire response times.





Other management activities

Other management activities that generally have short term effects to the scenic resource are stream channel and aquatic habitat restoration, species recovery and habitat restoration. The long term effect of restoring stream systems and habitats is assumed to benefit scenery.

Land exchange, urban storm water treatment projects, and administrative site facility construction may cause more lasting contrast with naturally appearing scenic conditions, but are assumed to be of a size and scale to be barely measureable at the landscape scale.

No new road construction is planned with any of the alternatives. Temporary roads may be constructed to implement vegetation management activities. Temporary road construction must follow required BMP's and design criteria but may result in minor long term impacts to scenic integrity, associated with vegetation management.

Reclassification of existing Forest Service System roads to allow different vehicle classes to access more of the existing road networks does differ between alternatives. However the scenic effects of this activity are minor, such as few additional gates and signs, and assumed to be of a size and scale to barely be measureable at the landscape scale.

Many activities are ongoing and common to all alternatives or are not expected to differ significantly between the alternatives. These include:

Utility corridors and communication sites

- Of the current conditions and ongoing activities, utility corridors and communication sites impact scenic resources the most. The existing scenic integrity inventory takes into account the effect of these facilities. However, the main variables that influence the number of new utility corridors and communication sites are population growth related. As population increases, technology changes and infrastructure ages, it is assumed that additional pressure will continue for new and replacement services. Since these variables are expected to be the same under all of the alternatives, the related impact to scenic integrity of managing existing facilities and developing new facilities is expected to be site-specific and similar under all of the alternatives and cannot be predicted.

Vehicle parking strategies

- Vehicle parking strategies do change between the alternatives. All alternatives would employ BMP's for parking areas. Alternatives B, and E have the same strategies for vehicle parking. Compared to Alt B, and E, Alternative C would manage the most roadside parking which would benefit scenic integrity and stability, and increase parking capacity. Alternative A would increase managed parking, but not the extent of Alternative C. Alternative D would reduce managed parking capacity which could benefit scenic integrity.

Trail construction

- Trail construction affects scenic quality in two primary ways. First, sensitivity level 1 trails, such as the Pacific Crest Trail or the Tahoe Rim Trail, draw users into the foreground of areas that may have previously been unseen thus increasing the sensitivity of those landscapes. Secondly, there are some direct effects of trail construction. However, trail building does not vary a measurable amount among the alternatives (see table 2-1) so effects to scenic resources from trail construction are so similar that they do not vary among the alternatives.

Aquatic and terrestrial ecosystem restoration, and invasive species management

Potential impacts from these management activities would be the same under Alternatives A, B, C, and E. Alternative D would have the least amount of active restoration and would therefore have the least amount of direct impact to scenic integrity. Scenic stability would benefit from the implementation of these management activities as they would be more likely to perpetuate the valued scenic attributes of the views of NFS lands and nearby waters.

Indirect effects from these management activities may include site-specific construction of structures necessary for project implementation. The impacts related to these elements would be local. Site-specific planning and design would be undertaken in order to limit adverse impacts to scenery while, at the same time, taking every opportunity to enhance scenery. As a result, these features may be installed so that they are noticeable to the casual observer, but do not dominate the view.

3.4.20.4. Analytical Conclusions

Comparison of Consequences by Alternative

Consequences to scenic integrity and scenic stability are summarized in Tables 3-65 and 3-66.

Table 3 65. Comparison of Consequences to Scenic Integrity by Alternative

Management Activities	Unit of Measure	Existing Condition	Alternative A	Alternative B	Alternative C	Alternative D	Alternative E
Vegetation Management in WUI	Acres of Treatment	High/ Moderate	Short-term Decrease	Short-term Decrease	Short-term Decrease	Short-term Decrease	Short-term Decrease
Vegetation Management Outside WUI	Acres of Treatment	High/ Moderate	Short-term Decrease	Short-term Decrease	Short-term Decrease	Short-term Decrease	Short-term Decrease
Aspen Stands, Meadows & Wetlands	Acres Restored	High/ Moderate	Increase	Increase	Increase	Increase	Increase
Vehicle Parking Capacity	Acres	Low	Low	Low	Low	Moderate	Low
Developed Recreation Area Expansion	Modeled Growth Scenarios	Low	Low	Low	Low	Moderate	Low
Special Areas (protected)	Wilderness Acres	Very High	Very High	Very High	Very High	Very High	Very High
N/A	Recommended Wilderness Acres	Very High	Very High	Very High	Very High	Very High	Very High
Management Area	Backcountry Acres	High	High	High	High	High	High

Table 3 66. Comparison of Consequences to Scenic Stability by Alternative

Management Activities	Unit of Measure	Existing Condition	Alternative A	Alternative B	Alternative C	Alternative D	Alternative E
Vegetation Management in WUI	Acres of Treatment	Low/ very low/ no stability	Increase	Increase	Increase	Increase	Increase
Vegetation Management Outside WUI	Acres of Treatment	Low/ very low/ no stability	Increase	Increase	Increase	Increase	Increase
Aspen Stands, Meadows & Wetlands	Acres Restored	Low/ very low/ no stability	Increase	Increase	Increase	Increase	Increase
Vehicle Parking Capacity	Acres	Low	Low	Low	Low	Moderate	Low
Developed Recreation Area Expansion	Modeled Growth Scenarios	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate
Special Areas (protected)	Wilderness Acres	High	High	High	High	High	High
N/A	Recommended Wilderness Acres	High	High	High	Moderate	Moderate	High
Management Area	Backcountry Acres	High	High	High	High	High	High

How the Alternatives Maintain or Achieve the Desired Conditions

Scenic Integrity Desired Condition

Scenery viewed from Lake Tahoe and the Basin's major roadways, public recreation areas, trails and urban centers predominantly display natural-appearing forest, meadows, mountains, and the shoreline of Lake Tahoe. Development, where visible, appears subordinate to and harmonious with the surrounding setting.

Existing conditions for scenic quality in 2011 are very similar to existing condition measured in 1982 (see ESI acres). Minimum Scenic Integrity Objectives (MSIOs) represent a minimum threshold for scenery management rather than a management goal (Table 3-67). Scenic conditions, as measured by existing scenic integrity, far exceed scenic integrity objectives set for each alternative. That trend is expected to continue under all alternatives over the next 10-15 years. Some programmatic strategic differences do exist between the alternatives that may affect scenic integrity; however Minimum Scenic Integrity Objectives are similar by acres under each alternative.

Table 3 67. Minimum Scenic Integrity Objective, by Acres and Alternative

Scenic Class	Existing condition 2011	Alt. A Current AVQO	Alt. B Proposed SIO	Alt C Proposed SIO	Alt D Proposed SIO	Alt. E Proposed SIO
Very High (VH)	20,847	24,973	24,674	24,674	24,674	24,675
High (H)	115,510	28,902	104,245	104,245	104,245	104,633
Moderate (M)	4,067	100,770	25,905	25,905	25,905	25,516
Low (L)	2,903		*	*	*	*
Very Low (VL)	406		*	*	*	*
No Integrity	1,474		*	*	*	*

* Restoration Objectives for Lands Below Moderate (M) Existing Integrity Level

Scenic Stability Desired Condition

The desired scenic attributes are ecologically stable and display minimal visual disruption resulting from disturbance events. Landscape alterations complement and blend with the characteristic landscape of the Lake Tahoe Basin. Vegetation treatments designed using the latest environmental design arts skills produce natural-appearing diverse forest structure.

Those alternatives that restore or protect desired scenic attributes as well as the processes that perpetuate them will have the greatest chance of improving scenic stability. Desired scenic attributes that can be measured and differ between the alternatives are age class diversity of Jeffrey Pine Mixed Conifer, White Fir Mixed Conifer and Red Fir vegetation types, and acres of aspen stands, riparian areas and meadows restored.

- Alternative A – maintains current age class diversity, disease risk and restoration objectives
- Alternative B – increases age class diversity, with less disease risk compared to Alternative A. Same restoration objectives as Alternative A.

- Alternative C – increases age class diversity, with less disease risk than Alternatives A or B. Same restoration objectives as Alternative A.
- Alternative D – decreases age class diversity, with greater likelihood for more disease risk than Alternative A. Less opportunity for restoration objectives due to land allocation and passive management
- Alternative E – increases age class diversity, with less disease risk compared to Alternative A. Same restoration objectives as Alternative A.

Natural processes can also affect scenery, such as wildland fires, insect and disease infestations, and the spread of terrestrial invasive plant species. The size and intensity of just a few recent fires, Angora, Gondola, and Showers, have had the most impact to the scenic resource in the last 25 years. If the trend to larger fires continues, then the expected impacts to scenic resources will continue. Wildfire risk predictions vary between the alternatives. Those alternatives lowering wildfire risk will have the greatest chance of maintaining or improving scenic stability.

- Alternative A – maintains current Fire Regime Condition Class, disease risk and terrestrial invasive plant species risk.
- Alternative B – less risk than Alternative A
- Alternative C – less risk than Alternatives A or B
- Alternative D – greater risk than Alternative A
- Alternative E – less risk than Alternative A

3.4.21. Social and Economic Conditions

3.4.21.1. Introduction

This is a summary of some of the key factors describing the social and economic condition of the Lake Tahoe Basin. See *Appendix F – Social and Economic Assessment* for a more detailed report.

The Lake Tahoe Basin Management Unit (LTBMU) is an integral part of the economy and social life of Lake Tahoe Basin communities. Visitors from around the country and the world are attracted to Lake Tahoe to enjoy a variety of recreational activities. The scenic quality of Lake Tahoe and its surrounding landscape make visiting the Lake Tahoe Basin a one-of-a-kind experience. The LTBMU contributes to the Lake Tahoe Basin's scenic quality through the conservation and management of vegetation, waterways, infrastructure, and recreation.

The Lake Tahoe Basin economy is driven largely by recreation and tourism. The LTBMU plays an important role in providing outdoor recreation opportunities and preserving the scenic quality of the Tahoe Basin's lands and waterways.

Two geographic areas were studied:

- Lake Tahoe Region (LTR) - defined by the watershed boundaries around the lake itself using Census County Divisions (CCD's),
- Greater Lake Tahoe Area (GLTA) - a larger region defined by the surrounding counties in California and Nevada (see Appendix F – Social and Economic Assessment for a map and detailed explanation).

This provides a comparison of the area immediately in the vicinity of the lake within the context of the larger surrounding area which includes the large communities of Placerville, CA and Reno, NV.

The GLTA is representative of the region's functional economy, meaning this is where Lake Tahoe Region residents and businesses are likely to purchase a significant amount of their goods, services, and housing. Counties within the GLTA are influenced by spending patterns of residents, visitors and businesses within the LTR, and have a direct influence on visitor rates and use patterns on the LTBMU.

3.4.21.2. Affected Environment

Social Conditions and Trends

Population

The Lake Tahoe Region (LTR), with a population of 51,774 represents a small fraction of the Greater Lake Tahoe Area (GLTA) population of 1,043,723 people in 2011. Within the LTR, more than half of the population resided in the South Lake Tahoe CCD. Between 2000 and 2011, Nevada's population grew by almost 34%, while California's population grew at a much slower rate, increasing by a little over 9%. The GLTA grew in population by close to 25%. In contrast, the LTR lost 17.6% of its population. An article in the Sierra Sun (March 9, 2011) attributed this loss in population to a worsening economy. Also, the gaming industry declined over 50% since 1990 so there are fewer jobs in the LTR to hold people there. There is also a trend toward increasing second home ownership by people who do not live year-round in the Lake Tahoe Basin area. These are used as vacation homes and do not contribute toward such things as children in schools, year-round shopping in the local community, etc.

The rise in populations of the states of California and Nevada translate into higher demand being placed on recreation opportunities in the Lake Tahoe Basin. The 25% rise in population in the surrounding GLTA results in greater day-use demand for recreation in the Basin.

Race and Ethnicity

Compared to California and Nevada, the GLTA and the LTR are not as racially and ethnically diverse. In the GLTA, 82% of the population is white, while in the LTR, 84% of the population is white. Within the LTR, South Lake Tahoe CCD is the most racially diverse of the four CCDs, followed by Lake Tahoe CCD.

Poverty

Poverty estimates of the LTR and GLTA were compared with averages across California and Nevada by ethnic groups. In general, the poverty rates in the GLTA and LTR are less than the state-wide averages.

Education Attainment

Educational Attainment in the GLTA and LTR compared favorably against state percentages. Both the GLTA and LTR had a higher percentage of high school graduates than Nevada and California. When considering the percentage of population with a bachelor's degree or higher, the LTR outranked all other regions (CA, NV, GLTA); however, GLTA was consistent with California and exceeded Nevada's rate.

Housing

When considering housing occupancy status, the LTR differs greatly from all other regions with a 45% vacancy rate, and outstripped the next highest rate, which was for the GLTA at 34%. Of the vacant housing units, the LTR and the GLTA were used primarily for seasonal, recreational, or occasional use. Only 8% of the vacant homes in the LTR were rental units compared to 34% for California and 37% for Nevada. When looking at homeownerships rates the GLTA exceeded all other regions (CA, NV and LTR), and the LTR was on par with California and Nevada.

Economic Condition and Trends

Employment

At the time this was written, employment data was not available for the 2010 Census data at the local CCD level. Appendix F presents an overview based on the 2000 Census data (as updated to 2003). Unemployment figures presented in Appendix F have been updated at the CCD or LTR level and represent the best available information. In general the LTR employment is dominated by the Accommodation and Food Service sector at 25%, followed by the Government sector at about 20%, and Arts, Entertainment and Recreation; Real Estate and Rental Leasing; and Retail Trade sectors each providing about 10% each. The LTBMU contributes to these tourism based employment sources and through direct input of wages and contracts to the Government sector.

Income

The Lake Tahoe Region (LTR) income follows the employment data. In 2006 the accommodation and food services industry provided the most income, followed by government. Income in the LTR is dominated by the wage or salary income sector with about 62%, as compared to much lower income being derived from self-employment income (about 12%), interest-dividends-net rental income (about 16%), or person current transfer receipts (about 10%) (see Figure F30 in Appendix F – Social and Economic Assessment).

Economics of Recreation

The economic value of specific recreation activities has not been quantified for the Lake Tahoe area. The economic benefits of specific recreation activities are qualitative rather than quantitative, based on speculation rather than proven socio-economic research.

Most of the research on the socio-economic value of recreation to the Lake Tahoe area has been general in nature, looking at recreational activities in broad categories. The LTBMU has been a participant in the National Visitor Use Monitoring (NVUM). Tables 3-68, 3-69 and 3-70 are taken from the 2010 NVUM Report, which is the most recent information available (USDA Forest Service 2010). This information provides a broad snapshot of the economic input of recreation activities into the Lake Tahoe area.

Table 3 68. Annual Visitation Estimate

Visit Type	Visits (1,000s)	90% Confidence Level (%)#
Total Estimated Site Visits*	**8,998**	**± 28.8**
Day Use Developed Site Visits	7,559	± 34.0
Overnight Use Developed Site Visits	138	± 16.0
General Forest Area Visits	1,180	± 26.3
Designated Wilderness Visits†	120	± 27.2
Total Estimated National Forest Visits§	**5,786**	**± 31.1**
Special Events and Organized Camp Use‡	60	± 0.0

* A Site Visit is the entry of one person onto a National Forest site or area to participate in recreation activities for an unspecified period of time.

† Designated Wilderness visits are included in the Site Visits estimate.

‡ Special events and organizational camp use are not included in the Site Visit estimate, only in the National Forest Visits estimate. Forests reported the total number of participants and observers so this number is not estimated; it is treated as 100% accurate.

§ A National Forest Visit is defined as the entry of one person upon 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.

This value defines the upper and lower bounds of the visitation estimate at the 90% confidence level, for example if the visitation estimate is 100 +/-5%, one would say “at the 90% confidence level visitation is between 95 and 105 visits.”

Table 3 69. Activity Participation on LTBMU

Activity	% Participation*	% Main Activity‡	Average Hours Doing Main Activity
Relaxing	65.5	11.2	9.2
Downhill Skiing	62.5	55.9	8.9
Viewing Natural Features	56.3	5.6	4.3
Hiking / Walking	47.0	8.8	3.5
Viewing Wildlife	43.2	1.5	3.6
Driving for Pleasure	31.8	2.1	3.5
Visiting Historic Sites	15.1	0.4	2.1
Other Non-motorized	14.9	2.8	3.7
Nature Center Activities	13.2	0	2.0
Bicycling	11.0	3.1	3.0
Resort Use	10.7	0.2	59.4
Cross-country Skiing	9.8	1.5	4.1
Nature Study	9.6	0.1	3.6
Picnicking	9.5	0.6	4.5
Non-motorized Water Activities	6.9	1.7	2.4
Motorized Water Activities	6.8	0.9	3.0
Snowmobiling	6.2	1.0	2.0
Fishing	5.6	0.4	3.3
Some Other Activity	5.3	1.6	3.0
Developed Camping	5.2	0.4	68.5
Gathering Forest Products	4.7	0	0
Backpacking	4.4	0.2	48.2
Primitive Camping	2.4	0.1	1.0
Horseback Riding	2.0	0	1.0
OHV Use	1.7	0.4	3.3
Motorized Trail Activity	1.4	0	0
Other Motorized Activity	1.3	0	0
Hunting	0.1	0	0
No Activity Reported	0	0	0

* Survey respondents could select multiple activities so this column may total more than 100%.

‡ Survey respondents were asked to select just one of their activities as their main reason for the forest visit. Some respondents selected more than one, so this column may total more than 100%.

Table 3 70. Trip Spending and Lodging Usage

Trip Spending	Value
Average Total Trip Spending per Party	$928
Median Total Trip Spending per Party	$329
% NF Visits made on trip with overnight stay away from home	67.3%
% NF Visits with overnight stay within 50 miles of NF	66.0%
Mean nights/visit within 50 miles of NF	5.8
Area Lodging Use	**% Visits with Nights Near Forest**
NFS Campground on this NF	2.9%
Undeveloped Camping in this NF	0.8%
NFS Cabin	18.5%
Other Public Campground	1.0%
Private Campground	0.5%
Rented Private Home	59.2%
Home of Friends/Family	7.1%
Own Home	11.3%
Other Lodging	0.2%

LTBMU Economic Contributions

An economic contribution analysis depicts the Forest Service's contribution to the local and regional economy. IMPLAN is the economic modeling tool created by the Forest Service in cooperation with the Federal Emergency Management Agency and the Bureau of Land Management that was used to estimate the Forest's contribution to the local economy. IMPLAN models the economic stimulus, i.e., the labor and income generated among 509 economic sectors identified in the North American Industrial Classification System (NAICS) within the study area. The economic sectors were aggregated by the first two digits of their classification number for report purposes to produce twenty aggregate sectors.

The model built for the LTBMU is based on zip codes which concentrate on the physical boundary of the Basin. This determination is driven by the issues raised by the public and resource managers. The Lake Tahoe region is well defined by the mountain ridges around the lake.

Table 3-71 describes the LTBMU's contribution to the Lake Tahoe Basin area as measured by jobs and labor income by industry sector. Note that "Jobs" refers to average annual employment and includes a combination of full and part time, temporary, and seasonal workers. "Labor Income" is the sum of employee compensation (the value of wages and benefits) and proprietor's income. The numbers in the "LTBMU-related" columns are Total Effects – direct effects plus the ripple (secondary) effects in the local economy.

Table 3 71. LTBMU Economic Contribution to Lake Tahoe Region (2008)

Industry	Jobs Area Totals	Jobs FS-Related	Labor Income Area Totals*	Labor Income FS-Related*
Agriculture	54	54	$2,070	$1,751
Mining	51	6	$2,261	$277
Utilities	199	4	$23,685	$620
Construction	3,287	27	$200,103	$1,588
Manufacturing	242	69	$14,983	$1,979
Wholesale Trade	329	81	$24,169	$6,236
Transportation & Warehousing	654	66	$27,195	$2,842
Retail Trade	3,563	385	$115,344	$14,799
Information	411	32	$26,545	$2,044
Finance & Insurance	2,382	50	$74,893	$2,281
Real Estate & Rental & Leasing	7,594	89	$107,985	$1,592
Prof, Scientific, & Tech Services	3,316	160	$178,494	$7,437
Mngt of Companies	156	16	$18,573	$1,881
Admin, Waste Mngt & Rem Serv	2,189	82	$78,082	$2,717
Educational Services	681	20	$15,962	$726
Health Care & Social Assistance	3,748	95	$239,840	$10,931
Arts, Entertainment, and Rec	2,816	320	$88,447	$10,649
Accommodation & Food Services	10,167	1,784	$316,644	$54,786
Other Services	3,150	77	$125,385	$4,244
Government	7,623	175	$498,144	$14,343
Total	**52,612**	**3,593**	**$2,178,808**	**$143,722**
FS as Percent of Total	**---**	**6.83%**	**---**	**6.60%**

* Thousands of 2010 dollars

The LTBMU's contribution to employment in the LTR by program area by alternative is shown in Table 3-72. Of the Forest Service programs, the greatest economic stimulus to the GLTA and LTA's economy is due to the recreation program.

Table 3 72. Employment by Program Area for the Lake Tahoe Region (total number of jobs contributed by alternative)

Resource	Alternative A (Current)	Alternative B	Alternative C	Alternative D	Alternative E*
Recreation: non-local only	3,166	3,324	3,641	2,691	3,324
Wildlife and Fish: non-local only	87	92	100	74	92
Grazing	0	0	0	0	0
Timber	0	0	0	0	0
Minerals	0	0	0	0	0
Ecosystem Restoration	50	50	50	50	50
Payments to States/Counties	31	31	31	31	31
Forest Service Expenditures§	258	258	258	258	258
Total Forest Management	3,593	3,755	4,081	3,105	3,755
Percent Change from Current	---	4.50%	13.60%	-13.60%	4.50%

*It is assumed that Alternative E would have similar employment number to Alternative B because the addition of approximately 5,000 acres of Backcountry and relatively small amount of recreation expansion over Alternative B.

§Forest Service Expenditures is the only place government employment for program planning and administration is counted. Employment in all other rows counts only private sector jobs.

An economic contribution to the area of analysis of close to 7% is a large contribution in comparison with other National Forests. The typical contribution is 1 - 2%. This contribution is relatively large because the study area is limited to the Lake Tahoe Basin and the LTBMU makes up around 75% of the area. Also, the LTBMU is one of the smallest forests in the country and has the highest per acre visitor rate. The dominant industries in the LTR are related to recreation and tourism. The LTBMU also contributes to relatively high wage positions in its administrative capacity related to the Southern Nevada Public Land Management Act. In addition, the LTBMU receives and administers, on average, $37.5 million in federal funding annually to support environmental improvement projects, which contributes to a large share of the employment and income being related to the government sector.

3.4.21.3. Environmental Consequences

Unit Budget

The general program of work and levels of goods and services provided is expected to remain fairly constant over the next 4 years, but is expected to decrease after that. Appropriated funding is expected to decrease from 2012 levels by 5-7% in 2013 and again in 2014, and remain flat after that. Funding from the Southern Nevada Public Lands Act (SNPLMA) will be largely expended by 2016, and is expected to be totally expended by 2020.

Presidential commitments from 1998-2003 are congressional earmarks funding the Lake Tahoe Environmental Improvement Program (EIP) and the Lake Tahoe Restoration Act (LTRA). Presidential commitments from 2004-2011 are SNPLMA funds (Table 3-73 and Figure 3-88). SNPLMA funds shown in Table 3-74 are funds expended; more funds may have been available for a given year.

Table 3 73. LTBMU Environmental Improvement Program (EIP) and the Lake Tahoe Restoration Act (LTRA Program Funding by Fiscal Year

($1,000)	FY 1998	FY 1999	FY 2000	FY 2001	FY 2002	FY 2003
Presidential Commitments	-	7,547	5,025	8,350	10,664	10,699
Appropriated Funds	7,560	5,919	8,436	11,494	12,769	12,435
Total	$7,560	$13,466	$13,461	$19,844	$23,433	$23,134

Table 3 74. LTBMU Program Funding Provided by the Southern Nevada Public Lands Management Act (SNPLMA)

FY 2004	FY 2005	FY 2006	FY 2007	FY 2008	FY 2009	FY 2010	FY 2011	Average
14,080,000	5,545	16,412	16,049	13,521	11,900	11,930	7,932	$9,975
8,033,000	11,702	10,006	12,181	10,654	13,269	15,054	15,237	$11,053
$22,113,000	$17,247	$26,417	$28,230	$24,174	$25,169	$26,985	$23,170	$21,029

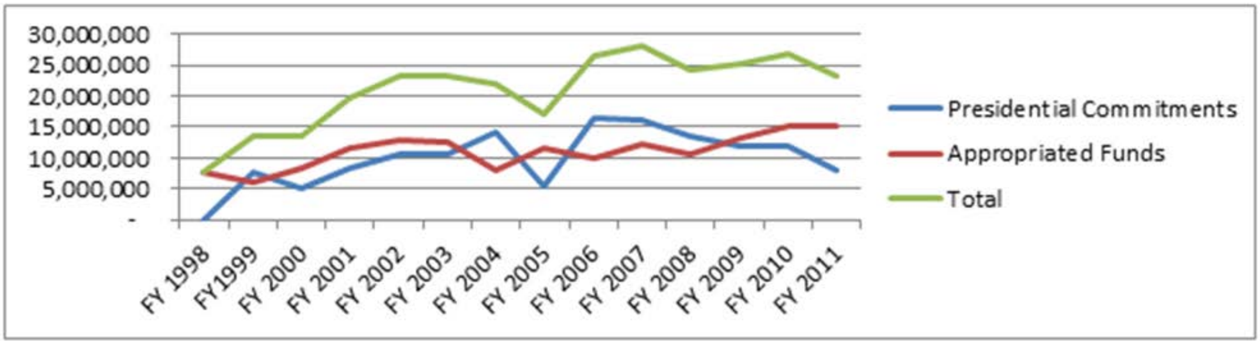


Figure 3 88. LTBMU Program Funding by Fiscal Year

Economics

Alternative C has the most recreation expansion projected which results in the highest labor income and employment projections, followed by A, E, B, and then D. Payments to counties are expected to be about the same across alternatives (Table 3-75). The LTBMU does not contribute any jobs and income from grazing or minerals (Table 3-76). There is no timber program, however some trees are sold as part of the ecosystem restoration activities and are assumed to be about the same contribution towards jobs and income across the alternatives. By providing a diversity of recreation opportunities the LTBMU is contributing to the overall health of the local economy.

3.4.21.4. Analytical Conclusions

Alternative C would provide the greatest amount of labor income and the greatest number of jobs, while Alternative D would provide the least amount of labor income and the fewest number of jobs. Payments to counties would be the same for all alternatives.

Table 3 75. Summary of Alternatives by Economic Alternative

Indicator	Unit of Measure	Alt. A Current Plan (No action)	Alt. B DEIS Preferred	Alt. C	Alt. D	Alt. E FEIS Preferred
Labor Income	$1,000	$143,722	$149,473	$160,974	$126,471	$149,473
Employment	# Jobs	3,593	3,755	4,081	3,105	3,755
Payments to Counties/States	$1,000	$2,313	$2,313	$2,313	$2,313	$2,313

Table 3 76. Employment (for the Lake Tahoe Region as defined by zip codes) – total number of jobs contributed

Resource	Alt. A (Current)	Alt. B	Alt. C	Alt. D	Alt. E
Recreation: non-local only	3,166	3,324	3,641	2,691	3,324
Wildlife and Fish Recreation: non-local only	87	92	100	74	92
Grazing	0	0	0	0	0
Timber	0	0	0	0	0
Minerals	0	0	0	0	0
Ecosystem Restoration	50	50	50	50	50
Payments to States/Counties	31	31	31	31	31
Forest Service Expenditures	258	258	258	258	258
Total Forest Management	3,593	3,755	4,081	3,105	3,755
Percent Change from Current	---	4.50%	13.60%	-13.60%	4.50%

3.4.22. Soils Resource

3.4.22.1. Introduction

In addition to supporting native vegetation and wildlife, soils play a critical role in supporting watershed and ecosystem health through their functions of accepting, storing, and releasing water. The soils analysis analyzes the effects of the alternatives in terms of their effects on soil quality and soil productivity. Discussion of water quality impacts can be found in the Water Quality section (Section 3.4.24 of this chapter) and the Water Quality specialist report (available in project record). Information in the soils analysis is not intended to predict water quality impacts and should not be used for that purpose.

The spatial scope of the analysis is limited to National Forest System (NFS) lands within the Lake Tahoe Basin administrative boundary. The analysis is further limited to lands dedicated to growing vegetation. Roads, trails and some parts of developed facilities such as resorts and campgrounds are not dedicated to growing vegetation. Soil productivity is a site-specific attribute of the land; soil productivity of one area is not dependent on the productivity of an adjacent area. For this reason, only soils on NFS lands are analyzed; effects to soil productivity on NFS lands generally do not affect productivity on adjacent lands under other ownership.

The temporal scope for assessment of soil resource environmental effects includes short term (1-10 years following activities) and long term (10-20+ years following activities) for this analysis.

Methodology

Consequences of activities and uses to the soil resource are discussed in terms of the magnitude, duration, and extent of the effect. Magnitude describes the degree of positive or negative impact on the resource. Consequences may be short term (less than 10 years) or long term (> than 10 years) in duration. Extent is a measure of the area of the effect.

The environmental consequences of the following major categories of activities and uses to the soil resource are discussed as follows:

- Stream channel restoration
- Vegetation and fuels management
    - Prescribed fire – underburning and pile burning
    - Hand and mechanical thinning
    - Temporary road construction and rehabilitation
    - Terrestrial invasive species management
- Developed recreation sites – sustainable use and expansion
- Dispersed Recreation
- Winter Recreation
- Road and trail use and maintenance
- Other Activities and Uses
- Wildfire

Some activities are not specified because they are a combination of activities from the above list. For example, aspen enhancement and meadow restoration may include hand and mechanical thinning and prescribed fire. Other activities are not discussed because they do not involve ground disturbance or other actions that could affect soil productivity.

Forest management activities and uses that cause soil disturbance have the potential to impact productivity. The following indicators form the basis for this analysis and are defined and discussed below:

1. Soil Porosity and Soil Hydrologic Function
2. Effective Soil Cover
3. Surface and Subsurface Soil Organic Matter
4. Severe Burning

These are the primary indicators of soil productivity that may be affected by forest management activities and uses. The indicators are described briefly below; additional information is available in the Soils Specialist Report.

Soil Porosity and Soil Hydrologic Function

Porosity is the space between individual soil particles. Maintenance of natural soil porosity is important for maintaining healthy native plant communities and for maintaining the hydrologic function of the soil. Soil hydrologic function is the ability of water to move into and through soils. Infiltration is the movement of water into soils, while hydraulic conductivity (sometimes called permeability) is the movement of water through soils. Compaction can alter soil porosity and soil hydrologic function, often in ways that are detrimental to plant growth.

Effective Soil Cover

The presence of effective soil cover generally indicates that the soil surface is adequately protected from accelerated (human-caused) erosion. Effective soil cover is defined as live vegetative plant canopies, plant litter and duff, and rock fragments at least ½ inch in diameter.

The topsoil (A horizon) is the most fertile and biologically active part of the soil profile due to its enrichment by organic matter in varying stages of decomposition. Loss of all or part of this horizon through erosion impairs the ability of the soil to support natural vegetation communities and often imparts a competitive advantage to terrestrial invasive plant species (weeds).

The Water Quality section discusses erosion as it relates to water quality.

Soil Organic Matter and Forest Floor

Surface organic matter includes plant litter and duff and is sometimes referred to as the forest floor. It protects the soil surface from erosion and moderates changes in soil temperature and moisture through its mulching effects.

Subsurface organic matter exists in various stages of decomposition; humus is the well-decomposed, relatively stable, dark-colored portion. Decomposed subsurface organic matter provides plant-available nutrients, increases soil pollutant filtering capacity, increases water-holding capacity, and promotes the transfer of air and water through soils through its role in aggregate formation.

Organic matter also serves as a major reservoir for terrestrial carbon. The effects of forest management activities and uses on carbon storage are of concern due to climate change. This is a relatively new area of investigation and much remains unknown (Trumbore and Czimczik 2008, Rasmussen et al. 2008).

Modeling of climate change in the Tahoe Basin suggests that soils will continue to sequester carbon for the next 100 years under a climate with increased temperatures because the rate of influx of detrital

carbon into the soil exceeds the rate of soil respiration, which releases carbon dioxide gas. Changes to the soil carbon pool were less than changes to the live carbon and detrital carbon pools, due to the time required for humification. Thus, some of the effects of climate change may not be apparent in the soil until after the 100 year study period. Additionally, consumption of above-ground carbon by fire may overshadow increased temperature or drought effects because fire significantly reduces soil carbon inputs. (Loudermilk et al. 2013).

Severe Burning

Severely burned soil is a condition where most woody debris and the entire forest floor are consumed down to bare mineral soil. Soil may have turned red due to extreme heat; in wildfires in the Sierra Nevada, about 1-2% of the area may have severely burned soil (Ulery and Graham 1993). Fine roots and organic matter are charred in the upper one-half inch of mineral soil. Severely burned soils are identified by ratings of fire severity and the effects to the soil. A range of soil impacts may result: soil humus losses, structural changes, hydrophobic characteristics (water repellency) and temporary reductions in soil organism populations due to lethal temperatures.

Assumptions

In the analysis for this resource, the following assumptions have been made:

- All activities and uses would comply with Forest Plan Standards and Guidelines.
- All activities and uses would employ Forest Service Best Management Practices and these practices would be effective at controlling erosion.
- Additional project-specific resource protection measures or mitigations would be prescribed and implemented as needed to maintain soil productivity.
- All activities and uses would be consistent with Forest Service policy as expressed in FS Manuals and Handbooks and other documents.
- The desired conditions for maintaining, enhancing, and restoring soil productivity apply to areas that are dedicated to growing vegetation. There is no requirement to maintain soil productivity on system roads and trails or on some portions of developed sites (e.g., corrals, parking areas).

Winter recreation would not affect the soil resource because activities and uses would be conducted in accordance with law, regulation, policy, Forest Plan Standards and guidelines, and project-specific resource protection measures. While incidental soil damage is expected, it would not be significant, is not predictable, and is not expected to vary by alternative.

3.4.22.2. Overview of the Affected Environment

Soils of the Tahoe Basin are predominantly derived from igneous rock, with minor contributions from metamorphic rocks. The volcanic (extrusive) rocks are mainly andesitic lahars and the granitic (intrusive) rocks are mostly granodiorite. Soils are generally coarse-textured (sandy), and relatively young, with low clay contents. These characteristics make them susceptible to erosion when disturbed. Depths range from very shallow on steep mountains to very deep in some meadows and glacial deposits. Meadow soils generally have higher silt contents than most other basin soils, along with thicker surface layers of partially decomposed organic material. Organic soils, including peat, are limited in extent.

Soils in the Lake Tahoe Basin are relatively low in nitrogen and carbon. Soils derived from granitic parent material are generally low in phosphorus while those derived from volcanic parent materials have high levels of phosphorus (USDA NRCS 2007, Karam et al. 2013).

General soil types and their associated management concerns are summarized in the Soil Specialist Report. The Soil Survey of the Lake Tahoe Basin Area provides more detailed information on soil properties and management (USDA NRCS 2007).

During the 19th and early 20th century, soil impacts from logging and grazing were widespread, and forest floor and topsoil loss along with compaction, likely decreased productivity (Murphy and Knopp 2000a). These impacts are only apparent today in isolated areas.

Fire suppression during the 20th century resulted in forest floor buildup that is greater than what would be expected under a normal fire return interval regime. The current overly dense condition of most forest stands in the Lake Tahoe Basin may have produced thicker surface organic horizons than were present before the Comstock logging era, with higher levels of carbon, nitrogen, phosphorous, and other nutrients than under more natural conditions (Karam et al. 2013). At present soil organic carbon accounts for about 35% of the total ecosystem carbon, and detrital carbon accounts for about 5% of the total ecosystem carbon (dead wood, leaf litter, and dead fine roots) (Loudermilk et al. 2013). Modeling suggests that humification of forest floor material may take up to 32 years in the Tahoe Basin (Karam et al. 2013).

Landscape level carbon dynamics may still be recovering from the late 19th century Comstock logging, which resulted in about a 60% clearcut of the basin. Most trees are less than 120 years and growing relatively rapidly; modeling predicts substantial increases in above and below-ground carbon over the next 100 years in the Tahoe Basin. While the Comstock logging may have the greatest impact on carbon storage (Loudermilk et al. 2013), fire suppression may have the greatest effect on the current nutrient status of Tahoe Basin soils (Karam et al. 2013).

Monitoring suggests that current vegetation management practices are not significantly impacting soil productivity or causing extensive accelerated erosion (USDA Forest Service 2010b and c). Erosion in the Heavenly Ski Area was a significant concern discussed in the EIS for the 1988 Forest Plan. Since then, management practices have been adjusted such that this is no longer a major concern (Cardno ENTRIX 2010).

A combination of past and current land use has resulted in a slightly elevated erosion risk in four 6th field watersheds. Trout Creek watershed receives heavy recreational use and is still recovering from road and railroad networks and flumes associated with Comstock logging. Angora Creek and Fallen Leaf watersheds receive heavy recreational use, including many non-system trails and relic roadbeds. Ward Creek watershed is still recovering from past logging and grazing impacts.

Erosion in the Gondola, Showers, and Angora fire areas has largely returned to background levels. Post-fire erosion was severe enough to impair productivity in limited areas only.

3.4.22.3. Environmental Consequences

Geomorphic Stream Channel and Habitat Restoration

Stream channel and habitat restoration activities would result in short term impacts of limited extent and net long term soil productivity increases.

Short term compaction results from heavy equipment use during construction; these impacts are of limited extent and are generally mitigated at the close of the project. Riparian restoration projects are often on Tahoe soils, which have a higher risk of compaction than most Tahoe basin soils due to higher silt and moisture contents in surface layers. This risk is countered by root growth over time, which ameliorates compaction or restores soil porosity; the greater amount of available water in riparian zones and vegetative growth probably means recovery proceeds faster in those areas than in upland settings.

Over the long term, surface organic matter would increase as a result of the enhancement of native vegetation communities; riparian vegetation would benefit from increased soil moisture content for a longer portion of the growing season due to increases in overbank flows.

Similarly, erosion potential would decrease over the long term as effective ground cover and the root mass of native vegetation increases.

The extent, magnitude, and duration of consequences would be similar for Alternatives A, B, C, and E. Under Alternative D, there would be a potential for fewer resource benefits after currently planned projects are completed.

Forest Vegetation and Fuels Management

Prescribed fire – underburning and pile burning

Underburning results in minor to negligible short term effects to soil productivity. Pile burning results in minor short term impacts over most of the activity areas, and severe impacts of limited extent which may be long term in duration.

Soil temperatures under burning piles vary with soil moisture, pile size, and the diameter of the material in the piles, creating a range of impacts. Impacts are greatest when burning larger diameter material under dry soil conditions (Busse et al. 2013). In underburns, these effects would be limited in area to soils under the occasional log or stump that burns for an extended period of time.

Underburning and slash pile burning generally have negligible effects on soil porosity. Potential impacts would be loss of surface soil aggregate structure and clogging of soil pores by ash. These effects are limited to the pile footprints.

Effective soil cover losses are a short term impact; cover is replaced by needle cast and regrowth of vegetation. Depending on the amount of fuels removed, piles may cover between 1% and 34% of the ground surface (Busse et al. 2013). Burn pile footprints often have a concave surface that retains water, providing an advantage to emerging vegetation.

During underburning, detrimental soil heating can be limited by burning when soils are moist to wet, which also may result in patchy duff consumption, thus reducing erosion potential (Knapp et al. 2009, Busse et al. 2010). Underburning may improve microbial response to wildfire. When a moderate intensity wildfire burned ponderosa pine forest, the microbial biomass in soils was nearly twice as great in soils subjected to prescribed fire three months before the wildfire than in soils without prescribed fire (Choromanska and DeLuca 2001). Prescribed fire can also result in short term nutrient releases that provide a burst of vegetative growth.

The consequences to the soil resource would be similar in duration for all alternatives. The extent of consequences from underburning would be similar for Alternatives A, B, and E. Under Alternative C the extent would be less than Alternative A, for the first round of treatments, but would increase after that because stand density would be low enough to permit underburning as a maintenance tool. Under Alternative D the extent of effects would be greater than Alternative A because Alternative D has the greatest emphasis on use of fire as a management tool. However, Alternative D would also carry a greater risk of wildfire than the other alternatives because underburning would be prescribed in stands with higher tree densities than in Alternatives A, B, C, and E. Increased wildfire risk means an increased risk of severe burning and erosion.

The extent of consequences from pile burning would be similar in Alternatives A, B, and E. Under Alternative C, the short term consequences would be greater than Alternatives A , B, and E because

treatment prescriptions would be more intensive, resulting in a greater amount of material to be piled and burned. After the first round of intensive treatments is complete, effects would diminish because a greater number of stands could be maintained through underburning. Effects from pile burning would be greatest under Alternative D. The reduced diameter limits for mechanized thinning would necessitate a greater acreage of pile burning as well as a greater volume of larger diameter material in the piles than in other alternatives, which in turn would increase the magnitude of the effects on soils because larger diameter material results in higher soil temperatures (Busse et al. *in press*).

Hand and mechanical thinning

The consequences of hand thinning to the soil resource are negligible as this activity results in very little soil disturbance. Most of the effects are from burning the piles created during thinning; effects of pile burning are discussed above, in the section on Prescribed Fire.

Mechanical thinning results in areas of compacted soil; the degree of compaction varies with the number of passes, the soil type, and soil moisture at the time of equipment operation. The extent of compacted areas varies with the kind of logging system. In past projects in the Lake Tahoe basin, severely compacted areas have been limited to less than 12% of the area treated when cut-to length (CTL) systems were used. Whole tree (WT) systems tend to impact more of the treated area than CTL (Han et al. Unpublished). In addition, soil compaction is often more severe in WT units than in CTL units (McNeil and Ballard 1992; Lanford and Stokes 1995). Where slash is available, the forwarder used in the CTL system drives on a slash mat, which cushions the soil, absorbing some of the ground pressure and vibration from the equipment. The effectiveness of the slash mat depends on its thickness and the number of times it is driven over (breakage reduces effectiveness).

Compaction can be minimized by operating on relatively dry soils and limiting the extent of equipment traffic through designating skid trails and limiting the size of landings. Operating on less sensitive or low risk sites is also very effective. Soils with low risk characteristics can tolerate greater variety of equipment and operating conditions (moisture) than high risk soils (Miller et al. 2004). Most of the Tahoe basin soils have a low compaction risk due to their coarse textures. Compaction is inhibited on rocky soils because compaction is limited when subsurface rocks are pushed against each other.

Surface soils tend to recover relatively quickly from compaction, but subsoil compaction may persist for decades, so loss of porosity is generally considered a long term impact (Sands et a 1979; Froehlich et al. 1985; Tiarks and Haywood 1996). Slight recovery may occur after 5-10 years (Page-Dumroese et al. 2006; Powers et al. 2005). Recovery rates may vary with repeated disturbance, soil moisture during equipment operation, soil texture, and rock fragment content (Miller et al. 2004; Williamson and Neilsen 2000; Liechty et al. 2002).

Short term impacts to the forest floor result as surface organic matter is displaced and crushed by equipment traffic, making it more susceptible to erosion. Post-treatment replacement of ground cover begins with needle cast in the fall. When chipping or mastication is used for slash disposal, ground cover is replaced more quickly, but is higher in carbon and lignin and lower in nitrogen and other plant nutrients than material that accumulates naturally.

Removal of vegetation would result in a temporary loss of potential surface and subsurface organic matter. As the trees in the stand grow, additional surface and subsurface organic matter would be produced through decomposition of litter and fine roots. Additionally, thinning is proposed in order to reduce stand density to conditions more appropriate to the ecosystem, so this temporary loss would not be a significant detriment to soil quality. The current overstocked condition of forest stands have likely resulted in forest floor accumulations that are greater than the norm for the ecotypes in the project area.

Soil loss from erosion is a risk of mechanized thinning, but has been successfully controlled on NFS lands in the Tahoe Basin through project design and use of BMPs (USDA Forest Service 2010b and c). Water quality impacts from erosion are usually evident before soil productivity is affected. This means that when monitoring results show that erosion has not impacted water quality, one can assume that soil productivity has not been affected.

The "Beschta report"(Beschta et al. 1995) is commonly quoted by our publics as a document that provides the scientific framework of principles and practices that should be used to guide salvage logging and post-fire treatments. In relation to soils, this report recommends that management of a post-fire landscape should be consistent with the principle of protecting the soil and recommends that no management activity should be undertaken which does not protect soil integrity in terms of soil loss and compaction. The report also recommends that salvage logging should be prohibited in sensitive sites, which for soils are defined to include severely burned areas, erodible sites, fragile soils, riparian areas, steep slopes, and any site where erosion may be accelerated. Risks to soils during post-fire tree removal activities are best analyzed and mitigated at the project level, commensurate with the amount and distribution of sensitivities discussed in this paper.

Consequences to soil productivity would be roughly equal under Alternatives A, B, and E which would result in minor short and long term impacts of limited extent.

The magnitude and extent of impacts would be slightly greater under Alternative C than under Alternatives A, B, and E, but this difference would be balanced by the lower frequency of disturbances due to thinning. Alternative C might be the most favorable for the soil resource due to the longer recovery time between mechanized treatments; porosity losses that require long term recovery would be less frequent. Although surface disturbance would be slightly greater because more trees would be removed at one time, surface disturbances recover relatively quickly. Based on modeling, Alternative C would result in up to 20% more shrub growth than Alternatives A, B, and E; nitrogen-fixing shrubs such as whitethorn (*Ceanothus leucodermis*) and snowbrush (*Ceanothus velutinus*) would provide additional nutrient inputs, slightly increasing potential productivity.

The extent and magnitude of effects from mechanized thinning would be least under Alternative D because there would be fewer acres of mechanized thinning.

Temporary road construction and rehabilitation

Temporary roads are often constructed as a part of vegetation management projects to access areas not accessible from the permanent road system. Over the past 10 years, the LTBMU has constructed or plans to construct roughly 19 miles of temporary road. Of these, 13 miles were on existing road alignments of closed or decommissioned roads, and 6 miles were new construction. Vegetation management projects have required roughly 5 feet of temporary road construction per acre treated.

Overall, consequences of temporary road construction are minor due to their limited extent and are long term in duration.

Soil compaction is primarily a concern with new temporary road construction; existing alignments have soil that is already compacted. For new construction, the degree of compaction at project completion depends on whether the road is ripped or recontoured at project close. Compaction, with the associated loss of porosity and hydrologic conductivity, is a long term effect of limited extent.

Organic matter loss is also a long term effect of limited extent. Road construction removes the forest floor and some or all of the organically-enriched topsoil is removed and displaced. When well-designed, temporary roads with adequate BMPs generally present a low risk of erosion.

Consequences would be similar under Alternatives A, B, C, and E. The extent of the consequences would be less under Alternative D because there would be less mechanized thinning.

Terrestrial Invasive Plant Species Management

The extent and magnitude of effects to the soil resource from weed management would be minor to negligible. Effects are described in detail in the Terrestrial Invasive Plant Species Treatment Project EA (USDA Forest Service 2010d). Short term impacts would result from physical and chemical treatments. Long term effects would be positive, as native vegetation would be enhanced. This would benefit the soil resource because many weed species do not provide as much ground cover and soil protection (plant canopy and litter) as native species. In addition, some invasive species alter soil microbial communities or secrete chemicals into the soil to the detriment of native plant species.

Consequences would be similar in Alternatives A, B, C, and E. Under Alternative D, treatment would be limited to selected priority species. This would reduce the extent of treatment impacts, and would also reduce the extent and magnitude of positive benefits.

Developed Recreation Sites – Use and Expansion

Use of developed recreation sites such as campgrounds, resorts, and scenic overlooks is largely dependent on site design and maintenance. Soil impacts are limited on newer sites and sites which have received BMP upgrades, while older sites that have not been redesigned or upgraded may have more severe impacts.

Site design is critical for maintaining soil productivity which supports the native vegetation and associated scenic values in developed recreation sites. Site design which limits intensive use to hardened areas protects the soils, resulting in reduced areas of compaction and loss of surface organic matter, and consequently, lower erosion potential. Accelerated erosion is adequately controlled on most developed sites (USDA Forest Service 2010b and c, Cardno ENTRIX 2011). The hardened areas of these sites, such as pathways, are not areas dedicated to growing vegetation, so there is no expectation for soil productivity to be maintained.

Expanding the area of developed recreation sites would increase the area of compacted soils, but the extent of this effect could be controlled through design. Expanding the season of use into spring and fall increases the risk of compaction because use while soils are wet would increase. This could be controlled to some extent through design, but is not always a priority in current practice. The extent of the area where the forest floor is diminished or missing would likely also increase, along with compaction. Effective cover and erosion risk could be controlled under extended season use, but there is always more risk during seasons with more rain (spring and fall).

Effects of Alternatives A and B would be similar. There is a potential for effects over a slightly greater extent under Alternatives C and E, and a slightly lesser extent under Alternative D.

Dispersed Recreation

Effects of dispersed recreation are largely captured under the discussion for developed recreation and trail use. Where dispersed recreation is concentrated in popularly used areas, sites are hardened as needed to limit resource damage. Hardening results in relatively small areas with productivity losses that are unsuitable for growing vegetation. Off-trail recreation by hikers, cyclists, and equestrians is limited and would result in negligible effects in most instances. A notable exception is the creation of unauthorized trails by cyclists and OHV riders which results in compacted surfaces that are highly susceptible to erosion because they are not designed to control runoff. Unauthorized trails would either be added to the system or closed and ecologically restored under all alternatives.

Effects of dispersed recreation on the soil resource would not vary significantly by alternative.

Winter Recreation

Winter recreation activities with the potential to affect soils include alpine skiing, snowboarding, and ski slope grooming, OSV use (over snow vehicles or snowmobiles), cross-country skiing and snowshoeing, and snowplay, including sledding. Potential impacts to soils from winter recreation include direct effects to exposed soils and indirect effects resulting from compaction of snow (Gage and Cooper, 2009).

Effects to exposed soils include soil compaction and increased erosion potential due to surface disturbance. Since winter recreationists seek out areas with snow, these are relatively rare and usually of minor extent.

When snow is compacted it can lower the soil temperature. In alpine ski areas, this leads to delayed snowmelt, which shortens the growing season, as well as to more rapid snowmelt, which increases the risk of erosion (Price 1985, Rixen et al. 2003). Similar effects have been documented on marked trails used by cross-country skiers and snowshoers (Eagleston and Rubin 2013).

Use of artificial snow (snowmaking) tends to produce more dense snow than natural precipitation, and deeper snow, which tends to mitigate the mechanical effects of snow grooming, and postpones snowmelt (Rixen et al. 2003).

In general, areas of concentrated use would have the most severe impacts. Thus, it is likely that effects due to snow compaction are most severe from alpine skiing, snowboarding, and ski slope grooming, while cross-country skiing and snowshoeing have the least severe effects. Effects from OSV use would be intermediate, and would tend to be more concentrated in areas where users access NFS lands from neighborhoods and near winter parking areas. Sledding, like alpine skiing, is often a concentrated use that tends to occur in the same place for many years, and in popular snowplay areas, effects from snow compaction could be similar to those in alpine ski areas.

Soil impacts from alpine skiing would vary slightly by alternative; they would be greatest in Alternative A, and least in Alternative D. Impacts from OSV use would be similar in Alternatives A, B, C, and E, and slightly less in Alternative D if the Freel Peak area were designated Wilderness. Impacts from other forms of winter recreation would not vary by alternative.

Soil impacts from winter recreation would be primarily limited to areas of concentrated use, which are of minor extent. Impacts would not pose a significant risk to soil productivity in any alternative.

Road and Trail Use and Maintenance

The permanent transportation system is not land dedicated to growing vegetation and so there is no mandate to maintain soil productivity on this land. Consequences to the soil resource from the use and maintenance of the transportation system are therefore limited to areas where use and maintenance impact areas outside the road or trail alignment. These are generally minor effects of limited extent on porosity and surface organic matter. Erosion on slopes below roads and trails may impact productivity in limited areas where runoff velocity is not well controlled. Monitoring has found such erosion to be uncommon (USDA Forest Service 2010b and c).

Based on the current condition, most effects would be minor for Alternatives A, B, and E. Under Alternative C, effects would be slightly greater than for A, B, and E due to the work needed to increase the maintenance level of selected routes. Effects of Alternative D would be slightly greater than Alternative C in the long term due to reduced maintenance levels.

The creation and use of unauthorized roads and trails results in compaction, loss of the forest floor and surface organic matter. Erosion of topsoil is often a problem because these routes are not engineered and have no provisions for drainage or runoff control. Existing unauthorized roads or trails would be added to the system or closed and ecologically restored. Some unauthorized roads provide needed access such as utility easements that are included under special use permits; these would be added to the managed road system in the future.

Unauthorized use is not expected to vary by alternative.

Wildfire

Potential impacts to soils in the event of wildfire include severe erosion, loss of nutrients and organic matter, reduced infiltration, and destruction of soil macro- and microorganisms. The 2002 Gondola Fire resulted in significant soil loss from erosion. Short term effects also included significant increases in soil solution concentrations and/or leaching of mineral forms of nitrogen, sulfur, and phosphorous. The most significant long term effect was the loss of ecosystem nitrogen from the forest floor and the fire (Murphy et al. 2006). Post-fire erosion often stabilizes within a few years (Berg and Azuma 2010, Robichaud et al. 2000, Benavides-Solorio and MacDonald 2005).

Although wildfire cannot be predicted, the alternatives do affect the risk and potential intensity and severity of wildfire. Hazardous fuel reduction treatments in the Lake Tahoe Basin have been shown to reduce fire behavior from a crown fire to a surface fire, thus reducing potential soil impacts because less heat is generated in a surface fire than in a crown fire (Murphy et al. 2006). Similarly, reducing crown fuels was found to moderate extreme fire behavior in four different ecosystem types across the United States. An important feature these sites had in common was historical short fire return intervals, a feature also shared by the Tahoe Basin (Omi and Martinson 2002).

The risk of a significant loss of soil productivity due to wildfire would be roughly equal under Alternatives A, B, and E. Risk would decrease more rapidly under Alternative C, though the decrease would be modest. Risk would be slightly greater under Alternative D than under A, B, C, or E because desired conditions for hazardous fuels would be only partially met outside the defense zone. The rationale for the differences among alternatives is described in more detail in the Fire and Fuels section.

Climate Change

Predictions of warmer temperatures, an increase in the proportion of precipitation falling as rain, and earlier peak snowmelt time could result in long-term indirect effects to soils.

Rain-on-snow events have the potential to cause significant erosion. These events may become more frequent as temperatures warm, but are not always associated with climate change – one of the largest was documented in 1862, when resultant flooding destroyed much of Sacramento and other areas.

Soils may be dry for longer periods during the summer due to warmer temperatures combined with earlier peak snowmelt, but these effects are not likely to be observable or measurable during the planning period.

Other Activities and Uses

A number of other ongoing and intermittent activities and uses have minor effects on soils in limited areas, including:

- Water, sewer, and power line maintenance and reconstruction
- Cell phone tower/water tower construction/reconstruction
- Other permitted non-recreation special uses

- Recreation residence use and maintenance
- Grazing

None of these activities and uses would vary by alternative, and it is not likely that they would significantly alter the existing condition in the future.

Water, sewer, and power line rights of way are accessed regularly for inspection and maintenance, including periodic tree removal under power lines. Inspection and maintenance activities result in compacted areas where surface organic matter is decreased or absent due to vehicle traffic and occasional ground disturbance when digging is necessary. Erosion control is mandated and monitored through compliance with permits issued for these activities. New construction or reconstruction of water, sewer, or power lines is infrequent, but can require larger disturbed areas. Recovery is generally long term.

Cell phone tower and water tower construction or reconstruction involve ground disturbance over a limited area and new sites may also require limited road construction. Limited areas of compacted soil and areas with decreased or absent surface organic matter are generally present. Erosion control is mandated and monitored through the permit system.

Other permitted uses include activities such as research projects, film- making, weddings and special events, and removal of forest products such as Christmas trees. Resource protection is controlled through the permit system and effects are generally negligible to minor and very limited in extent.

Limited areas of compaction and forest floor depletion are associated with foot traffic around recreation residences. These are small enough that soil productivity impacts are negligible, as evidenced by the surrounding native vegetation.

Grazing is primarily an incidental use on the LTBMU. There are no active grazing allotments and none are projected to become active in the future under any alternative. Grazing is primarily associated with outfitter-guide activities and other equestrian recreation. Impacts to soils are negligible, and would not vary by alternative.

3.4.22.4. Analytical Conclusions

Comparison of Consequences by Alternative

Overall, the consequences to the soil resource would be relatively similar under all alternatives (Table 3-77).

Table 3 77. Comparison of Consequences to the Soil Resource

	Use and Management Effects	Risk of Effects from Wildfire
Alternative A	Soil quality maintained at sustainable level.	Alternatives A, B, and E would have similar risk of impacts due to wildfire
Alternative B	Soil quality slightly improved over Alternative A.	Alternatives A, B, and E would have similar risk of impacts due to wildfire
Alternative C	Soil quality slightly decreased as compared to Alternative A, but still at sustainable level.	Alternative C would have the least risk of impacts due to wildfire.
Alternative D	Soil quality slightly increased as compared to Alternatives A and B.	Alternative D would have the greatest potential for soil impacts due to wildfire.
Alternative E	Soil quality slightly improved over Alternative A.	Alternatives A, B, and E would have similar risk of impacts due to wildfire

Stream channel and habitat restoration would result in minor very short term impacts and a net positive benefit over the long term for all alternatives. Consequences would be similar for Alternatives A, B, C, and E in the long term, but there would be fewer long term benefits under Alternative D.

Terrestrial invasive species management would result in negligible short term impacts and minor long term net positive consequences for all alternatives. Long term positive benefits could be somewhat less in Alternative D because fewer species would be treated. These findings assume the infested acres would be within the range analyzed in the TIPS EA.

Developed recreation site use and expansion would have minor negative consequences under all alternatives. Alternative D would have the least impacts, followed by Alternatives B and E, with Alternative C having the greatest impacts

Dispersed recreation and winter recreation would have minor negative consequences under all alternatives.

Road and trail use and maintenance would result in minor negative consequences under all alternatives. Alternatives A, B, and E would have similar consequences, consequences of Alternative C would be slightly greater than A, B, and E, and consequences of Alternative D would be slightly greater than Alternative C.

Vegetation and fuels management are most likely to have the greatest impacts on soil productivity because of the nature of their effects and because they impact the largest area of ground. The differences in consequences by alternative from forest vegetation and fuels management activities are thus considerably greater than the differences from other activities and uses. The potential for wildfire is also an important consideration because wildfire can significantly impair soil productivity. The consequences of vegetation and fuels management and wildfire would overshadow the consequences to the soil resource from other activities and uses.

Consequences of Alternatives A, B, and E would be similar; the risk of significant damage due to wildfire would be slightly less in Alternatives B and E. Impaired productivity would be slightly greater in the short term in Alternative C than Alternative A, due to more intensive silvicultural treatments and to a lesser extent by increased developed recreation. Impacts from vegetation and fuels management would be balanced in the long term by the need for fewer mechanized entries and the ability to use prescribed fire more safely over more acres. Potential impacts from wildfire would be similar in Alternatives B, C,

and E, but reduction in risk would be achieved slightly more quickly in Alternative C. Alternative D would result in the least impacts to soils overall, but carries the greatest risk for impacts from wildfire.

How the Alternatives Maintain or Achieve the Desired Conditions

Since soils are currently at or near natural levels of productivity throughout most of the planning area in areas dedicated to growing vegetation, the goal is to *maintain* the desired conditions. The desired conditions for soils would be maintained throughout most of the planning area in all alternatives; maintenance of desired conditions would differ slightly by alternative as described above. The desired condition related to impervious coverage is discussed under cumulative effects.

3.4.23. Terrestrial Wildlife Habitat and Species

3.4.23.1. Introduction

The purpose of this analysis is to evaluate and disclose the potential effects of the management approaches proposed under the five Forest Plan revision alternatives on special status terrestrial wildlife species and habitat. Cumulative effects are described in Section 3.5. The five alternatives under consideration (Alternatives A, B, C, D, and E) are described in Chapter 2.

Methodology

This analysis evaluates the potential effects of management approaches under the five alternatives within the following program areas: (1) Watershed and Aquatic Habitat Restoration, (2) Biological Resource Protection, (3) Forest Vegetation Management (and Fuels), (4) Recreation, and (5) Access to NFS Roads and Trails. The program areas represent the suite of possible management activities that comprise the focal elements for management planning and activities on the LTBMU. The program areas are described in the descriptions of the alternatives in Chapter 2.

Indicators of effects in this analysis include special-status terrestrial wildlife species/species groups and terrestrial wildlife habitats. The following special-status species are evaluated:

- Threatened, endangered, candidate, and proposed species under the Endangered Species Act of 1973 (as amended)
- Region 5 Forest Service Sensitive Species
- Tahoe Regional Planning Agency (TRPA) Special Interest Species

Table 3-78 lists all special-status species for the LTBMU, their listing status, habitat, and occurrence status; this reflects the revisions to the Regional Forester's Sensitive Species list for Region 5 made on July 3, 2013 (USDA 2013). In addition to these individual species, effects to migratory birds are addressed as a group. Effects on Management Indicator Species (MIS) are described separately in section 3.4.14 of this chapter.

On June 16, 2010 coordination began between the LTBMU and the U.S. Fish and Wildlife Service (USFWS), Reno, Nevada and Sacramento, California field offices for species protected under the ESA (threatened, endangered, and candidate species) on the revision of the Forest Plan. Discussions on the process for formal consultation, including requesting technical assistance for candidate species and incorporation of migratory bird act considerations were determined as well as the method of interaction and how information exchange would be completed during the revision process. With the changes in Forest Planning rules in late 2010, the consultation process with USFWS was placed on hold until the new Draft EIS and Draft Revised Forest Plan were released in the spring of 2012. On May 3, 2012 a formal request for consultation, technical assistance, and comments was sent to the USFWS (both Reno and Sacramento field offices) for the revised Draft EIS and Draft Forest Plan. On February 4, 2013 the USFWS issued a proposal to list the distinct population segment of the North American wolverine in the contiguous United States as threatened.

Table 3 78. Special-status species for the LTBMU, listing status, habitat, and potential for occurrence in the LTBMU during the life of the Plan

Species **Common Name** ***Scientific Name***	**Status** [1]	**Habitat** [2]	**Occurrence Status** [2]
Invertebrate			
Western bumblebee ***Bombus occidentalis***	S	Wild flowering plants and crops; rodent burrows for hive	Occurrence possible; one record since 2000.
Birds			
Waterfowl	SI	Lacustrine, riverine, wetlands, and marsh areas	Known to occur; waterfowl found throughout Basin.
Northern goshawk ***Accipiter gentiles***	S, SI	Forested areas associated with riparian systems, high canopy closure, high density of large and mature trees and snags, and open understories	Known to occur; detections at 28 of 32 Protected Activity Centers on LTBMU from 2001-2010
Golden Eagle ***Aquila chrysaetos***	SI	Early successional forests and shrub communities for foraging and cliffs and large trees for nesting	Known to occur; incidental detections in Round Lake area and Desolation Wilderness in 2011
Bald eagle ***Haliaeetus leucocephalus***	D, S, SI[3]	Open water with juxtaposed mature live and dead (snags) trees or steep cliffs	Known to occur; recorded in LTBMU since 1874; one known nest on LTBMU
Osprey ***Pandion haliaetus***	SI	Large snags and open trees in mixed conifer forests near large bodies of water	Known to occur; recorded as recently in 2011 at shore and inland sites
Peregrine falcon ***Falco peregrinus***	SI	Open areas; breeding near rivers, wetlands, lakes, or other aquatic features; nests on cliffs, banks, dunes, mounds, and human-made structures.	Known to occur; recorded as recently as 2011 at various locations in LTBMU
Great gray owl ***Strix nebulosa***	S	Meadows and early seral-stage habitats that support sufficient prey and have adjacent conifer forests with moderate to high canopy cover	Not expected to occur; last detected near LTBMU in 1979
California spotted owl ***Strix occidentalis occidentalis***	S	Late seral closed canopy forest; mature coniferous forests with high tree canopy cover, multilayered canopies, and an abundance of large and mature trees and snags; possible use of younger stands for foraging	Known to occur; detections at 15 of 21 Protected Activity Centers on LTBMU (2001-2010)
Willow flycatcher ***Empidonax traillii adastus***	S	Meadows that have high water tables in the late spring and early summer, and abundant shrubby, deciduous vegetation (especially *Salix* spp.); especially meadows with standing water or saturated soils	Known to occur; recorded in LTBMU since 1992

Species **Common Name** ***Scientific Name***	**Status** [1]	**Habitat** [2]	**Occurrence Status** [2]
Mammals			
Townsend's big-eared bat ***Corynorhinus townsendii***	S	Coniferous forests and riparian habitat for foraging; cave and cave surrogate habitat (e.g., mines) and buildings for roosting	Known to occur; recorded in LTBMU in 2007 and 2009 (Borgmann and Morrison 2008)
Pallid bat ***Antrozous pallidus***	S	Mixed conifer and pine forests at high elevation; crevices in rock outcrops, tree hollows, cave and cave surrogate habitat (e.g., mines), and buildings for roosting	Occurrence possible; suitable habitat exists
Fringed myotis ***Myotis thysanodes***	S	Open habitat with nearby dry forest and water source; crevices in rock outcrops, cave and cave surrogate habitat (e.g., mines), buildings, and snags for roosting	Known to occur; recorded since 2008 (CWHR 2008)
Pacific marten[4] ***Martes caurina***	S	High elevation mature and old growth conifer forests with complex understory structure, large snags and live trees and logs, and minimal human disturbance	Known to occur; recorded in LTBMU since 1980's; one known den
Pacific fisher ***Martes pennanti***	C	Late successional forests with high canopy cover, large live trees, and snags and logs	Not expected to occur; no detections in last 10 years in LTBMU, outside geographic and elevation range of species
North American wolverine ***Gulo gulo luscus***[5]	S, P	Diverse, coniferous forest types and non-forested alpine habitats with minimal human disturbance and cover	Occurrence possible; last detected 2 miles from LTBMU in 1994; recent wolverine detection in Truckee in 2008/09 was genetically related to Rocky mountain population (Moriarty et al. 2009)
Mule deer **(*Odocoileus hemionus*)**	SI	Riparian areas, meadows, and early to mid-successional habitats	Known to occur; species was detected throughout LTBMU during 2007 Basin-wide surveys

1. Status

   C: Candidate, P: Proposed, D: Delisted under Endangered Species Act of 1973 (as amended)

   S: Region 5 Forest Service Sensitive Species

SI: Special Interest Species (TRPA)

2. More detailed habitat associations and occurrence descriptions provided in species accounts below.
3. Both winter and nesting bald eagles are considered TRPA Special Interest Species.
4. This species was classified as American marten (Martes americana) but recent genetic and morphological evidence classifies this species as Pacific marten (Martes caurina) and of the subspecies sierrae (Dawson and Cook 2012).
5. Currently accepted taxonomy classifies wolverines as Gulo gulo and those in the contiguous U.S. as part of the New World subspecies, G. g. luscus (USFWS 2013).

Terrestrial wildlife habitat indicators evaluated in this analysis include: wet meadows, montane riparian (e.g., stream and creek habitat), lakeside marsh and shore habitat, aspen, Jeffrey pine, white fir-mixed conifer, red fir, lodgepole pine, subalpine forest, montane chaparral, cliff and cave habitat, and species-designated habitat (Protected Activity Centers).

Potential direct and indirect effects on special-status terrestrial wildlife species and terrestrial wildlife habitat are measured by the anticipated trend in species productivity (i.e., reproductive success) and habitat condition. The analysis involved identifying: (1) the possible management activities associated with each program area by alternative, (2) potential effects from these management activities, (3) the proposed magnitude of change in these actions by alternative (e.g., acres of expansion, acres of treatment, miles of trails), and (4) plan-level desired conditions, strategies, objectives, and standards and guidelines for each alternative.

Sources of information used in the analysis include a search of the USFWS database of special-status species for the LTBMU (USFWS 2011; accessed on June 6, 2013; http://www.fws.gov/sacramento/ES_Species/Lists/es_species_lists_NF-action-page.cfm) and a review of the peer-reviewed literature, Forest Service general technical reports, TRPA Threshold Report (2011) and Code of Ordinances (2012), and reports of research conducted in the LTBMU.

The SPECTRUM model was used to estimate trends towards achieving desired conditions for forest health and fuel reduction management under the five alternatives over a fifty year period after Plan implementation. A description of the model, including assumptions, applicability, and limitations, can be found in the section 3.4.11 (Forest Vegetation). It should be noted that the model was designed to meet the desired conditions of forest health and fuel reduction management and not to create wildlife habitat or evaluate condition or trends of wildlife habitat. For example, the model was provided with minimal information regarding wildlife habitat, only locations and restrictions on treatments in spotted owl and goshawk Protected Activity Centers (PACs) and spotted owl Home Range Core Areas (HRCAs). The model did not contain any other guiding parameters for wildlife habitat such as standards and guidelines related to the protection of den locations, nest locations for other bird species, connectivity of late seral habitat, or any other more qualitative guiding principal under each alternative. Furthermore, habitat associations and analysis of effects for terrestrial wildlife are based on CWHR classification which defines "open" canopy as S (10-24% canopy closure) and P (25-39% canopy closure), and "closed" canopy as M (40-59% canopy closure) and D (>60% canopy closure) but the model parameters differ from this definition for "open" canopy in the white fir and red fir forest types which is defined as <50% canopy closure, a difference of 10 percent (see *Table 1* in the Forest Plan – *Forest Vegetation, Fuels, and Fire Management Desired Conditions* section). We don't anticipate this difference to significantly alter our interpretation of model output at the level of the Forest Plan but some late and mid seral open habitat may actually be considered closed (40-50% canopy closure) according to CWHR classification of wildlife habitat. Also, the CWHR classes 3 (6-10.9" diameter-at-breast height (dbh)) and 4 (11-23.9" dbh) were lumped in the model output into mid seral in order to compare to the Historic Reference Condition model outputs used to develop forest vegetation seral stage distributions. But many species associated with mature forest conditions may use CWHR class 4 but are not as strongly associated (or not associated at all) with CWHR class 3. Where possible we have tried to evaluate mid seral trends separately for CHWR classes 3 and 4. Most importantly, the SPECTRUM model does not use an adaptive management framework which would serve as the cornerstone of the management approach under any alternative. Therefore, although the model results are described in this section as they would relate to trends in terrestrial wildlife habitat interpretations of model output should be made with caution.

Percent changes in seral stages predicted by the model for all alternative are categorized as: No change (0-10 percent change); or Increase or Decrease that is either Slight (11-20 percent change), Moderate (21-50 percent change), or Substantial (>50 percent change). Although the Draft BE (and DEIS) made reference to exact predicted percent changes in the seral stages, that approach does not present realistic

outcomes since the model cannot incorporate a variety of other limiting factors (e.g., den/nest locations, habitat connectivity, climate change) that would influence prescriptions and treatment decisions that are not incorporated into the model. Therefore, these categories more appropriately express predicted trends. We have added tables into this section of the FEIS that illustrate modeled predicted changes in mid and late seral closed canopy CWHR classes because CWHR classes form the basis of our understanding of species habitat associations (as described in detail in the Biological Evaluation for Terrestrial Wildlife) and also provide the foundation for the analysis of wildlife habitat. We also received a number of comments regarding the predicted changes in habitat for species associated with mature forest conditions like the spotted owl, goshawk, and marten.

Geographic information system (GIS) information for California Wildlife Habitat Relationship (CDFG 2005) habitats were used to calculate the amount of high and moderate capability habitat for terrestrial wildlife species in the LTBMU. For a detailed description of high and moderate capability habitat, including a description of these habitat types associated with each species please refer to the Biological Evaluation.

The analysis area for direct and indirect potential effects is defined as all NFS lands within the LTBMU administrative boundary. All measures of effect are evaluated at a basin-wide scale and based on the assumption that the revised LTBMU Forest Plan will be programmatic in nature and not area-specific and/or project-specific. All effects are evaluated on a 15-year basis for the anticipated life of the Plan; short terms effects will be addressed in project-specific NEPA analysis as projects under the revised Forest Plan come online.

Assumptions

In addition to universal assumptions described in the introduction to Chapter 3 of the FEIS, the following assumptions have been made:

- Expansion of recreation would be correlated with increased use.
- Increased access to Forest System lands would be correlated with increased use of access and increased dispersed recreation activities.
- Alternative A represents the 1988 LTBMU Forest Plan (as amended) as written and as currently implemented.
- Creation of new developed recreation sites (e.g., facilities, campgrounds) would be compatible with natural resource objectives.
- Expansion of ski resort operational boundaries under Alternatives A, B, C, and E means additional winter and summer use, and infrastructure (e.g., ski runs, facilities, lifts).

3.4.23.2. Overview of the Affected Environment

Major coniferous forest types in the Lake Tahoe Basin include Jeffrey pine, white fir -mixed conifer, and red fir, and there are old growth examples in each type. Forested habitat in the LTBMU has been influenced by major historic land uses and practices such as Comstock era logging (1860-1920), cattle and sheep grazing (1850s-195’s), rapid human development (1960-1980), and fire suppression throughout urbanization of the basin (1911-present). The result is a landscape with altered tree species composition, reduced vegetation structural complexity, decreased extent of old-growth forests, degraded biological diversity, increased risk of high-intensity wildfires, and altered ecosystems functions, such as water uptake, tree longevity, and decay characteristics (Manley 2004).

Contemporary old-growth forests are fewer in the basin than prior to the mid-1800s and have denser understories, a shift in species composition towards more white fir and incense cedar and less Jeffrey pine, and there is a higher incidence of tree disease and mortality (Manley et al. 2000 and Barbour et al. 2002 as cited in Manley 2004). In the montane zone, tree species composition and diameter have

changed such that there are more small-diameter and shade tolerant trees in the understory, particularly white fir, and fewer large-diameter trees (Barbour et al. 2002 as cited in Manley et al. 2010). In general, fire suppression and logging have contributed to current forest conditions that have higher tree densities in the smaller size classes, a shift to firs over pines, and a greater amount of fuels in the understory (Barbour et al. 2002 and Taylor 2004 as cited in Manley et al. 2010). The dense, homogenous and simplified structure of forests in the Lake Tahoe Basin can lead to a reduced potential to support diverse species assemblages.

Non-coniferous habitats in the Basin have also changed as a result of major historic land uses and practices. Aspen stands in the Sierra Nevada, including the LTBMU, are being replaced (shaded out) by conifers due to changes in historic fire regime. Montane chaparral on the landscape has diminished, having been converted to forest (Nagel and Taylor 2005 as cited in Manley et al. 2010). Limited management activities in proximity to stream riparian zones have resulted in the invasion of shade-tolerant conifers into many riparian areas (Manley et al. 2010) that compete with existing riparian vegetation (Haugo and Halpern 2007, Jones et al. 2005, Lang and Halpern 2007, Stam et al. 2008 all cited in Manley et al. 2010). Approximately half of the Basin’s meadows have been permanently lost, fragmented, or altered (Cobourn 2006 and Elliot-Fisk et al. 1997 as cited in Manley et al. 2010). Grazing is no longer prevalent in meadows in the Lake Tahoe Basin, but there may be substantial legacies of this former major land use (particularly altered plant and animal species composition), similar to circumstances elsewhere in the Sierra Nevada (Dull 1999 as cited in Manley et al. 2010).

The LTBMU is recognized as one of the nation’s most popular recreation areas and receives approximately 5.7 million visits per year. The high concentration of recreation activities and diverse types of recreation activities (e.g., motorized, non-motorized, developed, dispersed) affect the occurrence and abundance of wildlife, structure of wildlife communities, as well as condition of habitat. The LTBMU manages campgrounds, resorts and lodges, day use sites, recreation residences, and ski areas, and also provides special use permits for management of developed recreation facilities, outfitter and guide activities and organized events. The LTBMU also manages many trails and roads that provide access to dispersed and developed recreation activities. Examples of summer dispersed recreation activities include, but are not limited to camping, mountain biking, rock climbing, hunting, hiking, Off Highway Vehicle (OHV) travel, and dirt bike riding. Examples of winter dispersed recreation activities include, but are not limited to back-country skiing, cross country skiing, sledding, snow play, snowshoeing, and Over Snow Vehicle (OSV) travel (i.e., snowmobiling). Recreation activities occur throughout the Basin but many highly concentrated activities occur along the lake shore where there tend to also be a variety of sensitive habitat types (e.g., meadows, marshes, etc.) and species. This is particularly true of the south shore, an area that has particularly high recreation use and also a high concentration of sensitive wildlife species and habitats.

In general, hunting is not considered a major recreational activity in the Lake Tahoe basin. The large patchwork of campgrounds and communities throughout the basin as well as the pockets of land under non-federal ownership likely limits hunting opportunities. Still, hunting is a permissible activity on NFS lands in the LTBMU but is regulated by the California Department of Fish and Game (CDFG) and Nevada Department of Wildlife (NDOW). The state agencies issue permits/licenses for hunting of common species, including big game (e.g., deer bear), upland/small game (e.g., quail, grouse), and waterfowl. These agencies also impose a limit on the number of individuals of each species that can be hunted.

Changes in temperature, precipitation, and fire behavior have been occurring in the Lake Tahoe Basin and throughout the Sierra Nevada and are likely influencing terrestrial wildlife species. Mean annual temperature has risen by about two degrees Fahrenheit and precipitation has increased during the last century in the Lake Tahoe Basin (Safford 2010). Overall there appears to be a strong upward trend in air and lake temperature, rainfall intensity, a shift from snow to rain, earlier seasonal snowmelt events, and

increased inter-annual variability in the Lake Tahoe Basin (Coats 2010). The Sierra Nevada has experienced an increased frequency of fires since the 1980's (Westerling et al. 2006) and an increase in the mean and maximum fire size, total burned area, and fire severity between the early 1980's and 2007 (Miller et al. 2009); increases are attributed to the interaction between climate change and increasing forest fuels.

Changing climate conditions are likely influencing terrestrial wildlife species in the Lake Tahoe Basin but our understanding of the effects are not well understood and predictions are limited. Climate change has been correlated with latitudinal and altitudinal range boundary shifts (Parmesan 2006, Moritz et al. 2008, Crimmins et al. 2011) as well as phenological (timing) shifts (e.g., migration and blooming) (Parmesan & Yohe 2003, Root et al. 2003) in a variety of plants and animals. Uphill and higher elevation range shifts in response to historical warming have been well documented (Lawler et al. 2009). For example, in Yosemite National Park, Moritz et al. (2008) found substantial upward shifts in elevation limits of 50% of small mammal species sampled as well as an expansion of ranges in low elevation species, contraction of ranges in high elevation species, and changes in the community composition at mid- and high-elevations. Forister et al. (2010) found a similar upward shift in elevation range of butterfly species in the Sierra Nevada. In contrast, recent research on range shifts of 73 vascular plant species in various California mountain ranges over the last century showed that about half of them had shifted the center of their range slightly downhill, in response to increasing water balance due to rising precipitation, which has slightly outpaced increasing evapotranspiration due to increasing temperatures (Crimmins et al. 2011). Based on their results, the authors suggest that cooler and wetter sites at higher elevations have potential to be more sensitive to changes in precipitation than warmer and drier sites at lower elevations which would be more sensitive to temperature changes. Under changing climate scenarios, temperature and precipitation can interact in a variety of unusual ways that influence vegetation. Crimmins et al. (2011) suggest that downhill shifts in species' ranges are expected to be more likely at these higher elevation wetter sites (Crimmins et al. 2011). Although these results are not specific to terrestrial wildlife species, which have been found to have experienced uphill and higher elevation shifts in the Sierra Nevada (e.g., Mortiz et al. 2008, Forister et al. 2010), some terrestrial wildlife species could shift ranges in response to precipitation changes. For example, repeated bird surveys along Grinnell transects in the entire Sierra Nevada have provided evidence that bird species may be tracking both precipitation and temperature or either over time (Tingley et al. 2009). It can be expected that range shifts in terrestrial wildlife species will occur although the type (up or down) and pace of shifts are not well understood at this time.

It can also be expected that community composition will change with range shifts; related species and species in the same community may respond differently to changing environmental variables and these disparate responses may result in the breaking up of existing communities and formation of novel communities (Root et al. 2003, Mortiz et al. 2008). Novel communities that are formed will present new challenges in terms of predator/prey relationships, parasitism, change in foraging resources, among other things.

Terrestrial Wildlife Habitat

Below are the descriptions of the various habitat type values in the LTBMU to terrestrial wildlife species.

Wet Meadow

Wet meadow habitat can provide nesting, burrowing, cover, and/or foraging habitat for a variety of terrestrial wildlife species including fossorial mammals (e.g., gophers, moles, and marmots), meadow nesting birds (e.g., willow flycatcher and mountain bluebird [*Sialia currucoides*]), herbivores (e.g., mule deer and bears), insectivorous bats, and mammalian carnivores and raptors. Wet meadows are important nesting, breeding, and foraging habitat for willow flycatcher, a region 5 Forest Service Sensitive Species, and yellow warbler (*Dendroica petechia*). Meadows also support a number of nest predators such as chipmunks (*Tamias spp.*), Douglas squirrel (*Tamiascriurus douglasii),* and long-tailed weasels (*Mustela frenata*) (Cain et al. 2006). Wet meadows support a variety of insects and are important foraging habitat for insectivorous bats. At least five bat species, including Townsend's big-eared bat, a Region 5 Forest Service Sensitive Species, have been recorded in meadows in the LTBMU (Borgman and Morrison 2008). Meadows can serve as potential foraging locations for a variety of carnivorous mammals and raptors that feed on small mammals, and ungulates such as mule deer.

Lakeside Marsh and Shore Habitat

Marshes are wetlands where standing water exists year-round, except in shallower areas during late summer or unusually dry years and may support the growth of emergent plants, such as cattails, bulrushes, reeds, and sedges, as well as many floating and submergent plants (Caduto 1990 as cited in Manley et al. 2000). Marshes can provide valuable nesting, foraging, and cover opportunities for a variety of waterbirds, including ducks, shorebirds, and rails (Manley et al. 2000). Beaches are numerous and shoreline extensive in the Lake Tahoe Basin. Both marshes and shoreline habitat can provide essential nesting and foraging opportunities for a number of raptors including bald eagle, osprey, and peregrine falcon.

Montane riparian

Riparian areas consist of vegetation commonly associated with lentic (standing) or lotic (running) water, such as willows, alders, aspen, and meadows (Manley et al. 2000). Riparian areas occur throughout the Lake Tahoe Basin and have an exceptionally high value for many wildlife species. However, many of the montane riparian communities in the LTBMU are currently overstocked with conifers. Riparian areas provide water, thermal cover, migration and movement corridors and diverse nesting and feeding opportunities (Grenfell Jr. 1988). The shape of many riparian zones, particularly the linear nature of streams, maximizes the development of a natural edge which is used by a variety of mammals as movement corridors, such as marten a region 5 Forest Service Sensitive Species. Montane riparian habitats also serve as important nesting, foraging, and cover habitat for a variety of birds. These habitats are also especially important for bats as they follow the stream course foraging for insects; other bats (i.e., western red bat [*Lasiurus blossevillii*]) prefer to nest in riparian vegetation.

Aspen

Intact aspen communities are valuable nesting, foraging, and cover habitat for passerine and other bird species, rodents, large native ungulates, and raptors. The Lake Tahoe Watershed Assessment declared aspen groves as an Ecologically Significant Area (ESA) because they have an exceptionally diverse array of associated species and are uncommon in the Lake Tahoe Basin (covering less than 0.5 percent of the basin's land area) (Manley et al. 2000). Aspen stands in the Sierra Nevada, including the LTBMU, are being replaced (shaded out) by conifers due to changes in historic fire regime. In response to the Watershed Assessment the LTBMU has been implementing a multi-year restoration project focused on restoring aspen stands throughout the basin that are at risk of loss from the landscape. Aspen stands typically support a high diversity, richness, and abundance of birds as compared to adjacent habitats

(Richardson and Heath 2004), and several bird species have been shown to have a strong affinity for aspen, including northern goshawk, red-breasted sapsuckers (*Sphyrapicus ruber*), dusky flycatcher (*Empidonax gentilis*), warbling vireo (*Vireo gilvus*), Swainson's thrush (*Catharus ustulatus*), and MacGillivray's warbler (*Oporornis tolmiei*) (Richardson and Heath 2004). Willow flycatcher, although more strongly associated with montane meadows, has been detected in meadow habitat with aspen in the LTBMU (Bombay et al. 2003b). Aspen stands are also habitats favored by a variety of cavity nesters such as bluebirds, sapsuckers, downy woodpeckers, and chickadees (Verner and Purcell 1988). Several mammal species are also associated with aspen and include ungulates such as mule deer (*Odocoileus hemionus*), rodents such as pocket gophers (*Thomomys*), voles (*Microtus*), shrews (*Sorex*), and mountain beaver (*Aplodontia rufa*) (Beier 1989, Coggins and Conovers 2005 and Loft et al. 1991 as cited in Manley et al. 2010).

Jeffrey pine

A number of terrestrial wildlife species use Jeffrey pine habitats by seeking cover in the herbaceous vegetation layer or downed logs, nesting or denning in snags and live trees, and/or foraging on pine seeds. The current condition/trend of Jeffrey pine in the LTBMU is provided in Table 3-37 of section 3.4.11 (Forest Vegetation). The understory herbaceous vegetation layer that is generally associated with early seral stages and open canopy stands, including grass and forb species as well as montane chaparral shrubs, sagebrush, and bitterbrush can provide cover for a variety of terrestrial wildlife species especially small mammals and ground nesting birds. More closed canopy stands can preclude the growth of understory vegetation and consequently reduce wildlife species richness associated with this feature. The Jeffrey pine type is composed predominantly of vigorous trees, but dead and declining trees are a component and provide for snags and downed logs which can provide for rich nesting, denning, and cover habitat for terrestrial wildlife. A number of cavity-nesting bird species (e.g., bluebirds, woodpeckers, nuthatches, chickadees) often use Jeffrey pine habitat for nesting (especially in snags) and foraging (Gucker 2007). California spotted owls use Jeffrey pine habitat for foraging and for nesting when large-diameter trees are present (Gucker 2007). The value of the Jeffrey pine forest type as a habitat for wildlife is also due to the food value of the Jeffrey pine seeds and seedlings. Pine seeds are included in the diet of more wildlife species than any other genus except oak (McBride 1988). American black bears, a variety of small mammals, and many bird species use Jeffrey pine habitats and/or feed on Jeffrey pine seedlings or seeds (Gucker 2007). Small mammals such as chipmunks and squirrels often cache and feed on Jeffrey pine seeds. Jeffrey pine seeds are an important food resource for Clark's nutcracker (Gucker 2007). The bark and foliage also serve as important food sources for squirrels and mule deer (McBride 1988).

White fir-mixed conifer

In the Lake Tahoe Basin, the white fir-mixed conifer forest type is dominated by white fir, with Jeffrey pine, sugar pine, red fir and incense cedar as important associates. The current condition/trend of white fir/mixed conifer in the LTBMU is provided in Table 3-37 of section 3.4.11 (Forest Vegetation). Snags and downed logs in this habitat type, as with Jeffrey pine, can provide nesting, cover, and denning habitat for a variety of wildlife species, including cavity dependent species. White fir is the preferred tree species for insect-gleaning yellow-rumped warblers and western tanagers, and is also commonly used by other insect-gleaning birds, such as mountain chickadee, chestnut-backed chickadee, golden-crowned kinglet, and blackheaded grosbeak (Shimamoto 1988). The extent of white fir-mixed conifer in the LTBMU and across the Sierra Nevada is increasing steadily under fire suppression. Shade tolerant white fir trees are filling in stands previously comprised of Jeffrey pine. Fire-suppressed white fir-mixed conifer forest stands tend to have high tree densities in the smaller size classes, few shade intolerant pine associates, and a large amount of fuels in the understory. Generally, the high density of trees prevents sunlight from reaching the forest floor and limits the shrub cover. A reduced shrub cover limits potential cover and foraging locations for a variety of terrestrial wildlife species, especially small mammals and birds and

their predators (e.g., spotted owls). In addition, a high density of small trees can also potentially limit the ability of California spotted owl and northern goshawk to navigate through forest stands. In areas where the canopy is more heterogeneous and shrub cover is high, this habitat feature can provide cover and foraging opportunities for a variety of terrestrial wildlife species.

Red fir

As with Jeffrey pine and white fir-mixed conifer habitat types, red fir forests can provide habitat for a number of terrestrial wildlife species. Marten prefer large snags, stumps, and logs in closed canopies of these forests for den sites (Cope 1993a). Other animals that use California red fir forests include fisher, wolverine, black bear, squirrels, chickadee, pileated woodpecker, great gray owl, Williamson's sapsucker, and pocket gopher (Cope 1993a). The cones are cut and cached by squirrels. Deer browse new growth in the spring (Cope 1993a). Infrequent, low to mixed severity fires are characteristic in this type, including throughout spotted owl and goshawk PACs and HRCAs. The current condition/trend of red fir in the LTBMU is provided in Table 3-39 of section 3.4.11 (Forest Vegetation). Where the canopy is open, a higher shrub layer exists in the understory (generally in higher elevations but patchy) and provides cover and foraging opportunities for a variety of small mammals and birds.

Lodgepole pine

Mammals and bird species use lodgepole pine forests for food, cover, and nesting/denning habitat. Dead or dying trees provide nesting sites for cavity-nesting birds (Cope 1993b). The fallen branches from these trees provide sites for ground-nesting birds and mammals. Although dead trees may be hazardous to elk and deer that are traveling quickly, dense stands of Sierra lodgepole pine provide excellent escape and resting cover (Cope 1993b). The seeds are a food source for squirrels, chipmunks, birds, and mice (Cope 1993b). Riparian lodgepole stands in the LTBMU are often very dense and comprised of many thin-stemmed individuals and high densities of snags and down timber. Understory diversity can range from very low to very high, depending on the availability of sunlight at the ground surface. Where stands are dense and sunlight to the forest floor is limited, understory shrub layer may be low or absent, limiting the opportunities for cover and foraging. Stands at meadow and lake edges are often much more open, and may support high levels of shrub and herb cover, and possible greater diversity of species. In drier stands, which also form part of the subalpine forest, the tree canopy is usually open (<50% cover) and characterized by trees of large diameter that can be used for nesting.

Subalpine forest

Major tree species in subalpine forest include mountain hemlock, whitebark pine, red fir, lodgepole pine, western white pine, and sierra juniper. Subalpine forest occurs on ground that is frozen for much of the year. Coniferous forests at high elevations in California typically support fewer species of birds and mammals than any other major forest type in the State (Verner and Purcell 1988). The reasons, though, not clearly established, probably involve some combination of climate, short growing season, lower primary productivity, moisture stress, and lower production of insects and other invertebrates that provide food resources for many vertebrates (Verner and Purcell 1988). Great gray owl, pileated woodpecker, marten, and wolverine are known to occur in these habitat types (Verner and Purcell 1988). Small mammals and birds (e.g., Clark’s nutcracker) cache and disperse seeds in these habitat types.

Montane chaparral

The growth form of montane chaparral species can vary from treelike to prostrate. Its structure is affected by site quality, history of disturbance (e.g., fire, erosion, logging) and the influence of browsing animals (Risser and Fry 1988). For example, on shallow granitic soils in the Sierra Nevada, low dense growths of pinemat manzanita and huckleberry oak characterize an edaphic climax community, associated with scattered conifers and much exposed granite. Montane chaparral is characterized by evergreen species; however, deciduous or partially deciduous species may also be present. Understory vegetation in the

mature chaparral is largely absent. Conifer and oak trees may occur in sparse stands or as scattered individuals within the chaparral type. Montane chaparral can provide habitat for a wide variety of wildlife. Numerous rodents inhabit chaparral. Deer and other herbivores often make extensive use of chaparral (Risser and Fry 1988) Montane chaparral provides critical summer range foraging areas, escape cover and fawning habitat. In the Sierra, fawning areas are frequently found where the chaparral lies adjacent to or contains an interspersion of perennial grass or meadow-riparian habitat (Risser and Fry 1988). However when chaparral is mature, the structure may be impenetrable to large mammals (Risser and Fry 1988). Some small herbivores use chaparral species in fall and winter when grasses are not in abundance (Risser and Fry 1988). Many birds find a variety of habitat needs in the montane chaparral. It provides seeds, fruits, insects, protection from predators and climate, as well as singing, roosting and nesting sites (Risser and Fry 1988).

Cliffs, Caves, and Cave-Surrogates

Large cliffs may provide habitat for a variety of raptors in the LTBMU including peregrine falcon, osprey, bald eagle, and golden eagle. Peregrine falcons currently nest in cliff habitat in the LTBMU; some of these cliffs are also used for dispersed recreation activities such as rock climbing. Caves and cave surrogates (e.g., mines, adits, and vacant buildings) can provide habitat for many bat species, including Townsend's big-eared bat. At least three large, abandoned mine shafts and adits exist on the LTBMU and may provide cave-like habitats. No natural caverns are yet known on the LTBMU, although natural caverns have been discovered on National Forest System lands located immediately adjacent to the LTBMU administrative boundary.

Protected Activity Centers and Home Range Core Areas

In addition to the individual habitat types described above, the LTBMU manages 22 California spotted owl and 35 northern goshawk Protected Activity Centers (PACs), for a total of 6,763 acres (6,261 acres on LTBMU only) and 8,110 acres (7,911 acres on LTBMU only) respectively. California spotted owl PACs include the best available 300 acres of habitat on NFS lands in as compact a unit as possible surrounding a territorial owl's activity center. Northern goshawk PACs include the best available 200 acres of forested habitat on NFS lands in the largest contiguous patches possible and surrounding all known and newly discovered breeding territories detected on NFS lands. PACs are managed to meet the life history requirements of spotted owls and goshawks. As a result, management activities that would modify the habitat so that it trends away from desired conditions are prohibited.

The LTBMU also manages 22 California spotted owl Home Range Core Areas (HRCAs) for a total of 21,368 acres (19,732 acres on LTBMU only). HRCAs on the LTBMU include 1,000 acres of the best available and contiguous California spotted owl habitat in the closest proximity to the owl activity center. The acreage in the 300-acre PAC counts toward the total HRCA acreage. As with PACs, HRCAs are also managed to meet the life history requirements of spotted owls.

Terrestrial Wildlife Species

The following species accounts provide information for special-status species in the LTBMU, including habitat associations, threats, management direction under the 1988 LTBMU Forest Plan (as amended) and other applicable directives, as well as historical and contemporary occurrence in the Lake Tahoe Basin. For additional information on species please refer to the Biological Assessment/Biological Evaluation. MIS are described separately in Section 3.4.14 of this chapter.

Pacific Fisher – Candidate Species Protected under ESA

The Pacific fisher (*Martes pennanti*) is currently a U.S. Fish and Wildlife Service (USFWS) candidate (C) species under the Endangered Species Act (ESA) of 1973, as amended. Fisher is typically associated with contiguous late successional forested habitat with relatively dense canopy cover and the presence of large

live trees and snags and logs, although second-growth and non-forested habitat use has been detected (Lofroth et al. 2011). In California, habitat loss and modification in the 1800s may have contributed to range contractions but there are few documented records to verify this (Lofroth et al. 2010).

The 1988 LTBMU Forest Plan (as amended) provides designation criteria, desired conditions, and standards and guidelines for the protection of fisher den sites in the Sierra Nevada, including limited operating periods (LOPs), restrictions on fuels treatments, and the requirement to mitigate impacts where a den site has been disturbed.

The current North American distribution is substantially reduced from the historic distribution (Gibilisco 1994). The historic range in California and Oregon included the southern Cascade Ranges, northern Coastal Ranges, and Sierra Nevada Ranges (Zielinski et al. 1995, Zeilinksi et al. 2005) including the Lake Tahoe basin. Within California, the range of the fisher has since contracted and now appears to consist of two isolated native populations: one in the northwestern portion of the state that extends into southwestern Oregon, and the other in the southern Sierra Nevada (Zielinksi et al. 1995, Zielinski et al. 2005, Slauson et al. 2007, Lofroth et al. 2010). Few fisher detections have been made in or adjacent to the LTBMU, the most recent records of this species on or adjacent to the LTBMU include: (1) the south shore of Lake Tahoe south of the South Upper Truckee bridge in Christmas Valley in 1967, (2) just outside the western Lake Tahoe basin to the west of Barker Pass on the Tahoe National Forest in 1972; and (3) the west shore of Lake Tahoe in Sugar Pine State Park near the mouth of General Creek in 1984 (CDFG 2008).Therefore, due to the lack of detections in the LTBMU within the last 10 years and recent data regarding the geographic range of the species in California, it is assumed that the LTBMU is outside the contemporary range of the species and will continue to be outside the range during the life of the Plan.

The geographic range of the fisher is changing due to reintroduction efforts in the northern Sierra Nevada and is predicted to continue changing with climate change. Nevertheless, the range is not expected to include the LTBMU within the life of the Plan. Since 2009, California Department of Fish and Wildlife (CADFW) has been re-introducing fishers into Sierra Pacific Industry's Stirling Management Area which includes portions of Tehama, Butte, and Plumas counties and is approximately 80 miles northeast of the Lake Tahoe Basin. In a study of climate change effects on species in the genus Martes, Lawler et al. (2011) concluded that macroclimate conditions closely correlated with fisher presence in California are likely to change greatly over the next century, resulting in a possibly pronounced loss of suitable habitat with the largest climate impacts occurring at the southernmost latitudes of their range (i.e., in the southern Sierra Nevada). It is within the realm of possibilities that the range of the species may shift up in altitude and north. Although Lawler et al. (2011) noted that fisher habitat is driven to a great extent by mesotopographic and local vegetation features that could not be incorporated into their climatic models, fire occurrence and behavior have substantial effects on local vegetation and these factors are driven to a large extent by climate/weather, so they also looked at stand-level implications of fire under a series of future fire scenarios. Based on this analysis, Lawler et al. (2011) recommended protecting fisher habitat through targeted forest-fuel treatment, and applying more liberal fire-management policies to naturally ignited fires during moderate weather conditions.

North American Wolverine – Proposed for listing under ESA, Region 5 Forest Service Sensitive Species

The North American wolverine (*Gulo gulo luscus*) is a Region 5 Forest Service Sensitive species and is proposed for listing as threatened under the Endangered Species Act (USFWS 2013). Wolverine use diverse coniferous forest types (Copeland 1996, Hornocker and Hash 1981) and unlike fisher and marten, this species also uses non-forested alpine habitats (Banci 1994 and Copeland 1996). This habitat generalist appears to select areas that are free of significant human disturbance and requires den sites associated with structural cover (e.g., boulders and persistent snow cover) in cirque basins or avalanche chutes at high elevations (summarized in USDA 2001). The presence of deep and persistent snow appears be a major contributing factor to habitat selection by wolverines. Wolverine select areas that are

cold and receive enough winter precipitation to reliably maintain deep persistent snow late into the warm season (Copeland et al. 2010). It would appear that wolverine year-round habitat use also takes place almost entirely within the area defined by deep persistent spring snow (Copeland et al. 2010). No records exist of wolverines denning in snow free habitats despite the wide availability of these habitats within their range (USFWS 2013). A major threat to this species is loss of alpine habitat from climate change. Other potential threats to this species include habitat loss and fragmentation and increasing human presence. The 1988 LTBMU Forest Plan (as amended) provides designation criteria, desired conditions, and standards and guidelines for the detections of wolverines including detection and verification procedures, the use of LOPs, and follow up surveys.

Extensive carnivore surveys have occurred on the LTBMU over the past 10 years and wolverines have not been detected. An estimated 198 acres of high and moderate capability denning habitat, 32,609 acres of high and moderate capability resting habitat, and 34,153 acres of high and moderate capability foraging habitat currently exist for wolverine within the LTBMU. Wolverines have been detected on or adjacent to the LTBMU since 1971 but none of the following detections were associated with a den site: (1) on Echo Summit at Highway 50 in 1941 (2) approximately one mile northwest of the LTBMU near the Lower Truckee River at the east end of Squaw Valley in 1953, (3) approximately 5.5 miles west of the LTBMU near Strawberry, CA in 1971, (4) approximately one mile northwest of the analysis area in Emerald Bay between Highway 50 and Eagle Lake in 1990, and (5) approximately 2 miles west of the LTBMU near Island Lake on the Eldorado National Forest in 1994 (CDFG 2008). During February and March 2008, and late winter and spring 2009, a lone male wolverine was detected approximately 14-19 miles northwest of the LTBMU near Truckee, California. This was the first verified record of a wolverine from California since 1922. Agency biologists and researchers determined that the wolverine is most closely related to, and most likely came from, a population on the western edge of the Rocky Mountains rather than either the historic California population or contemporary northern Cascades (Washington) population (Moriarty et al. 2009). This attempted dispersal event may represent a continuation of the wolverine expansion in the contiguous United States and other wolverines may have travelled to the Sierra Nevada and remain undetected (DOI 2013). However, there is no evidence that California currently hosts a wolverine population or that female wolverines have made, or are likely to make, similar dispersal movements (USFWS 2013). In summary, detections of wolverine or their den sites have not occurred within 5 miles of the Lake Tahoe Basin within the past two years; however the contemporary range of this species appears uncertain and may include limited portions of the Basin.

Region 5 Forest Service Sensitive Species

Forest Service Sensitive species are those plant and animal species identified by a Regional Forester for which population viability is a concern, as evidenced by (FSM 2670.5):

a) Significant current or predicted downward trends in population numbers or density.

b) Significant current or predicted downward trends in habitat capability that would reduce a species' existing distribution.

Western bumblebee – Region 5 Forest Service Sensitive Species

The western bumble bee (*Bombus occidentalis)* was recently added to the Region 5 Forest Service Sensitive species list. This species is associated with habitat with flowers for nectar and rodent burrows for hives.

The species is experiencing severe declines in distribution and abundance due to a variety of factors including diseases and loss of genetic diversity (Tommasi et al. 2004, Cameron et al. 2011, Koch et al. 2012). The overall status of populations in the west is largely dependent on geographic region: populations west of the Cascade and Sierra Nevada mountains are experiencing dire circumstances with

steeply declining numbers, while those to the east of this dividing line are more secure with relatively unchanged population sizes. The reasons for these differences are not known.

Bumble bees are threatened by many kinds of habitat alterations that may fragment or reduce the availability of flowers that produce the nectar and pollen they require, and decrease the number of abandoned rodent burrows that provide nest and hibernation sites for queens. Major threats that alter landscapes and habitat required by bumble bees include agricultural and urban development. In the absence of fire, native conifers encroach upon meadows which also decrease foraging and nesting habitat available for bumble bees. According to studies done in England (Goulson et al. 2008), grazing during the autumn and winter months may provide excellent bumble bee habitat and prevent the accumulation of coarse grasses. Heavy grazing and high forage utilization should be avoided since flowering plants providing necessary nectar and pollen may become unavailable, particularly during the spring and summer when queens, workers and males are all present and active.

There are only three collection records from national forest lands since 2000: two are on the Plumas, and one is on the LTBMU.

Northern Goshawk – Region 5 Forest Service Sensitive Species

The northern goshawk (*Accipiter gentilis*) is a Region 5 Forest Service Sensitive Species and a TRPA Special Interest Species. Goshawks use areas with high canopy closure, a high density of large trees, and open understories (Keane 1999, USDA 2001).

Some of the threats facing goshawk include habitat loss and fragmentation (e.g., loss of large diameter trees), forest structure changes and changes in prey populations due to fire suppression and climate change, risk of habitat loss due to stand-replacing fires, and disturbance from human activity in and near territories. A study conducted by Morrison et al. (2011) in the Lake Tahoe Basin indicated that northern goshawks are susceptible to human disturbance; human activity was twice as high within infrequently occupied territories as compared to frequently occupied territories. Many kinds of human activities have been documented to affect raptors by altering habitats; physically harming or killing eggs, young, or adults; and by disrupting normal behavior (Postovit and Postovit 1987, Delany et al. 1999 as cited in Morrison et al. 2011). A recent study on nesting northern goshawk response to logging truck noise found that while goshawks alerted (turned their head in the direction of the noise) to the noise they did not flush and response was inversely proportional to the distance of the nest from the road (Grubb et al. 2012).

TRPA Code of Ordinance designated disturbance zone for goshawks is the 500 acres of best suitable habitat surrounding a population site, which shall include a 0.25-mile radius around each nest site. The 1988 LTBMU Forest Plan (as amended) also provides designation criteria, desired conditions, management objectives, and standards and guidelines for the protection of northern goshawk nests and activity centers, delineated as Protected Activity Centers (PAC). Goshawk PACs include the best available 200 acres (more or less depending on availability of suitable vegetation) of the highest quality nesting habitat, and the most recent nest site and alternate nests within a goshawk breeding territory as described in management direction for the forest (USDA 2004).

There are currently 35 northern goshawk PACs on the LTBMU, following a re-mapping effort in 2008 to incorporate the most up-to-date detection, nest location, and land boundary information available. Three PACs were added in 2013 following an assessment of new nesting behavior during the 2012 season. In the last 10 years (2003-2012), goshawks have been detected in 30 (94%) of the 32 PACs that were monitored during this time (excludes PACs added in 2013). Data for northern goshawk in the LTBMU are stored on the USDA Natural Resource Manager Natural Resource Information System (NRM NRIS) (USDA 2013b).

Bald Eagle – Region 5 Forest Service Sensitive Species

The bald eagle (*Haliaeetus leucocephalus*) was federally delisted as threatened under ESA in 2007 and was selected as a Region 5 Forest Service Sensitive Species. This species is protected under the Bald and Golden Eagle Protection Act of 1940, and the winter and nesting population in the LTBMU is designated as a TRPA Special Interest Species. Bald eagles require open water with juxtaposed mature trees or steep cliffs for nesting, perching, foraging, and roosting (Bent 1961 in Murphy and Knopp 2000). This species typically perches in “large, robustly limbed trees, on snags, on broken topped trees, or on rocks near water” (Peterson 1986 and Laves and Romsos 2000). Habitat (unpubl.USFS data 1994) and perch sites (Laves and Romsos 2000) identified in the Lake Tahoe Basin indicate that local bald eagles prefer late successional stands (particularly Jeffrey pine) and trees that are larger in diameter and taller than the dominant tree canopy (particularly trees greater than 40 inches dbh, greater than 98 feet tall, and dead topped trees with robust, open branch structures).

The Recovery Plan for the Pacific Bald Eagle (USFWS 1986) states that the main threats to this species in Zone 28 (Sierra Nevada Mountains) are disturbance at wintering grounds and loss of potential nest habitat**.** Bald eagles are also sensitive to human disturbance. In Washington, bald eagles have been found to be adversely affected by recreation that involves both pedestrian traffic and boat use by adversely affected feeding activity (Stalmaster and Kaiser 1998). Stalmaster and Newman (1978) found that wintering bald eagles were adversely affected by human disturbance and distribution patterns were significantly changed by human activity. Eagles were displaced in areas of high human activity and moved to areas of lower human activity. Flush distances were lower when the disturbance was on land than in the water and lower still if the eagle couldn’t see the cause of the disturbance. Knight and Knight (1984) found that bald eagles became habituated to canoes in areas where they were common.

TRPA Code of Ordinances includes the designation of a 0.5 mile radius buffer around a bald eagle nest that shall remain free from disturbance and have also designated bald eagle winter disturbance free zones in the LTBMU. The 1988 LTBMU Forest Plan (as amended) was developed prior to the delisting and also provides standards and guidelines to identify potential bald eagle nesting sites and manage them to encourage the reestablishment of four pairs. In May 2000, also prior to the delisting, the LTBMU Bald Eagle Management Plan was prepared in an effort to recommend actions that will encourage the recovery of the species in the Basin.

Bald eagles have been recorded in the Lake Tahoe basin since 1874 and occur year-round. Up until 2012, the LTBMU was conducting annual bald eagle nesting surveys in conjunction with osprey nesting surveys and in cooperation with California Department of Parks and Recreation, Nevada Department of Wildlife, and Tahoe Regional Planning Agency (TRPA). USFS no longer participates in these surveys but receives the data from TRPA. This species has been known to breed at Marlette Lake on the east side of Lake Tahoe (Nevada State Park land) and at Emerald Bay (California State Park land) on the south shore. There are two nesting territories in the Basin, one at Marlette Lake on Nevada State Parks land (one of the nests is an infrequently used alternate nest) and the other at Emerald Bay on California State Parks land. Bald eagle numbers peak during the fall and winter, corresponding with kokanee salmon spawning activity (Murphy and Knopp 2000). The LTBMU has hosted and now participates in (and Tahoe Institute for Natural Sciences (TINS) hosts) an annual mid-winter bald eagle counts. An average of 12 bald eagles (range 7-18) has been identified during the mid-winter surveys between 1999 and 2012. The number of individuals detected fluctuates annually; nearly twice as many individuals were detected in 2011 (N=17) as in 2010 (N=9) but 2012 had similar counts to 2009 (N=10). The LTBMU currently manages approximately 370 acres of the Taylor Creek and Tallac Creek wetlands and meadows north of Highway 89 in the south shore region as bald eagle wintering habitat from October 15 through March 15 annually.

Great Gray Owl– Region 5 Forest Service Sensitive Species

The great gray owl (*Strix nebulosa*) is a Region 5 Forest Service Sensitive species. Great gray owls typically forage in meadows and early seral-stage habitats that support sufficient prey, primarily *Microtus* and *Thomomys* spp. (USDA 2004, Sears 2006). Nesting and roosting occur in adjacent conifer forests, generally in areas where canopy cover averages greater than 40 percent (USDA 2004). Some of the potential threats to this species include timber harvest, fire suppression, post-fire salvage harvest, grazing, and alteration of hydrological regimes that has reduced the number of large conifers and oak trees used for nesting, as well as the quality of meadows and forest stands used for foraging (Dull 1999, Hutto and Gallo 2006, Saab et al. 2009). Additional threats include West Nile virus, direct and indirect human disturbance from recreational activities, and climate change (Gancz et al. 2004, Rauscher et al. 2008, Miller et al. 2009, Hull et al. 2010). The 1988 LTBMU Forest Plan (as amended) provides designation criteria, desired conditions, management objectives, and standards and guidelines for the protection great gray owl activity centers, delineated as Protected Activity Centers (PAC).

There are no PACs for great gray owls on the LTBMU and it is presumed that this species does not occur in the LTBMU and will not occur during the life of the Plan. Surveys for great gray owl have not been conducted on the LTBMU and this species has not been detected during large-scale surveys conducted on the Basin for other owls. Nearby, surveys have detected great gray owls on the Eldorado, Stanislaus, Sierra, and Tahoe National Forests but not on the Plumas or Sequoia National Forests. The nearest detection of this species to the Lake Tahoe basin occurred near Carson Pass in 1971 approximately 1.1 miles south of the LTBMU. A second great gray owl detection was reported near Grover Hot Springs State Park, approximately 7.9 miles southeast of the LTBMU in 1979. Based on the lack of detections on the Forest and the presumption that this species likely would have been detected during surveys for other owls if it were present, the great gray owl is not expected to occur in the Lake Tahoe basin.

California Spotted Owl – Region 5 Forest Service Sensitive Species

The California spotted owl (*Strix occidentalis occidentalis*) is a Region 5 Forest Service Sensitive Species and a Management Indicator Species (MIS) for the late seral, closed canopy coniferous forest habitat on the LTBMU. Additional information for the California spotted owl as an MIS is provided in the section entitled *Management Indicator Species*.

Spotted owl nesting and roosting locations are strongly associated with mature coniferous forests with high tree canopy cover (≥70%), multilayered canopies, and an abundance of large trees and snags (Forsman et al. 1984, Bias and Guitierrez 1992, Call et al. 1992, Verner et al. 1992, Bond et al. 2004, Chatfield 2005). Spotted owl foraging habitat consists of a broader range of vegetation types that may include younger, more open habitat (Williams et al. 2011, Roberts and North 2012, Keane 2013). Large coarse woody debris is a key habitat feature of spotted owl prey. It has been suggested that some level of landscape (forest) heterogeneity may be an important consideration for spotted owl management and can improve spotted owl conservation (Williams et al. 2011, Roberts and North 2012). Although forests with ≥ 70% canopy cover exist in the LTBMU, multilayered and very dense canopies that are often associated with spotted owls (especially northern spotted owl in the Pacific Northwest) are not characteristic of the forests here and many owls inhabit, mate, and reproduce in stand with < 70% canopy cover. Please refer to Section 3.4.11 - Forest Vegetation for a more detailed description of the characteristics of mixed conifer (and pine) forests in the LTBMU.

The 1988 LTBMU Forest Plan (as amended) provides designation criteria, desired conditions, management objectives, and standards and guidelines for the protection of California spotted owl Protected Activity Centers (PAC) and home range core areas (HRCA). PACs include 300 acres of the highest quality nesting habitat available and the most recent nest site or activity center within a spotted

owl breeding territory as described in management direction for the forest (USDA 2004). An HRCA is 1,000 acres, includes its associated PAC, and is comprised of the best available contiguous habitat.

There are currently 22 California spotted owl PACs (and associated HRCAs) on the LTBMU, following a re-mapping effort in 2008 to incorporate the most up-to-date detection, nest location, and land boundary information available. One PAC was added in 2013 following an assessment of new nesting behavior during the 2012 season. During the last 10 years (2003-2012), spotted owls have been detected in 16 (76%) of the 21 PACs that were monitored during this time (excludes the PAC added in 2013). Data for California spotted owl found in the LTBMU are stored on the USDA Natural Resource Manager Natural Resource Information System (NRM NRIS) (USDA 2013b).

Potential threats and stressors to this species include stand replacing catastrophic fires, expansion of barred owls (*Strix varia*), loss of large trees and dense canopy cover, habitat fragmentation, climate change, and disease.

Years of fire suppression have led to dense forested conditions with heavy fuel loading; these conditions can reduce the quality of foraging and nesting habitat (Roberts and North 2012). For example, extremely dense stand conditions characteristic of fire suppressed forests are not typically used for spotted owl foraging (Verner et al. 1992, Irwin et al. 2007). Occupancy of nesting spotted owls in fire suppressed forests may also be negatively influenced by an increasing proportion of these smaller trees (< 23 inches in diameter) around the nest (Blakesley et al. 2005).

Dense conditions characteristic of fire suppressed forests (especially ladder fuels) can also be correlated with an increased risk of fire. In a draft synthesis of recent available scientific research on California spotted owls, Keane (2013) concluded that spotted owls continue to occupy landscapes that have experienced low- to moderate-severity fire as well as some mixed severity fire. However, the effects of varying fire severities on spotted owl demographics (e.g., survival, reproduction) across multiple spatial and temporal (short term vs long term) scales are not well understood and the current research presents mixed results.

High severity (catastrophic) fire is considered to be a major potential threat to the California spotted owl (USFWS 2006). Large-scale stand replacing fires can be detrimental to spotted owls, at least in the short term, possibly because these large areas do not contain habitat features important to spotted owls (Anthony and Clark 2008). High severity fires that kill most or all of the living trees effectively reduces the availability of preferred nesting and roosting habitat (mature coniferous forests with high tree canopy cover (≥70%), multilayered canopies, and an abundance of large trees and snags) that can take centuries to regrow. In southwest Oregon, Clark (2007) and Clark et al. (2011) found that annual survival rates were lower in northern spotted owls inhabiting burned areas or displaced by the wildfire as compared to owls that inhabited areas outside the burn perimeter. Clark (2007) observed that although 23 northern spotted owls used all types of fire severity, within burned areas owls strongly selected low severity or unburned areas with minimal overstory canopy mortality. In this burned landscape, owl high-use areas were characterized by lower fire severity and greater structural diversity. Bond et al. (2009) reported that foraging may occur preferentially in high severity burned areas; the study followed seven owls in four year old burned areas and found higher than expected owl foraging in high severity burned areas. The study is limited by small sample size (7 owls), short duration (12 weeks), nonrandom selection of owls, and delay (4 years) following a wildfire. Bond et al. (2002) hypothesized that wildfires may have little short term impacts on spotted owls; the authors reported that northern, California, and Mexican spotted owl survival, site fidelity, mate fidelity, and reproductive success at 11 territories one year after fires seemed uninfluenced by the fires. Four of the territories were mapped as having experienced low-to moderate-severity fire and four experienced high severity fire that burned >30% of the territories. Roberts et al. (2011) estimated that California spotted owls studied in Yosemite National Park had similar detection, density, and occupancy rates between randomly selected unburned sites (16) and recently

burned (<15 years since burn) sites (16) that had predominantly burned at low- to moderate- severity. Jenness et al. (2004) found no statistical relationship between fire with mixed severity effects and Mexican spotted owl occupancy and reproduction in Arizona and New Mexico but the authors caution that higher occupancy and reproduction in unburned sites may not have been detected as statistically significant because of small sample size, lack of information on temporal and spatial variability in owl occupancy rates, and high variability in burn extent and severity. In a comparison of owl occupancy dynamics in burned versus unburned sites in the Sierra Nevada, Lee et al. (2012) found that the probability (model mean-averaged) of colonization and local extinction did not differ substantially between burned and unburned sites and the authors concluded that fire has no significant effect on occupancy dynamics. The authors also found that owls continued to occupy sites (a distinct area in which a single or territorial owl or pair had been detected) where almost one third (32%) of suitable habitat had been burned at high severity. They hypothesize that there may be a critical spatial threshold (proportion of a site) above which a burn at high severity could adversely affect spotted owl occupancy. Collectively, a large number of studies of fire effects on owls suggest the presence of large trees and high overstory canopy closure are the most important pre- and postfire conditions associated with spotted owl occupancy (Roberts and North 2012). However, it is clear that additional information is needed to better understand the effects of fire on spotted owls.

In the Sierra Nevada, between 1999 and 2002, 18 spotted owl PACs were severely affected by wildfire and could be considered "lost" (USDA 2004). From 2003 to 2008, a GIS exercise by the USFS found that 33 PACs had more than 75% of their area burned at either high or moderate severity, and rendered unusable by spotted owl, due to 8 major wildfires on NFS lands (see Table 1 and footnotes in Yasuda Declaration on October 21, 2008 for *Sierra Forest Legacy et al. vs Mark Rey, Tuolumne County Alliances for Resources and Environment et al., California Ski Industry Ass'n, and Quincy Library Group).* The Moonlight fire on the Plumas National Forest burned approximately 65,000 acres (46,000 on National Forest System lands) in September 2007. Based on fire severity assessment methods and severity maps (Safford et al. 2007, Miller 2007, Miller and Thode 2007), a total of approximately 43,938 acres (National Forest and private) burned at high and moderate-high severity (Basal Area Mortality > 50%); approximately 31,682 acres of forest vegetation was burned at high and moderate-high severity on National Forest system lands (Rotta 2011). This fire resulted in the immediate long-term loss of 17 California spotted owl PACs and HRCAs, as well as the loss of 96% of the suitable nesting habitat and 86% of the suitable foraging habitat within the landscape (Rotta 2011).

In addition to understanding the effects of wildfire severity on short and long-term spotted owl survival, reproduction and persistence, more information is needed on the potential effects of altering post-fire habitat (e.g., salvage logging) on spotted owls. There are relatively few published studies on the effects of post-fire salvage logging on California spotted owls. In the San Bernardino and San Jacinto Mountains of Southern California, Lee et al. (2013) did not find statistically significant effects of fire or salvage logging on California spotted owl occupancy dynamics but did note that salvage logging reduced owl occupancy relative to sites that were burned and not logged. For northern spotted owls, results of studies in Oregon suggest that owl survival and territory occupancy are negatively influenced by a combination of past timber harvest, severe wildfire, and post-fire salvage logging (especially within the core nesting area) (Clark 2007, Clark et al. 2011, Clark et al. 2013). Clark (2007) found owls avoided burned areas that were logged following the fires. Unfortunately Clark was not able to tease apart the effects from any one influential variable so it is not clear to what extent past timber management, fire severity, or post-fire salvage logging individually effect spotted owls, just that they jointly have an adverse effect.

Overall, there is not a lot of available information about the effects of mechanical vegetation treatments on spotted owls and habitat condition (Keane 2013). The results of simulation modeling research summarized in Keane (2013) suggests that some fuels treatments can reduce fire risk and with minimal effects on owl reproduction, and may have long-term benefits of reducing wildfire risk that outweigh

short-term effects of treatments. Seamans and Gutiérrez (2007) found that alteration of ≥20 hectares (49 acres) of mature forest in spotted owl territories may decrease the probability of colonization. The results from a separate opportunistic case study of fuel reduction treatments (mechanical thinning of understory trees and/or prescribed fire) on PAC occupancy and owl reproduction in the Stanislaus National Forest indicates that such treatments can be compatible with owl use and reproduction as owls continued to occupy the treated PACs and produce young (Rich 2007). In the Plumas National Forest, where the Moonlight fire resulted in the loss of PACs, fuel reduction treatments are occurring in the Meadow Valley Project area. Of the seven original confirmed pairs of spotted owls, there were 3 confirmed pairs, one unconfirmed pair, and one barred owl in the project area in 2012 (Keane, pers. comm., 2013). The data cannot conclude cause for the change in spotted owl occupancy but show the association of treatment and change in spotted owl occupancy as well as occupancy of a strong owl competitor. The technique used in the Meadow Valley project, DFPZ (Defensible Fuel Profile Zone) is currently not practiced on the LTBMU but the results from this study demonstrate that although owls could incur short term impacts from fuel reduction treatments, this risk outweighs the potential consequences of losing the habitat to a stand replacing fire like the Moonlight fire which resulted in the immediate long-term loss of 17 California spotted owl PACs and HRCAs in the same National Forest. In their 12-month finding to not list the California spotted owl under ESA, the USFWS (2006) recognized that “the primary technique of fuels reduction, which is thinning understory trees with mechanical equipment and/or prescribed fire, may have detrimental effects on spotted owl habitat in the short term, but may favor development of habitat in the longer term, and may reduce the likelihood of catastrophic fire that could substantially degrade or eliminate habitat”.

Spotted owls face a number of stressors unrelated to fire and forest management activities including the invasion of barred owls (*Strix varia*), climate change, and disease and contaminants. As with the previous description of effects of fire and forest management activities, the information on ecological stressors comes primarily from Keane (2013). Barred owls are an increasing risk factor for California spotted owls in the Sierra Nevada. Barred owls can hybridize and also out-compete spotted owls. Barred owls were first recorded within the range of the California spotted owl in 1989 on the Tahoe National Forest. Two sparred owls (hybrids of spotted and barred owls) were reported in the Eldorado National Forest during 2003 – 2004 (Seamans et al. 2004), and one of these sparred owls is still present on the study area. Barred owls were first recorded in the southern Sierra Nevada in 2004 (Steger et al. 2006). Ongoing research has documented 73 records of barred or sparred owls in the Sierra Nevada to date, with the majority of records from the northern Sierra Nevada (Tahoe, Plumas, and Lassen National Forests). Of note, five new records of barred owls were documented in the Stanislaus and Sierra national forests in 2012, indicating further range expansion of barred owls in the southern Sierra Nevada. Barred owl numbers are likely higher than documented in the Sierra Nevada, as there have been no systematic surveys for them to date.

Across their range, spotted owls exhibit population-specific demographic relationships with local weather and regional climates (Glenn et al. 2010, Glenn et al. 2011, Peery et al. 2012). Based solely on projections of climate change (i.e., not incorporating other factors such as habitat, etc.), this population-specific variation is anticipated to result in population-specific responses to future climate scenarios, which could range from little effect to potentially significant effects. These population-specific responses could result in high vulnerability. For California spotted owls, Seamans and Gutiérrez (2007) reported that temperature and precipitation during incubation most affected reproductive output, and conditions in winter associated with the Southern Oscillation Index (SOI) most affected adult survival on the Eldorado National Forest. Weather variables explained a greater proportion of the variation in reproductive output than they did for survival. Further, these two weather variables were also included in the best models predicting annual population growth rate (Seamans and Gutiérrez 2007). MacKenzie et al. (2012) found that SOI or other weather variables explained little variation in annual reproduction for this same population of owls. Future responses to climate change are likely to be governed by complex interactions of factors that directly affect spotted owls and their habitat, as well indirect factors that can affect habitat

(e.g., insect pests, disease, increased fire risk, etc.). Carroll (2010) recommended that dynamic models that incorporate vegetation dynamics and effects of competitor species in addition to climate variables are needed for rigorous assessment of future climate change on spotted owls.

Little information exists on disease prevalence in California spotted owl populations, and no information exists regarding the effects of disease on individual fitness or population viability. Blood parasite prevalence sampling for California spotted owls in the northern Sierra Nevada documented that 79 percent of individuals were positive for at least one infection, whereas 44 percent of individuals tested positive for multiple infections (West Nile Virus (WNV)), a mosquito-borne flavivirus that was first detected in eastern North America in 1999 and spread rapidly across the continent. WNV has been demonstrated to have high acute species-specific mortality rates in many raptor species (owls, hawks, and their relatives) (Gancz et al. 2004, Marra et al. 2004). None of the 141 individual California spotted owl blood samples collected from the southern (Sierra National Forest, Sequoia-Kings Canyon National Park) or northern (Plumas and Lassen National Forests) Sierra Nevada from 2004 – 2008 have tested positive for WNV antibodies, which would indicate exposure and survival (Hull et al. 2010). Adult, territorial California spotted owls have high annual survival (80 – 85 percent) that has been stable across years, and no evidence has been published from the four long-term demographic studies indicating changes in adult owl survival. Nevertheless, although no effects have been documented to date, future outbreaks of WNV may pose a risk to California spotted owls.

Four demographic studies of California spotted owl have been ongoing for a number of years within the Sierra Nevada: (1) Eldorado National Forest (since 1983); (2) Lassen National Forest (since 1990); (3) Sierra National Forest (since 1990); and (4) Sequoia-Kings Canyon National Park (since 1990). One of the primary objectives of the demographic studies is to monitor rate of change (lambda (λ)) in owl populations (i.e., the number of owls present in a given year divided by the number of owls present the year before). For these demographic models, a lambda of one indicates a stable population; less than one indicates the population is decreasing and greater than one indicates an increasing population. Lambda is estimated from models and is typically presented as an estimate of the rate of population change, along with the standard error (SE) or a 95% confidence interval (CI). The 95% confidence interval represents the reliability of the estimate of lambda. Managers typically view a population as stable if the 95% confidence interval overlaps a lambda of one.

A meta-analysis of the data from 1990 to 2005 for the four spotted owl populations in study areas concluded that, with the exception of the Lassen study area, owl populations were stable, with adult survival rate highest at the Sequoia-Kings Canyon study site (Blakesley et al. 2010). The 95% confidence limit for lambda in the Lassen study area ranged from 0.946 to 1.001 (estimated value 0.973), which barely included 1, and the analysis estimated a steady annual decline of 2 – 3% in the Lassen study population between 1990 and 2005 (Blakesley et al. 2010).

Recent analyses from the same four demography study areas suggest that there may be a concern for decline in spotted owls within the three National Forest demography study areas in the Sierra Nevada. A preliminary analysis conducted by Sierra Nevada Adaptive Management Project (SNAMP) in 2011 indicates that the owl population on the Eldorado National Forest may be declining but the 95% confidence interval for lambda overlaps one (1) (Gutierrez et al. 2012). Tempel and Gutiérrez (2013) conclude that data from the Eldorado Density Study Area (60% USFS managed land in Eldorado National Forest and 40% private land managed timber companies) suggest a 31% decline in the spotted owl population size from1993-2010 but again, the 95% confidence interval slightly overlapped one (1) for all parameters. Using data for an 18-year study period, Conner et al. (2013) found that the different estimators for ‘realized population change’ (expressed as ‘delta’ - ratio of population size at end time to initial population size) indicated population declines of 21-22% for the Lassen study area and 11-16% for Sierra study area, and an increase of 16-27% for Sequoia-Kings Canyon study area. The annual rate of population change (lamda) also showed a declining trend. However, similar to the analyses conducted by

Tempel and Gutiérrez (2013) the confidence intervals overlapped 1.0 for all estimators and all study areas. As stated in Conner et al. (2013) "If a population is growing (lambda greater than 1), managers cannot tell whether the growth is from internal recruitment or immigration. Likewise, if a population is declining, managers cannot determine whether the declines are due to deaths within the population or emigration. Thus, additional information on specific vital rates is necessary to understand what is driving lambda and ultimately, the mechanisms driving population dynamics." Causation for any potential decline in occupancy is unknown.

Willow Flycatcher – Region 5 Forest Service Sensitive Species

The willow flycatcher (*Empidonax trailii*) is a Region 5 Forest Service Sensitive species. Willow flycatchers are closely associated with meadows that have high water tables in the late spring and early summer, and abundant shrubby, deciduous vegetation (especially *Salix* spp.). Furthermore, this species prefers and is significantly more likely to occupy and defend territories that have standing water or saturated soils during the breeding season, often selecting the wettest portions within meadows (summarized in USDA 2001).

The 1998 LTBMU Forest Plan (as amended) provides standards and guidelines for the protection of willow flycatcher sites, including guidance to develop restoration actions to restore historically occupied sites.

Degradation and alteration of willow flycatcher habitat (i.e., montane meadows) is a primary factor contributing to population declines (Green et al. 2003). Degradation could include, but is not limited to: (1) alterations to the hydrological patterns leading to meadow drying, (2) destruction of shrub vegetation resulting in loss of nesting sites and cover for predator avoidance, (3) increased predator access to meadow interior, (4) loss of foraging substrate and decreased insect abundance, and (5) potentially increased contact with brown-headed cowbirds (Green et al. 2003).

Livestock grazing, predation, and human activity have all been considered threats to flycatcher nesting habitat. Grazing has been essentially eliminated in the Lake Tahoe basin, assisting in the restoration of primary habitat for the species. However, grazing continues to be considered a suitable use on the LTBMU. Poorly managed grazing can alter the hydrologic and vegetative characteristics of meadows and contribute to poor quality habitat for nest selection and increased visibility (vulnerability) of nests to predation (Brookshire et al. 2002, Auble et al. 1994, Stanley and Knopf 2002, Scott et al. 2003). Nest predation is the leading cause of nest failure in willow flycatcher nests in the Lake Tahoe Basin (Mathewson et al. 2011). Human activity (presence of people, dogs, and vehicles) has also been found to be a significant impact to land birds, surpassing that of habitat loss from development (Schlesinger et al. 2008).

In the past three decades, willow flycatchers have undergone substantial population declines in California. In the Lake Tahoe Basin, the flycatcher population has declined from 1997-2010 (Mathewson et al. 2011) and there is some level of uncertainty about the ability of the local population to rebound (Mathewson et al. 2012). Multiple factors likely contributed to the decline including poor quality of meadow habitat, shortened breeding-season length and stochastic weather events, the initial small population size, and low reproduction that influenced dispersal dynamics (Mathewson et al. 2011). Mathewson et al. (2011) suggest that populations in the Lake Tahoe Basin would approach stable (λ=1) with increased reproductive success. Nest predation was the primary cause of nest failure at our study sites. The authors recommend two types of restoration, including: (1) restore meadows currently occupied by willow flycatchers and (2) restore meadows within 5 miles of occupied sites to provide habitat for dispersing flycatchers. Mathewson et al. (2011) suggest that restoration could enhance nest success and recommend increasing riparian shrub cover (e.g., willow) and improving meadow wetness to both increase vegetation and reduce predation rates on nests, fledglings, and adults. The USFS recognizes the need to restore

meadows in the Lake Tahoe Basin. Several large-scale meadow and riparian restoration projects (e.g., Cookhouse Meadow, Big Meadow, Upper Truckee River, Taylor-Tallac, High Meadows, and Meeks Bay) have or will soon be restoring these habitats.

Townsend's big-eared bat – Region 5 Forest Service Sensitive Species

Townsend's big-eared bat (*Corynorhinus townsendii*) is a Region 5 Forest Service Sensitive species. This species has been found in a variety of habitats including coniferous forests and riparian areas and is highly associated with cave and cave surrogate structure (e.g., mines, buildings) for roosting (Kunz and Martin 1982). The distribution of the species appears to be significantly constrained by the availability of suitable roosting sites and the degree of human disturbance at roosts.

The primary threats facing this species throughout its range are disturbance and destruction of roost sites, timber harvest practices, and loss of riparian habitat (Piaggio 2005). However, the largest emerging threat to all cave-roosting species (including pallid bat and fringed myotis) is white-nose syndrome. There is a grave concern that it could spread to the western states and California. As of October 2011, the U.S. Fish and Wildlife Service records suspected detections as far west as Oklahoma (http://www.fort.usgs.gov/wns/). This disease has rapidly spread throughout the eastern US and Canada since its discovery in 2006.

Currently, there are no standards and guidelines in the 1988 LTBMU Forest Plan (as amended) to protect this species. Measures to protect the species in the LTBMU have been developed on a project-specific basis.

Townsend's big-eared bat was first detected on the LTBMU in 2007 in Blackwood Creek and Big Meadow Creek watersheds. This species was identified again in 2009 at two adits and a vacant building in the LTBMU. This species has not been positively identified at survey locations in the LTBMU since 2009.

Pallid bat – Region 5 Forest Service Sensitive Species

The pallid bat (*Antrozous pallidus*) was recently added to the Region 5 Forest Service Sensitive species list for the LTBMU. In high elevation areas, this species is associated with conifer forests (Hermanson and O'Shea 1983) and Baker et al. (2008) suggest open pine forest is preferred within these higher elevations areas. In forested habitats in the Sierra Nevada Mountains, Baker et al. (2008) found pallid bats in areas with greater availability of Sierran mixed conifer and white fir than open meadows, grasslands, barren areas, and montane chaparral. They caution, however that they were unable to discern actual habitat use at a finer scale. Johnston and Gworek (2006) found pallid bat activity in the Sierra Nevada Mountains greatest where there was open mixed conifer forest near short grassland habitat. Roosts located were primarily in incense cedar trees (ibid.). Crevices in rock outcrops are the primary roost sites, although buildings, caves, tree hollows, and mines are also used (Hermanson and O'Shea 1983; Rambaldini 2005; Stephenson and Calcarone 1999; Miner and Stokes 2005; NatureServe 2011). Tree roosting has been documented in large conifer snags, inside basal hollows of redwoods and giant sequoias, and bole cavities in oaks.

As with the Townsend's big-eared bat, the largest emerging threat to all cave-roosting species is white-nose syndrome. Other habitat threats that are relevant to high elevation forests include the loss of large diameter snags and live trees for roosts due to fire (Miner and Stokes 2005). While this species typically roosts in rock outcrops, it often uses alternate day roosts, which large trees may provide. Retention of existing large trees and long term production of replacement large trees would provide potential habitat into the future. Mine closures may eliminate roosting sites and hibernacula for pallid bats, even though this species primarily roosts in rock outcrops (Rambaldini 2005; Ferguson and Azerrad 2004; Miner and

Stokes 2005; Pallid Bat Recovery Team 2008). Likewise bridge reconstruction may eliminate roost sites if done in a way that does not provide a design suitable to pallid bats (Ferguson and Azerrad 2004).

The range in California is statewide and it is predicted to occur on every National Forest in the Region (CWHR 2008). Occurrence records from the state (CNDDB 2011) and Forest Service records (NRIS 2011) do not indicate that this species has been observed within the LTBMU but potentially suitable habitat exists in the LTBMU.

Fringed myotis – Region 5 Forest Service Sensitive Species

The fringed myotis (*Myotis thysanodes*) is a bat species that was recently added to the Region 5 Forest Service Sensitive species list for the LTBMU. In general, this species is found in open habitats that have nearby dry forests and an open water source (Keinath 2004). In California, this species is found from approximately 4200 to 7200 feet in elevation in pinyon-juniper, valley foothill hardwood and hardwood-conifers (CWHR 2008). There is increased likelihood of occurrence of this species as snags greater than 11 inches (30 cm) in diameter increases and percent canopy cover decreases (Keinath 2004). Snag decay classes were two to four (Keinath 2004) in ponderosa pine, Douglas-fir, and sugar pine. Open water sources may include artificial sources, such as stock tanks and ponds, in addition to natural sources (Keinath 2004). The fringed myotis roosts in crevices found in rocks, cliffs, buildings, underground mines, bridges, and in large, decadent trees (Weller 2005). They day and night roost under bark and in tree hollows, and in northern California they day roost in snags only (Keinath 2004; Weller and Zabel 2001). Medium to large diameter snags are important day and night roosting sites (Weller and Zabel 2001).

As with Townsend’s big-eared bat and pallid bat, the largest emerging threat to all cave-roosting species is white-nose syndrome. Habitat alteration threatens this species because it dependent on older forest types. Keinath (2004) summarized this in the Region 2 conservation assessment for the fringed myotis, indicating that this species depends on abundant large diameter snags and trees with thick loose bark. Thus, harvesting old growth and removal of snags for safety or fuel reduction reasons may reduce available roost sites.

In California, it is distributed statewide except the Central Valley and the Colorado and Mojave Deserts (CWHR 2008). According to Forest Service records, the fringed myotis is found on the LTBMU.

Pacific Marten – Region 5 Forest Service Sensitive Species

The Pacific marten (*Martes caurina*) is a Region 5 Forest Service Sensitive species and a Management Indicator Species (MIS) for the late seral, closed canopy coniferous forest habitat component on the LTBMU. Additional information for the marten as an MIS is provided in the section entitled *Management Indicator Species*. This species was previously classified as American marten (*Martes americana)* but recent genetic and morphological evidence led to a re-classification as Pacific marten (*Martes caurina*) and of the subspecies *sierrae* (Dawson and Cook 2012).

In the Sierra Nevada, this species is known to inhabit high elevation (4,500-10,500 feet) late-successional, mature red fir and lodgepole pine forests with large, decadent live trees and snags, and complex physical structure near the ground comprised of an abundance of large dead and downed wood (Buskirk and Powell 1994 *in* Buskirk and Ruggiero 1994, Zielinksi 2013). In the LTBMU, marten have also been associated with mixed conifer and pine habitat. Martens can inhabit younger forests if important elements of the mature forest are still present, especially structures for resting and denning (Purcell et al. 2012, Zielinksi 2013). Riparian areas, especially near mature forest, are important for foraging (Zielinksi 2013). The abundant large trees and dead-wood structures associated with marten presence provide prey resources, resting structures, and escape cover (Zielinksi 2013). Rest structures typically include snags,

logs, and stumps; trees and snags used for resting are often the largest available (>35 inches in diameter) (Purcell et al. 2012). Rest structures vary with season such that above-ground cavities are used in summer and subnivean logs, snags, and stumps are used during the winter (Zielinski 2013). Den structures typically include arboreal cavities in live trees, snags (Gilbert et al. 1997, Raphael and Jones 1997, Bull and Heater 2000) and logs, rock crevices and red squirrel middens (Ruggiero et al. 1998). Resting and denning structures may be the most limiting resource for marten on the landscape since this species uses multiple structures within their ranges (Purcell et al. 2012).

The 1988 LTBMU Forest Plan (as amended) provides designation criteria, desired conditions, and standards and guidelines for the protection of marten den sites in the Sierra Nevada, including limited operating periods (LOPs), restrictions on vegetation treatments, and the requirement to mitigate impacts where a den site has been disturbed. Under the current direction, the LOP to protect den sites only applies to vegetation treatments; special use areas (i.e., recreation areas) are not required to implement an LOP to protect den sites.

Some of the threats facing martens include habitat loss and fragmentation, especially clear-cutting, fuel reduction treatments, and wildfire (Zielinksi 2013). Marten are very sensitive to habitat loss and fragmentation and rarely occupy landscapes after >30% of the mature forest has been harvested (Zielinksi 2013). Martens tend to avoid clear cut openings or will cross only small openings (e.g., < 500 feet). However, openings that have some structure retained (e.g., isolated trees, snags, logs), were more likely to be crossed by marten in the Rocky Mountains, even if the openings were relatively large (maximum distance = 600 feet), than if the opening had no structures and were small (summarized in Zielinksi 2013). Females tend to be more specialized than males in their habitat needs and tend to avoid managed areas of lesser habitat value and greater predation risk (summarized in Zielinski 2013).

The effect of thinning treatments (including fuel reduction treatments) on marten in the Sierra Nevada is currently being studied. The effects can be positive and negative for marten; positive if treatments set the trajectory toward historical conditions while retaining key habitat features (e.g., snags, large and complex trees, coarse woody debris), and if unsuitable stands are treated to accelerate the recruitment of mature forest characteristics and reduce the chance of catastrophic wildfire (Slauson and Zielinksi 2008). The effects can be negative if the treated habitat increases the risk of predation by reducing canopy cover significantly, removing resting and denning structures and escape cover (e.g., tree boles), and/or reducing the complexity of the understory (clear cutting from below). Treatments effects can also be negative if habitat patches require a lot of energy and risk to travel between (increased fragmentation), if treatment has adversely effected prey resources, and if den structures are reduced or altered in a way that reduces the survival of young (Slauson and Zielinski 2008).

According to Zielinksi (2013), there is a need to understand the tradeoff between treating stands to reduce fuel loadings and loss of the stand to catastrophic wildfire. Some simulation work for fisher suggests that the indirect and immediate negative effects of treatment are justified for the long term positive effects for the prevention of large wildfires in fisher habitat that could damage and fragment habitat over larger areas (Scheller et al. 2011). Purcell et al. (2012) suggests that research findings support the validity of recommendations made in North et al. (2009) to treat habitat for marten in areas where historically, fire would have burned less frequently, such as north-facing slopes, canyon bottoms, and riparian areas. Regardless, the type and timing of treatments as well as home range and landscape-level effects from treatments should be carefully evaluated to understand the short and long term outcomes.

In addition to vegetation management, marten are also sensitive to recreation activities, particularly snow activities (e.g., ski facilities). Much of the information presented on marten and ski resorts comes directly from Zielinski (2013) and Slauson (unpublished data). Ski resorts are considered likely to affect marten populations because they remove and fragment high-elevation fir forest habitat. The operation of ski resorts includes the continued compaction of snow, presence of high densities of skiers, and nocturnal

grooming activities. All these factors can have negative effects on marten both directly (females may avoid these areas) or indirectly (snow compaction and forest fragmentation facilitate high predation by coyotes) (Slauson et al. 2008). To create ski runs, ski resorts are considered likely to affect marten populations because they remove and fragment high-elevation fir forest habitat. To create ski runs, chair lifts, and associated facilities, trees are removed, creating open areas and fragmenting forest. Skiers and staff are active during the majority of the day, and grooming and some skiing activity occur during the night. Thus, martens that are sensitive to these activities may not find time for important foraging activities. Ski resort effects are not limited to winter, as habitat fragmentation is a year-round effect and many resorts are developing summer recreational activities (e.g., hiking, mountain biking).

There are approximately 25 ski resorts in the Sierra Nevada, and nearly all occur within the range of the marten (Zielinski 2013). The Lake Tahoe region includes approximately half of these resorts (not all found on the LTBMU), constituting the highest density of resorts in the Sierra Nevada and one of the highest in North America (Zielinski 2013). Kucera (2004) conducted the only intensive study of martens in a ski area in California. He captured 12 individuals at the Mammoth Mountain ski area, 10 of which were males, 1 was female, and 1 was of unknown sex, resulting in a highly skewed sex ratio similar to what Slauson is finding at ski resorts in the LTBMU. The single female raised two kits, but did not use developed areas and only used natural rest sites. Martens appeared to move away from the ski area and into unmanaged forest after winter. Kucera (2004) suggested that this fits a seasonal use pattern where martens occupy ski areas during winter when natural prey is least available and human-supplied food is most plentiful, then they move into unmanaged forests in spring. This migration would allow them to exploit artificial food sources during winter, but return to places where females maintain home ranges to breed in summer. Realizing that this study required confirmation and a larger sample, Slauson and Zielinski (unpublished data) began a 4-year study in 2008 to evaluate the effects of ski area development and use on home range and demography of marten populations. Preliminary data are described below, a published report is forthcoming.

Although martens do occupy portions of many ski areas in the LTBMU, female martens appear to exhibit a higher sensitivity to forest fragmentation from ski-run creation than males, avoiding areas highly fragmented by ski runs (Slauson and Zielinksi unpublished data). These results are similar to those for clear cuts in that males may show some plasticity in their use of managed habitat but females are more selective. For example, although Slauson et al. (in prep) have detected martens using approximately 70% of the Heavenly ski area during the spring, females use less than 33% for reproductive habitat. Furthermore, while males occupy more highly fragmented portions of ski areas than females, male survivorship appears to be lower in sites with higher fragmentation (Slauson and Zielinksi unpublished data). Martens give birth to their young in late March and early April, typically coinciding with the end of the ski operations period in most years. As the snowpack breaks up martens shift their activity to be more active during the daytime to focus their foraging activities on diurnally active species, such as chipmunks and golden-mantled ground-squirrels (Slauson and Zielinksi unpublished data). Therefore, there is a greater potential for human-marten interactions during the late spring and early summer when both humans and martens are active during the daytime (Slauson and Zielinksi unpublished data) and this potential for interaction may increase with new national policy allowing ski facilities to host more summer activities.

Other snow activities may affect marten but data from the LTBMU indicate that OHV/OSV use did not affect marten occupancy or probability of detection and that overall OHV/OSV use in the study areas was low (1 OHV/OSV pass every 2 hours) and exposure occurred in <20% of a typical home range (Zielinski et al. 2008).

Within the LTBMU, marten appear to be well distributed in the western and southern portions but are comparatively rare in the northern and eastern portions (Slauson et al. 2008). Slauson et al. (2008) analyzed data from several marten surveys that were conducted in the LTBMU between 1993 and 2005

and found that marten were detected at 36% of all sample units that were surveyed, occupying areas supporting mesic conifer forest typically dominated by red fir, white fir, western white pine, and lodgepole pine (Slauson et al. 2008). The majority of detections were made in the western (50% of sites) and southern (31% of sites) regions of the LTBMU. Detections in the northern and eastern portions of the basin were scarce despite 30% of the total survey effort occurring in these two areas, and the authors suggested that these areas may have supported less suitable habitat conditions (e.g., open canopy) due to drier conditions and also likely influenced by the development that has altered the composition and connectivity of suitable habitat along the transition from mesic to xeric forest types from west to east in the Lake Tahoe Basin (Slauson et al. 2008). Due to the contemporary development patterns on the southern end of the Lake Tahoe Basin combined with natural factors, the southern distribution of martens in the Basin is most likely a peninsular distribution, extending from the southwest (Luther Pass area) where martens are likely able to move in and out the southern portion of the Basin. This peninsular distribution in the south portion of the LTB has no potential for input of martens from the north, south, or east due to the lack of suitable habitat combined with the substantial level of development that has occurred. Peninsular distributions of martens are more reliant on the existing conditions within their distribution to support their persistence than portions of the distribution better connected, such as the west shore population.

Slauson et al. (2008) stressed the importance of the west shore as the only known linkage for populations north and south of the Basin. Recent modeling suggests that the west shore of Lake Tahoe is part of an important corridor linking northern and southern populations. Consistent with Slauson et al. (2008), there is a gap in marten occupancy and habitat just west of the Basin but suitability increases again just west of this gap, creating another parallel habitat corridor (Spencer & Rustigian-Romsos 2012) that may not have been identified in Slauson et al. (2008).

Two marten dens have been positively identified in the Lake Tahoe basin with a third possible, although there are likely greater than 30 breeding females in the LTBMU in any given year, each using many dens for kit rearing (Slauson, pers. comm. 2011). All known/possible dens were discovered opportunistically in 2009 and 2012 and are predominantly on the west and southern portion of the basin. One den that was positively identified in 2012 is located at an elevation of approximately 6650 feet and within the CWHR Jeffrey Pine type, class 5M. The den identified in 2009 is located at an elevation of approximately 6560 feet and within the CWHR Sierra Mixed Conifer type, class 4M. Moriarty et al. (Table 1, 2011) indicates that various 4M habitat types (lodgepole pine, montane riparian, red fir, subalpine conifer, and white fir) are considered “high quality habitat” for marten. CWHR also classifies some 4M habitat as high quality denning habitat for marten.

Preliminary data from a study of marten in the Lake Tahoe Basin suggest that areas used by females for reproduction were stable and did not change annually which suggests that reproductive habitat is a limiting factor for marten populations (Slauson and Zielinksi unpublished data). Thus the maintenance of existing suitable reproductive habitat is one of the most critical factors for maintaining marten populations and distributions.

Historically, martens were understood to be well distributed throughout the Cascades and northern Sierra Nevada but recent surveys suggest that the populations are now fragmented, distribution is reduced, and suitable habitat has also been reduced and isolated in parts of the range (Zielinksi et al. 2005, Kirk and Zielinksi 2009, Spencer & Rustigian-Romsos 2012). In a study of marten in northeastern California, north of the LTBMU, Kirk and Zielinksi (2009) reported that marten populations detected are associated with areas that contain the largest amount of reproductive habitat consisting of mature, old forest. The highest density of detections was located in the largest protected area in the study region. Moriarty et al. (2011) reported approximately 60% fewer detections of marten at Sagehen Experimental Forest (SEF) on the Tahoe National Forest than those in the 1980s. These results, although on a smaller spatial scale, are similar to those reported by Kirk and Zielinksi (2009). Although the cause of the decreased detections is

unclear, Moriarty et al. (2011) hypothesized that this was associated with loss and fragmentation of habitat; during the same period 39% of forested areas at SEF experienced some form of timber harvest (11% clear-cut or shelterwood and 28% salvage). Habitat and occupancy models developed by Spencer and Rustigian-Romsos indicate that habitat connectivity for marten is fragmented north of the Plumas National Forest where martens appear to be restricted to isolated or semi-isolated high elevation areas (consistent with Kirk and Zielinksi (2009)) whereas south of the Plumas, habitat connectivity does not appear to be greatly limiting for martens although the authors suggest that Interstate 80 may be a significant barrier to movement. An emerging issue across marten populations in California is a highly skewed sex ratio, near 2:1 males to females (Slauson pers. comm. 2013). Reproductive habitat appears to be much more limited throughout the range. Therefore, there is a greater need for maintaining existing reproductive habitat and restoring it where it has been lost (Slauson pers. comm. 2013).

Marten occupancy and geographic range is predicted to be influenced by climate change such that the species will be highly sensitive to climate change, and would probably experience the largest climate impacts at the southernmost latitudes (i.e., in the southern Sierra Nevada) (Lawler et al. 2011).

TRPA Special Interest Species

The TRPA has designated Special Interest Species that are locally important because they are public interest species or are rare, sensitive, threatened, or endangered species designated under state or federal species protection acts. The northern goshawk and bald eagle are considered Special Interest Species and have been described in the previous section entitled Forest Service Sensitive Species; all other Special Interest Species are described below.

Waterfowl – TRPA Special Interest Species

Waterfowl Special Interest Species include species of ducks, geese, shorebirds, loons, grebes, mergansers, rails, gulls, terns, and herons. For these species groups, undisturbed marsh and riparian vegetation is critical habitat for nesting and feeding (TRPA 2004a). Successful nesting, breeding, and feeding in these species is challenged by human presence in suitable habitats that can cause disturbance of individuals and result in displacement, nest abandonment, increased energy expenditure, reduced energy intake (i.e., lower feeding rates), among other consequences (Belanger and Bedard 1990 and Rogers and Smith 1997 as cited in TRPA 2004a).

TRPA Code of Ordinances includes a measure that calls for the protection of wetlands for nesting and resting sites for waterfowl as well as waterfowl management areas in the Lake Tahoe Basin. The current LRMP (as amended) includes provisions to manage suitable wetlands for low levels of human disturbance between March 1 and June 30 for waterfowl (except Pope Beach recreation site which may be opened beginning Memorial Day weekend); harassment by dogs must be controlled.

Golden Eagle – TRPA Special Interest Species

Golden eagle (*Aquila chrysaetos)* is associated with early successional forests and shrub communities for foraging and cliffs and large trees for nesting. Threats to this species include disturbance by human as a result of recreation activities, particularly rock climbing, as well as loss of habitat.

The TRPA Code of Ordinances includes a zone within a 0.25 mile radius of golden eagle nest sites that is to be protected from habitat manipulation while occupied by golden eagles.

Golden eagle surveys have been conducted during the past several years in the LTBMU. The species was detected in 2009 at Angora Peak. Golden eagle was not positively identified during 2010 or 2011 surveys but incidental detections of golden eagles were made by LTBMU staff in 2011 at Meiss Meadow and Desolation Wilderness. No information on golden eagles is known from 2012.

Osprey – TRPA Special Interest Species

Osprey (*Pandion haliaetus*) is migratory and arrives in the Tahoe Region from South and Central American wintering grounds in March and April when the snow begins to melt and fish return to shallower waters. Osprey is associated with open forests with large snags for nest sites that are typically located near open water. Nest sites include large coniferous and deciduous trees, cliffs, and poletops located near or over water. Primary threats to osprey in the LTBMU include disturbance from recreation activities (e.g., boating, camping, etc.) and loss or degradation of habitat due to conflicts with recreation needs.

The TRPA Code of Ordinances includes a zone within a 0.25 mile radius of osprey nest sites that is to be protected from habitat manipulation while occupied by osprey.

Detections of active osprey nests in the LTBMU have fluctuated since 1997. The number of active nests detected decreased between 2003 and 2005, and 2007 and 2008 but there has been an overall increase in the number of active nests detected since 1997 with approximately 11 active nests detected in 1997 and 27 in 2011. Since 2008, the number of active nests detected has been steadily increasing with 22, 24, 26, and 27 active nests detected in 2008, 2009, 2010, and 2011, respectively. Information for osprey in 2012 is not yet available to the USFS.

Peregrine Falcon – TRPA Special Interest Species

The peregrine falcon (*Falco peregrinus*) is associated with rivers, wetlands, lakes, or other aquatic features for breeding and cliffs, banks, dunes, mounds, and human-made structures for nesting. Nests are usually situated on open ledges or potholes and a preference for southern facing slopes increases with latitude (USFWS 1984). Peregrine falcons are threatened by human disturbance from recreation activities, including rock climbing.

The TRPA Code of Ordinances includes a zone within a 0.25 mile radius of peregrine nest sites that is to be protected from habitat manipulation while occupied by the falcons. The current LRMP (as amended) includes a standard that prohibits rock climbing on nesting cliffs between April 1 and July 31.

Three birds were introduced to the Lake Tahoe Basin in each of 1985, 1986, and 1987. From 1987 to 2007 there had been no official record of peregrine falcon in the basin other than a handful of incidental detections. In 2007 there were three reported incidental detections. Surveys for peregrine falcons began in 2008 and a pair was detected but successful nesting was not confirmed. From 2009 through 2012, successful nesting has been confirmed in the Lake Tahoe Basin. As of 2012, two locations in the LTBMU had confirmed successful peregrine falcon nests.

Mule deer – TRPA Special Interest Species

Mule deer are associated with riparian areas, meadows, and early to mid-successional habitats. Threats to mule deer include habitat fragmentation and loss.

The TRPA Code of Ordinances includes measures to protect mule deer fawning habitat as well as migration and movement corridors.

Results from the Multi-species Inventory Monitoring (MSIM) in the LTBMU indicate that the mule deer may have declined slightly since early/mid 1900s, as it was described as a common resident historically, whereas now it appears to be less common but still present. During MSIM surveys in 2007, the mule deer was found to be broadly distributed across the Lake Tahoe Basin having been identified at 13 (22%) of sampled sites.

Migratory Birds

Migratory birds have become a focus of conservation concern due to evidence of declining population trends for many species. Under the National Forest Management Act (NFMA), the Forest Service is directed to "provide for diversity of plant and animal communities based on the suitability and capability of the specific land area in order to meet overall multiple-use objectives" (P.L. 94-588, Sec 6 (g) (3) (B)). The January 2000 USDA Forest Service (FS) Landbird Conservation Strategic Plan, followed by Executive Order 13186 in 2001, in addition to the Partners in Flight (PIF) specific habitat Conservation Plans for birds and the January 2004 PIF North American Landbird Conservation Plan, references goals and objectives for integrating bird conservation into forest management and planning.

In late 2008, a *Memorandum of Understanding between the USDA Forest Service and the USDI Fish and Wildlife Service to Promote the Conservation of Migratory Birds* was signed. The intent of the MOU is to strengthen migratory bird conservation through enhanced collaboration and cooperation between the Forest Service and the Fish and Wildlife Service as well as other federal, state, tribal and local governments. Within the National Forests, conservation of migratory birds focuses on providing a diversity of habitat conditions at multiple spatial scales and ensuring that bird conservation is addressed when planning for land management activities.

To facilitate a regional approach to bird conservation, regional geographic units called bird conservation regions (BCRs) were developed under the North America Bird Conservation Initiative (http://www.nabci-us.org/bcrs.html). BCRs encompass landscapes with similar bird communities, habitats, and resource issues. In *Birds of Conservation Concern 2008*, the U.S. Fish and Wildlife Service (FWS) (2008) identified the species in each BCR in greatest need of conservation action and proactive management to prevent the need for listing them as endangered or threatened. These species are termed Birds of Conservation Concern (BCC), and a list is given for each BCR. A BCC may be present in a BCR but not included in that BCR's list because its population numbers are not a concern in that region.

In addition, Audubon California (2009) has designated 145 important bird areas in the state. See http://www.ca.audubon.org/iba for additional information about these areas.

3.4.23.3. Environmental Consequences

This section describes the potential direct and indirect environmental consequences of the activities proposed by each program area under the four Forest Plan alternatives on terrestrial wildlife habitat condition and terrestrial wildlife species productivity. Cumulative effects are described in Section 3.5 of this chapter. MIS are described separately in Section 3.4.14 of this chapter.

Watershed and Aquatic Habitat Restoration

It is anticipated that restoration of aquatic habitat and watershed condition under all alternatives would have long-term benefits to terrestrial wildlife habitat and special-status terrestrial wildlife species in the LTBMU. This expectation is based on the assumption that restoration projects under all alternatives would not only improve physical habitat elements such as vegetation diversity and structural complexity but also achieve restoration of natural processes that help ecosystem functions and maintain wildlife habitat over the long-term. In other words, planting riparian vegetation alone may not achieve restoration of wildlife habitat over the long-term but planting vegetation that facilitates recruitment, and fulfills major functions of riparian habitats such as physical filtering of water, stabilization of banks and floodplains, water storage, can benefit wildlife species (George and Zack 2001).

The most pronounced positive trend in habitat condition and species productivity is expected to occur under alternatives B, C, and E. These alternatives function similarly to A, which is also expected to show a positive trend, but Alternatives B, C, and E provide clear, written strategies and objectives that are

lacking in Alternative A. The most pronounced positive trend in habitat condition is expected to be experienced in wet meadow, aspen, montane riparian, and marsh and lake shore habitat types because these habitat types are specifically targeted during restoration of watershed condition and aquatic habitat. The most pronounced positive trend in productivity is expected to be experienced by willow flycatcher, bald eagle, northern goshawk, Townsend's big-eared bat, peregrine falcon, osprey, waterfowl, and mule deer because these species are either reliant on the aforementioned habitat types (i.e., willow flycatcher with meadows; bald eagle with marsh and lakeshore habitat; waterfowl with marsh, wetland, and riparian habitats) or associated to some degree with these habitat types (i.e., northern goshawk with aspen; Townsend's big-eared bat and meadows, marsh, and montane riparian; peregrine falcon with rivers, wetlands, and lakes; osprey with lakeshore and marsh habitat; mule deer with riparian corridors and meadows). Those species that are reliant on riparian habitat for nesting, cover, and/or foraging are expected to have the most pronounced positive trend. A long-term demographic study in the Lake Tahoe Basin indicates that the population trend of willow flycatchers has been declining (Mathewson et al. 2007, 2011, 2012). Although Mathewson et al. (2012) are not confident that the trend can be reversed the authors suggest that restoration efforts that improve meadow conditions (i.e., water table, shrub cover, etc.) in both occupied and nearby (dispersal) meadows may improve the condition of breeding habitat for the benefit of the species.

Because migratory birds are so ubiquitous and diverse, maintenance and restoration of many types of habitats, including aquatic habitat under this program area, is relevant to migratory birds. As a result, provisions for these species are integrated into numerous desired conditions, objectives, and standards and guidelines that would target restoration of habitat under Alternatives B, C, and E. Such considerations are already in place under Alternative A. Alternative D includes protection measures but does not include restoration following the completion of currently planned projects.

In the absence of restoration under Alternative D, following the completion of currently planned projects, it can be expected that the condition of various habitat types normally targeted by watershed and aquatic restoration (i.e., wet meadow, montane riparian, aspen, marsh and Lake shore) would remain stable with the potential to diminish, and the productivity of associated special status species would also remain stable but with the potential to decline. Many of the aforementioned habitat types in the Lake Tahoe Basin are being overcrowded and encroached upon by conifers and degraded by urbanization and recreation, essentially changing the structure, function, and value of these habitat types for wildlife (Manley et al. 2010). For example, without restoration and in the absence of disturbance such as fire, it is likely that conifers will continue to encroach and shade out aspen trees in the understory (Shepperd et al. 2006); the result would include a loss of aspen as well as negative impacts on herbaceous cover and stand moisture that are essential habitat components for many mammal and bird species (Manley et al. 2010). Studies in the Lake Tahoe Basin have demonstrated that healthy herbaceous communities and limited conifer intrusion in aspen may be optimal habitat conditions for aspen-associated breeding birds (Richardson 2007, Richardson and Heath 2004).

Habitat degradation under Alternative D from lack of restoration could be the most pronounced for wet meadow, marsh and lake shore habitat, montane riparian, and aspen habitat types as well as for willow flycatcher, bald eagle, and northern goshawk. Effects may be the most pronounced for willow flycatcher, a species that is dependent upon wet meadows where riparian shrub cover, water table, and soil saturation in meadows is sufficient and bald eagle, a species that relies on marsh and lakeshore habitat for foraging and nesting opportunities. Without restoration of meadows and associated water sources that maintain meadow wetness, willow flycatchers could be at an increased risk of predation and could experience a loss in insect prey based on the results of willow flycatcher demographic studies in the LTBMU. Townsend's big-eared bats forage in a variety of habitats but it can be expected that a decline in productivity could occur in those habitats where water tables are diminished and the habitat no longer supports sufficient insect prey.

Although it is possible that habitat condition could decline without restoration, Alternative D proposes to use fire as a primary tool for vegetation management and the use of fire, when combined with aquatic restoration efforts, could benefit habitats such as aspen and historically wet meadows.

In terms of climate change, the restoration strategies associated with Alternatives A, B, and C all provide opportunities to maintain or improve biodiversity of the landscape and also improve resilience of watershed systems and their associated habitats to better enable these habitats and their communities to adapt to changing climate conditions. Alternatives B and C go one step further than Alternative A and recognize the importance of improving aquatic habitat components for associated species in addition to reducing stream sedimentation. Alternative E not only recognizes the importance of improving aquatic habitat for sensitive species but also includes clear desired conditions, strategies, objectives, and standards and guidelines that address climate change. Without the opportunity to actively restore or maintain habitats under Alternative D, vulnerable habitats may be more at risk for degradation or loss as conditions change.

Biological Resource Protection

The condition of terrestrial wildlife habitat is expected to be maintained under all alternatives under the Biological Resource Protection Program Area and with a potential for improvement in condition under Alternatives B, C, and E because these alternatives include desired conditions, strategies, objectives, and standards and guidelines that: (1) reflect the contemporary needs of special-status species and associated habitat in the LTBMU, (2) incorporate restoration objectives to meet desired conditions, and (3) emphasize important habitat features and movement corridors that could support community assemblages. Although the species- and location-specific approach emphasized by Alternative A (and also adopted under Alternative D) has value for the protection of den and nest sites, wet meadows for willow flycatchers, cliffs for peregrine falcons, PAC habitat for spotted owls and goshawks, and late seral closed canopy forest (Old Forest Emphasis Areas) for associated species, this more narrow species-specific approach may be unable to maintain or enhance habitat elements important to many special-status species and their associated species assemblages across the landscape. Alternatives B, C, and E have been developed in such a way that they focus on the retention and creation of important habitat elements (e.g., snag retention, cliff and cave accessibility, meadow restoration, habitat connectivity) rather than specific habitat requirements of individual species with the exception of spotted owls and northern goshawk that continue to have protected habitats in the form of PACs under all alternatives. An added benefit of this approach is that the habitat features identified may also support other species that use these features, inhabit this habitat type, and/or are part of the species assemblage that supports these special-status species. However, Alternative A (and D) includes more stringent standards for the retention of PAC canopy cover and retention of trees greater than 30 inches in diameter. The goal of Alternative A is to create more late seral closed canopy habitat and the goal of Alternative D is to grow more big trees. In this way, the trends in species productivity under Alternative A may be better than those under Alternatives B, C and E for species associated with late seral closed canopy forest (e.g., marten, spotted owl, northern goshawk). However, Alternative E (more than Alternatives B and C) clearly prioritizes the protection of late seral closed canopy habitat where it occurs (rather than in pre-designated areas) through standards and guidelines and allows for the ability to improve PAC habitat for the benefit of spotted owls and goshawks where the condition has deteriorated. Alternative E also includes a standard that treatments shall not reduce canopy cover in dominant and co-dominant trees by more than 10% across a stand. Alternative E (and B and C to some extent) also provides the greatest flexibility to reduce the risk of large scale catastrophic wildfire that could essentially reduce vast amounts of suitable nesting and denning habitat for species associated with mature forest. Alternative E also emphasizes the value of burned forest habitat to associated species and addresses the importance of being able to adapt to a changing climate. The measures to protect habitat components (e.g., movement corridors, cliff habitat) and restoration objectives can assist the habitats and wildlife communities of the LTBMU in being better able to adapt to the stresses of changing climate conditions. Alternative E contains specific objectives related

to wildlife habitat under changing climate conditions. Wildlife would benefit from the emphasis on natural processes that is characteristic of Alternative D, especially the reintroduction of fire. However, logistical constraints for the use of fire under this (and all) alternative, and lack of proposed restoration following completed projects could fall short of enabling terrestrial wildlife species and associated habitat components to be better adapted to climate change.

The potential for the most pronounced positive trend in species productivity under the Biological Resources Protection Program Area is expected to occur under Alternatives B, C, and E, but particularly Alternative E, for western bumble bee, willow flycatcher, Townsend's big-eared bat, pallid bat, fringed myotis, peregrine falcon, waterfowl, osprey, golden eagle, mule deer, and migratory birds. Alternatives B, C, and E emphasize the restoration of a minimum of three willow flycatcher historic and occupied habitat sites. Western bumble bee may benefit from meadow restoration that improves flowering vegetation (through improved hydrologic function) but may also be limited by hive locations where meadow wetness increases and small mammal burrows decrease. Restoration of meadow systems as well as riparian habitats as proposed under these alternatives is also expected to benefit mule deer that forage in meadows and aspen, and species like Townsend's big-eared bats that forage over water features. These alternatives officially recognize the importance of cave and cave-surrogate habitat in the LTBMU for Townsend's big-eared bat and include measures to protect this habitat and protect the species through implementation of a Limited Operating Period (LOP). Peregrine falcon and golden eagle are expected to benefit from the more all-encompassing protection measures provided to cliff habitat under these alternatives. Bald eagles, waterfowl, and osprey are expected to benefit from the restoration efforts proposed for aquatic habitat under Alternatives B, C, and E. Bald eagle and osprey are also expected to benefit from the measures to protect and retain large and complex snags.

Measures to protect migratory bird habitat were considered when developing the desired conditions, strategies, objectives, and standards and guidelines for the Biological Resources Protection Program Area under Alternatives B, C, D, and E. All Alternatives contain measures to maintain and protect habitat for migratory bird species.

Alternative A provides standards and guidelines for the protection of PACs and marten den sites and may provide the most effective approach to protect these species where they are known to occur in the LTBMU except in recreation areas where LOPs do not apply (unless vegetation treatments are occurring). Alternatives B and C are relatively silent when it comes to protection of marten den sites. Like Alternative A, Alternative E provides measures to protect marten den sites as well as PACs and complex structural stand features (i.e., down woody debris, snags, etc.) and connectivity of habitat. Both Alternative A and E allow vegetation treatments in PACs but Alternative E also allows treatments in PACs for the restoration of habitat to improve or maintain condition for the species. Alternative E has the same standards for the protection of marten den sites as Alternative A.

PACs continued to be protected under all Alternatives. Restoration of PAC habitat under Alternatives B, C, and E, although intended to benefit the long term condition of habitat for the species, could temporarily affect habitat for spotted owls and goshawks. The potential for impacts would depend on the location and scope of the specific restoration project. Although potential impacts are described here, the intent of restoration is to improve habitat for the specific benefit of the spotted owl and goshawk and therefore, impacts, if they were to occur, would be temporary. Generally, temporary impacts could include the alteration of key habitat elements (e.g., canopy cover, large trees, snags, coarse woody debris, etc.), alteration of foraging habitat and/or prey base, reduced reproductive success, and/or reduced survival of adults. Reduction in canopy cover and/or removal of large trees (or snags) to allow for growth of larger trees (competitive release) could negatively affect nesting attempts or nest success if thermal protection is modified and/or predation increases. Adult survival (as well as reproductive success) could be challenged by restoration actions if habitat suitability for prey is altered (e.g., removal of coarse woody debris, removal of shrub layer) and adult owls or goshawks now need to expend more energy and expose

themselves to increased predation risk to locate and catch prey. Alternative E provides clearer guidance than Alternatives B and C for the retention of canopy cover and basal area for a PAC and for the General Forest. Alternative E also states that 70% canopy cover is the desired condition for PACs whereas Alternatives B and C use 50% cover as a desired condition. Alternative E also states that treatments shall not reduce canopy cover in dominant and co-dominant trees by more than 10% across a stand.

Many of these potential impacts are not expected to occur because PAC restoration projects would be driven solely by the purpose and need to maintain and/or restore suitable habitat for spotted owls and goshawks. Resource protection measures would be in place for any PAC restoration project (e.g., snag retention, canopy cover, etc.) in order to retain suitable habitat, including important structures. If impacts were to occur on a project-specific basis, it is not expected that any of these potential impacts would be lasting because of the aforementioned reasons. Therefore, potential impacts from PAC restoration, if they were to occur, are assumed to be temporary.

The long term benefit that can be realized by conducting focused restoration activities to maintain and/or improve habitat condition for spotted owls and goshawks in PACs, as opposed to doing nothing, may outweigh the short term impacts that could occur. Under the current direction (and Alternative D), treatments allowed in PACs are intended to reduce fuels and are permitted where PACs overlap the WUI. Many PACs overlap the WUI in the LTBMU. Fuel reduction treatments are an ongoing activity under all alternatives and would be designed to be consistent with achieving PAC desired condition. Still, many forested stands in the Sierra Nevada (and the LTBMU) that are outside WUI, are becoming increasingly stocked with trees, particularly smaller, shade tolerant trees. Many stands also contain unusually high levels of slash and large downed wood. These dense, thicket-like conditions of trees can compromise the suitability of spotted owl nesting, roosting, and foraging habitat and make it more susceptible to catastrophic wildfire. Goshawks also are adapted to foraging in more open forested conditions and nesting in stands that allow a clear flight path in to the nest from below, conditions that are not similar to forested stands with thickets of smaller trees. Without some type of focus-driven restoration for the benefit of the stand condition for these species, PAC habitat could deteriorate over time and become more susceptible to widespread negative effects from insects, drought, disease, and catastrophic stand replacing fire.

Although fire is a historic part of the processes affecting habitat in the Sierra Nevada and insect outbreaks are also part of the ecological processes that influence forests within this region, the forested stands within the LTBMU are outside of their natural range of variability and more susceptible to high severity crown fires and massive, widespread die offs from insect outbreaks. Stand replacing fires and insect outbreaks that completely remove nest and roost trees, and that are on a large geographic scale (especially compared to the relatively small size of the LTBMU) are not likely to benefit these species. Therefore, the long term benefit of these focused restoration efforts are believed to outweigh the potential for short term effects. Alternative E proposes to restore the same number of PACs as Alternatives B and C but this alternative, more than the other alternatives, provides the clearest guidance for suitable PAC conditions. Ultimately, restoration of PACs would proceed under an adaptive management framework in which response to restoration would provide insight to the design of potential future treatments.

Forest Vegetation Management and Fire

For the most part, forest vegetation, fuels, and fire management approaches would be conducted in conjunction with wildlife habitat desired conditions. However, each alternative includes varying degrees of flexibility in the type of technique that can be used (e.g., hand thin, mechanical thin, prescribed fire), size of trees that can be removed, the extent to which the canopy can be opened, size of early seral openings that can be created, the amount of post-fire habitat that can be treated, and the extent of wildland fire management. These approaches could conflict with sensitive terrestrial wildlife species and alter wildlife habitat; the potential for impacts and magnitude of potential impacts depends on the proposed

management actions that would be evaluated during project development and as part of the interdisciplinary team process under NEPA. Protection measures are in place for biological resources under all alternatives and additional protection measures could be created during project development.

All alternatives allow for the creation of early seral openings. Alternative D would emphasize hand thinning and prescribed fire to accomplish this desired condition; these techniques would be most compatible with wildlife habitat and wildlife species. However, implementation would be challenged by limited size of trees that can be removed and the need for conditions conducive to safe prescribed burning or wildland fire management. Alternatives B, C, and E have the greatest flexibility to create the most and the largest openings (up to 10 acres). Alternative C can create the most acres of openings each year. Early seral openings can have both beneficial and harmful effects on wildlife, depending on the location of the opening, sensitive resources present, and structure of the opening following treatment. Early seral openings can increase heterogeneity on the landscape and may favor the colonization of early seral-associated small prey species. Conversely, openings can disrupt movement where they are created in otherwise continuous forested habitat. Openings can also increase predation risk where individuals are forced to cross these areas. Openings are characterized by edge habitat that can be usurped by non-native species such as brown headed cowbirds and barred owls. Spotted owls and martens are the species with the greatest potential for adverse impacts from early seral openings. The creation of large gaps or large areas of low-quality habitat may affect dispersal of young and adult owls and successful colonization of unoccupied territories (Keane 2013). Openings can adversely affect marten movement and predation risk, and martens tend to avoid openings, especially under snow conditions when openings can make individuals susceptible to predation (see species account above). However, marten may cross openings that have some retention of structure such as trees or coarse woody debris. Alternative E clarifies that early seral openings would retain trees (including clumps of trees); early seral openings would not be synonymous with clear cuts. Alternative E clarifies that early seral openings would not be created in late seral habitat, but could be created in mid seral habitat, including mid seral closed canopy habitat; this latter habitat type is used by marten and spotted owl in the LTBMU and these species could be adversely affected by the opening and the fragmentation of mid seral closed canopy habitat. Alternative E includes clearer guidance than Alternatives B and C on the process for selecting locations of openings and design of openings with the least potential for conflict with other resources, including sensitive terrestrial wildlife species.

Predicted trends in early, mid (closed and open canopy), and late (closed and open canopy) seral stages are summarized in Section 3.4.11 (Forest Vegetation). These trends are based on modeled outputs using the SPECTRUM model with limited constraints for wildlife habitat beyond those for PACs and HRCAs. The model used prescriptions, operational constraints, and disturbance (e.g., fire, bark beetle) to assess the relative ability of the various alternatives to achieve the vegetation desired conditions, not to create, protect (except for PACs and HRCAs), or evaluate wildlife habitat. The model output indicates that late seral closed canopy habitat for all forest types combined increases under Alternatives A and D over a fifty year period following Plan implementation (see Table 3-42). Conversely, late seral closed canopy habitat is predicted by the model to experience no change under Alternatives B and E and a slight decrease under Alternative C (see Table 3-42). Based on model output, it would appear that Alternatives A and D are predicted to provide more late seral closed canopy habitat than the other alternatives for species such as California spotted owl, Pacific marten, Northern goshawk, wolverine, and great gray owl. However, late seral closed canopy habitat is comprised of CWHR classes 5M, 5D, and 6 and the model predicts that 5D increases substantially and 6 decreases substantially across all alternatives (Table 3-79). Therefore, it would appear that the real driver of differences between the alternatives in terms of late seral closed canopy habitat is the trend in 5M which generally shows more positive (substantially increasing) trends under Alternatives A and D and more static to moderately increasing trends under Alternatives B, C and E except for red fir which is predicted to show no change under Alternative A, slight decrease under Alternatives B and E, and moderate decrease under Alternatives C and E. Spectrum model CWHR class

outputs are shown below to more comprehensively illustrate predicted changes to habitat not readily seen with the more lumped seral stages presented in the Forest Vegetation (3.4.11) section.

Table 3 79. SPECTRUM model predicted changes in late seral closed canopy CWHR classes 5M, 5D, and 6 for the five Alternatives.

Percent changes are categorized as: No change (0-10 percent change); or Increase or Decrease that is either Slight (11-20 percent change), Moderate (21-50 percent change), or Substantial (>50 percent change).

Seral Stage	Alt. A	Alt. B	Alt. C	Alt. D	Alt. E
All Forest Types					
5M	Moderate Increase	No change	No change	Moderate Increase	No change
5D	Substantial Increase	Substantial Increase	Substantial Increase	Substantial Increase	Substantial Increase
6	Substantial decrease	Substantial decrease	Substantial decrease	Substantial decrease	Substantial decrease
White fir/mixed conifer					
5M	Substantial increase	No change	No change	Moderate increase	No change
5D	Substantial increase	Substantial Increase	Substantial Increase	Substantial Increase	Substantial Increase
6	Substantial Decrease	Substantial Decrease	Substantial decrease	Substantial decrease	Substantial Decrease
Jeffrey Pine					
5M	Substantial increase	Moderate increase	Moderate increase	Substantial increase	Moderate increase
5D	Substantial increase	Substantial increase	Substantial increase	Substantial increase	Substantial increase
6	Substantial decrease	Substantial decrease	Substantial decrease	Substantial decrease	Substantial decrease
Red fir					
5M	No change	Slight decrease	Moderate decrease	Moderate decrease	Slight decrease
5D	Substantial increase	Substantial increase	Substantial increase	Substantial increase	Substantial increase
6	Substantial decrease	Substantial decrease	Substantial decrease	Substantial decrease	Substantial decrease

According to the model output, mid seral closed canopy habitat decreases under all five alternatives. Under all alternatives this pattern is driven primarily by a decrease in 4M and 4D CWHR classes (Table 3-80). However, 4D in red fir forests increases under all alternatives. Overall, 3M tends to increase and 3D increases or stays the same. Marten and goshawk are associated with 4M and 4D habitats for denning, nesting, foraging, resting, and roosting. The 4M and 4D CWHR classes are also associated with moderate capability habitat for the spotted owl.

Table 3 80. SPECTRUM model predicted changes in mid seral closed canopy CWHR classes 3M, 3D, 4M, and 4D for the five Alternatives.

Percent changes are categorized as: No change (0-10 percent change); or Increase or Decrease that is either Slight (11-20 percent change), Moderate (21-50 percent change), or Substantial (>50 percent change).

Seral Stage	Alt. A	Alt. B	Alt. C	Alt. D	Alt. E
All Forest Types					
3M	No change	Substantial Increase	Substantial increase	Moderate increase	Substantial Increase
3D	Substantial Increase	Substantial Increase	Substantial Increase	Substantial Increase	Substantial Increase
4M	Moderate decrease	Substantial decrease	Substantial decrease	Moderate decrease	Substantial decrease
4D	Moderate decrease	Moderate decrease	Moderate decrease	Moderate decrease	Moderate decrease
White fir/mixed conifer					
3M	Substantial decrease	Substantial increase	Substantial increase	Substantial decrease	Substantial increase
3D	Substantial Increase	Substantial increase	Substantial increase	Substantial increase	Substantial increase
4M	Moderate decrease	Substantial decrease	Substantial decrease	Moderate decrease	Substantial decrease
4D	Substantial decrease	Moderate decrease	Moderate decrease	Moderate decrease	Moderate decrease
Jeffrey Pine					
3M	Moderate decrease	Substantial increase	Substantial increase	Moderate increase	Moderate decrease
3D	No change	No Change	No change	No change	No change
4M	Moderate decrease	Moderate decrease	Moderate decrease	No change	Moderate decrease
4D	Substantial decrease	Substantial decrease	Substantial decrease	Substantial decrease	Substantial decrease
Red fir					
3M	Substantial increase	Substantial increase	Substantial increase	Substantial increase	Substantial increase
3D	No change	No Change	No change	No change	No change
4M	Substantial decrease	Moderate decrease	Substantial decrease	Substantial decrease	Moderate decrease
4D	Substantial increase	Substantial increase	Substantial increase	Substantial increase	Substantial increase

Alternatives A and D incorporate Old Forest Emphasis Areas (OFEAs) land designations. OFEAs were not delineated by the local unit but through a regional process and for the purpose of connecting habitats of old forest dependent species Sierra Nevada wide. However, these areas in the LTBMU do not contain all of the old or late seral closed canopy forest stands in the LTBMU. Alternative E would emphasize the same concepts (desired conditions) originally designed for Alternative A, but apply them to each location of late-seral forest throughout the LTBMU. That is, design treatments to enhance/perpetuate the existing late-seral forest stands while enhancing/promoting mid-seral adjacent stands that most effectively connect late-seral habitats (e.g., spotted owl or Goshawk Protected Activity Centers (PACs) and Home Range Core Areas (HRCAs)). In order to enhance or perpetuate late-seral stands, in some cases on a project-specific basis, prescriptions will need to have some flexibility in order to accomplish this objective. That is, have the ability to kill or remove trees greater than 30 inches in diameter. This option, though an exception, will become more essential as larger trees become more prevalent, but still need space to grow. Such a prescription that includes this exception will focus primarily on outcomes with wildlife habitat in mind.

These flexibilities, although intended to improve the condition of late seral forests, have the potential to affect species associated with mature forest like marten and spotted owl. For example, removal of trees larger than 30 inches in diameter could alter the prey base, reduce the canopy cover, and/or increase potential for predation where the tree provided protection for nesting or denning locations. Nest trees would not be removed. All of these potential impacts are dependent on the treatment and scope of activities, a level of detail that is beyond the scope of this analysis since projects and locations are not assigned by any alternative.

The removal of large trees could also benefit the habitat of species associated with mature forest conditions. The limited exceptions under which a tree greater than 30 inches in diameter would be removed are focused, for the most part, on the enhancement of a stand and directed towards improving resiliency and reducing susceptibility to insects, disease, drought, and large-scale catastrophic fire over the long term. Removal of some larger trees could also promote the accelerated growth of adjacent trees to even larger diameters and reduce the risk for catastrophic fire where these trees are densely packed. Alternative E clarifies the limited exceptions under which a tree greater than 30 inches in diameter can, but not must, be removed. This alternative also clarifies that selected trees would not need to be removed but could be girdled for snag creation or felled for coarse woody debris.

The lack of one-size-fits all minimum canopy retention levels for the general forest under Alternatives B and C as opposed to Alternatives A and D could have negative impacts on species associated with dense canopy cover such as goshawk, spotted owl, and marten. Of the three alternatives that allow reduction in canopy cover, Alternative E contains the most clear protection measures for retention of canopy cover including a standard that treatments shall not reduce canopy cover in dominant and co-dominant trees by more than 10% across a stand. Reducing the canopy cover in a stand could increase the risk of predation, alter thermal conditions of the stand, and cause displacement of individuals and/or their prey depending on the location and scope of treatments. These types of impacts could be of short duration and also be mitigated by strategic spatial and temporal spacing of treatments as well as the implementation of resource protection measures and LOPs at the project level. Species typically associated with dense canopy cover throughout their range are found in habitat with variable canopy cover conditions in the LTBMU. For example, marten in the LTBMU have been found denning in habitats characterized by 40-59% canopy cover (CWHR class “M”) and many spotted owl and goshawk PACs in the LTBMU that contain successful nesting pairs are also located in stands characterized by average canopy covers between 40 and 59%. Reduction in the canopy of late seral closed canopy habitat is not expected to have lasting negative effects on these and other late seral associated species since the canopy would not typically be reduced to a point where late seral closed becomes late seral open canopy habitat.

Ultimately, the purpose of treating late seral stands is to promote resiliency of this habitat for the long term.

In general, forest vegetation treatments can have both positive and negative effects on sensitive terrestrial wildlife habitat. Little is understood about the effects of forest thinning on many sensitive species in the Sierra Nevada. For example, the effects of thinning on marten in the Sierra Nevada are currently under study. Some thinning projects may benefit marten provided that key habitat elements are retained following treatments or the treatment sets the trajectory for the improvement of habitat to achieve mature conditions (Slauson and Zielinski 2008). Spotted owl may also benefit from treatments that improve heterogeneity on the landscape. As with thinning treatments, little is known about the impacts of fuel reduction projects on species associated with more mature forest conditions. Fuel reduction treatments that remove understory features like coarse woody debris and shrubs may negatively affect marten and other species that are associated with these understory features. All alternatives include treatments to reduce fuels in the WUI.

The late-successional, and often dense forests favored by spotted owls and goshawks for nesting and roosting, and marten for denning and resting are at risk to stand-replacing fires because of heavy fuel loading (Agee et al. 2000 as cited in Roberts and North 2012). Although fire is a natural and beneficial part of the landscape, the forested stands within the LTBMU are outside of their natural range of variability and more susceptible to high severity crown fires. Stand replacing fires that completely remove nest and roost trees and denning and resting sites, and that are on a large geographic scale (especially compared to the relatively small size of the LTBMU) are not likely to benefit these species. Spotted owls persist in landscapes influenced by fire but there is not a lot of information to suggest that nesting and roosting habitat is retained and occupied in the long term following a stand-replacing event. Therefore, the long term benefit of vegetation treatments in reducing the potential for large scale high severity fires are believed to outweigh the potential short term effects but more research is needed. Recent research by Lee et al. (2012) suggests that some proportion (32%) of an owl "site" can be severely burned and still be occupied by owls but so little is known about whether or not there exists (and what that would be) a threshold in owl tolerance based on the proportion of the landscape that experiences a high severity fire. Forest landscapes exposed to repeated burning are often buffered from the effects of future wildfires and characterized by a mosaic of forest patched with high structural heterogeneity at multiple spatial scales (Collins et al. 2009, Stephens et al. 2008 as cited in Roberts and North 2012). This heterogeneity can improve spotted owl persistence by protecting late-successional patches from stand-replacing fire and potentially enhancing the abundance or diversity of prey species within an individual territory (resulting from greater habitat diversity).

Where fire occurs on the landscape, whether it be prescribed or wild, the alternatives differ in the approach for creation and retention of this habitat. Alternative C would conduct the most prescribed burning but Alternatives B, D, and E would allow for the most acres of managed wildland fire, including areas outside of Desolation Wilderness. Alternative D does not allow for restoration of burned forest habitat beyond activities that would be needed to meet public safety. Both spotted owls and marten can be adversely affected by the removal of burned habitat, depending on the size and location of the activities, especially distance of post-fire treatments to nests or den habitat. Therefore, Alternative D would provide the most habitat protection for species associated with burned forest habitat. However, because this alternative is unable to thin trees greater than 12 inches in diameter and has limited ability to allow for wildland fire under safe conditions, it can be expected that forests under this condition would be extraordinarily dense and any fire that occurs under this alternative may be a crown (high severity fire) and remove key habitat elements for nesting and denning. Therefore, Alternative D would provide for the greatest retention of burned forest habitat but also has the greatest risk of large-scale high severity fires. All other alternatives allow for restoration of burned forest habitat which could remove snags used for nesting, roosting, denning, and/or resting and result in adverse effects to associated species. Alternative

E, unlike the other alternatives proposing restoration, prioritizes wildlife habitat needs in the decision to conduct and development of restoration projects.

Vegetation treatments are expected to have a long term positive influence on habitats such as meadows, montane riparian, and aspen and species such as western bumble bee, willow flycatcher, northern goshawk, and mule deer where they occur in these habitat types in the LTBMU. In theory, these positive effects are expected to be greatest under Alternative D but more likely Alternatives B, C, and E because of the ability to remove larger diameter conifers than Alternatives A and D; conifers in these communities in the LTBMU are currently outcompeting aspen and other native riparian vegetation where they coexist and encroaching on meadows and montane riparian communities. These alternatives would also allow for a greater scope of prescribed burning and managed wildfire than Alternative A (but not D) which could more naturally mimic natural disturbance regime and allow for greater regeneration of vegetation. Meadows could respond positively where encroaching conifers have been removed from perimeters and where underburns are utilized to regenerate native meadow vegetation. Vegetation treatments to remove conifers from the overstory of aspen stands and use fire as a tool to disturb soil in the understory can improve aspen condition (Sheppard et al. 2006). Similarly, thinning montane riparian communities from encroaching conifers may reduce competition with riparian species such as willow, alder, among others.

Creation of early seral stages and improvements of late seral forested conditions are important for associated migratory bird species that use these habitat types.

Although grazing is not anticipated to be used as a primary or secondary form of vegetation management, grazing can have negative effects on wet meadows and montane riparian habitat and associated species such as willow flycatcher. Grazing can directly cause structural alterations to willow flycatcher habitat that could “expose nests, reduce substrate for insects, and diminish foliage cover that protects nests” (Mathewson et al. 2007). Some grazing can be beneficial for the western bumble bee but having grazing degrades habitat for this species.

All alternatives include protection measures for biological resources. These protection measures include LOPs, PAC and HRCA stand structure guidelines, habitat connectivity guidelines, down woody material and snag retention guidelines, and others as described in Chapter 2 and the Draft Forest Plan Revision. Additional protection measures can be developed during project development.

Project-level effects of the methods used for treatments and the locations of treatments would be evaluated when projects come online. Overall, taking into account the program-level objectives of these alternatives, it would appear that Alternative D would be the most compatible with wildlife habitat objectives theoretically because it primarily uses fire (and hand techniques) to restore habitat and focuses on the creation of large trees that could benefit species such as the spotted owl, goshawk, and marten. This alternative also shows an increase in late seral closed canopy habitat. However, Alternative D does not have the flexibility to use other techniques or respond to changing management scenarios if conditions conducive to safe burning or managed wildland fire cannot be met. Therefore, this alternative has the potential to be limited in its applicability and may not be able to achieve forest resiliency desired conditions. Alternative A focuses on the retention of late seral closed canopy habitat for the benefit of associated species (this habitat increases under A) and also has more a feasible implementation approach than Alternative D. Moreover, Alternative A limits the removal of trees larger than 30 inches dbh and sets strict standards for closed canopy retention. Alternative A may provide the greatest benefit to late seral closed canopy-associated species. However, both Alternatives A and D have restrictions on vegetation treatments that may reduce their ability to improve resilience to stressors that could increase under changing climate scenarios. Alternatives B, C, and E have restoration strategies and objectives that would more readily achieve desired conditions for increased resiliency of stand conditions to changing climate conditions and stressors but would include the potential to remove large diameter trees and reduce canopy cover. However, Alternative E provides guidance for the retention of canopy cover and basal area

in late seral closed-canopy stands, retention of post fire habitat, and creation of early seral stages and removal of large trees in ways that would minimize conflicts with wildlife associated with these habitat types and structural elements. Under Alternative E (and B), there would be no measureable change in the amount of late seral closed canopy habitat. Under Alternative C, late seral closed canopy habitat would decrease slightly for all forest types. Mid seral closed canopy habitat and CWHR class 6 would decrease under all alternatives and this potential change in habitat would challenge associated species such as marten, spotted owl, and goshawk.

Recreation

It is expected that habitat condition and species productivity have the potential to trend negatively under all alternatives as recreation demand, and consequently use increases. However, the magnitude of potential change by each recreation resource varies by each alternative. Alternative C provides for the greatest potential increase in acres of recreation sites (acres), day use parking, and overnight accommodation units. However, Alternative A provides for the second greatest potential expansion in these three developed recreation areas but provides for the greatest increase in ski areas and slopes, nearly twice that proposed by the other alternatives. The effects of Alternative A may parallel if not exceed those of Alternative C because of the ability of Alternative A to have the greatest expansion of ski areas and slopes, create new facilities as described in the 1988 LTBMU Forest Plan (as amended), and apparent inapplicability of LOPs and vegetation management standards and guidelines in recreation areas under the current direction. Alternatives B and E are similar in nearly every way (and propose far less expansion than Alternatives A and C) except E proposes a slightly greater number of overnight accommodation units than Alternative B. Alternative D proposes a reduction in developed recreation sites, day use parking, overnight accommodations, and ski areas and slopes. Alternatives A, B and E do not recommend any area for wilderness designation. Alternative E includes a new backcountry area in the northwest corner of the LTBMU where many sensitive species, especially late seral associated species are located. Although Alternative C includes the recommended designation of Dardanelles as a wilderness area, which can be viewed as beneficial for protecting natural resources as they currently exist, the total amount of potential expansion and creation of developed recreation facilities could counteract the potential benefit of the wilderness designation when viewed from a Basin-wide perspective. Alternative D proposes two areas for Wilderness. Ultimately, effects on sensitive terrestrial wildlife species by any proposed alternative would be dependent upon sites that are selected and the sensitive resources that use or are adjacent to these sites.

Many of the recreational facilities currently found in the LTBMU (excluding ski facilities) are located around the Lake Tahoe perimeter, especially around the South shore, and are adjacent to sensitive habitat types like lake marsh and shore, meadows, and riparian communities (i.e., streams, creeks and rivers). These habitat types have the potential to experience the most pronounced negative trend in habitat condition under Alternatives C and A which could affect bald eagle, willow flycatcher, waterfowl, mule deer, migratory birds and osprey. These species and groups are sensitive to human disturbance and habitat degradation, loss, and fragmentation that could result from facility expansion and/or creation. There is potential for permanent displacement of these species in areas with increased developed recreation.

Habitat types such as Jeffrey pine, white fir-mixed conifer, and lodgepole pine are also expected to experience a negative trend where they exist within and adjacent to developed recreation areas, especially campgrounds and ski areas, and species such as spotted owl, northern goshawk, marten, and wolverine are expected to be adversely affected where expansion and creation occur in or adjacent to occupied forested habitat although wolverine are not expected to occur at or near developed recreation sites due to the heavy human use and relatively low elevation compared to other areas in the LTBMU.

Overall, Alternative D has the potential to reduce recreation facilities and would include the recommended designation of two wilderness areas. Although Alternative D is expected to have a positive

trend in habitat condition and the productivity of species because of the potential reduction of developed recreation facilities, it is possible that a negative trend could be experienced if recreation capacity under this alternative fails to meet demand and recreation use either continues in what would now be unmanaged areas and/or use shifts geographically to previously less used areas or shifts by type and includes more dispersed recreation activities in areas that previously experienced low levels of use.

Recreation can have varying degrees of adverse impacts on terrestrial wildlife resources such as habitat loss, degradation, and fragmentation; disruption of behavior (e.g., foraging, reproduction, etc.); reduction or alteration in supply and availability of food and cover; direct physical harm to individuals and/or offspring (e.g., eggs, young, etc.); and increased refuse, anthropogenic food sources, noise, and pet presence. Although it remains unclear which species are most affected by recreation and how the growing number of visitors may amplify those effects (Manley et al. 2010), examples from some studies can improve our limited understanding of recreation impacts on various species found in the LTBMU. For example, a study conducted by Morrison et al. (2011) in the Lake Tahoe Basin indicated that northern goshawks are susceptible to human disturbance; human activity was twice as high within infrequently occupied territories as compared to frequently occupied territories. Bald eagles in Washington have also been found to be adversely affected by recreation that involves both pedestrian traffic and boat use by adversely affected feeding activity (Stalmaster and Kaiser 1998). Many kinds of human activities have been documented to affect raptors by altering habitats; physically harming or killing eggs, young, or adults; and by disrupting normal behavior (Postovit and Postivit 1987, Delany et al. 1999 as cited in Morrison et al. 2011). Human activity was shown in Schlesinger et al. (2008) to be a greater disturbance to land bird species in the Lake Tahoe Basin than even loss of habitat from development.

Additional recreation facilities and consequential increased human use (see assumptions above) can not only lead to harassment and disturbance of species that tend to be more secretive but also attract other species to developed sites because of additional anthropogenic sources (e.g., food, denning and resting sites, etc.). Habitat enrichment (i.e., supplemental food) occurs in developed areas of the Lake Tahoe Basin and can lead to population growth and/or shifts in species distributions towards more developed sites (Manley et al. 2010). In the Lake Tahoe Basin, bear encounters in campgrounds, resorts, and recreation residences are frequent and a number of conflicts have been recorded, sometimes resulting in euthanization of individual bears. These types of conflicts are expected to increase with expanded and/or new facilities that support an increased capacity of visitors. However, Alternative E now includes a desired condition and strategy directly focusing on the need to improve developed recreation site conditions to minimize the potential for human-bear conflict. Developed recreation sites can also attract a variety of small mammals and birds that respond to an increased food supply. Martens appear to be benefiting from anthropogenic resources in some ski areas in the Lake Tahoe Basin. In these ski areas, martens have been reported using anthropogenic food sources (e.g., dumpsters), using resort structures (e.g., chalets, buildings) as rest sites, and their tracks in snow are occasionally detected beneath lift lines. Food available at ski areas, from humans, may also attract small mammals which, in turn, may provide food for martens.

Although downhill ski resorts in the LTBMU may provide wildlife (e.g., marten) with anthropogenic food and resting resources, these resorts have several potential adverse effects on wildlife species. As described by Manley et al. (2010), potential adverse effects of ski resorts on wildlife include: “(1) forest losses and fragmentation (only shrub and grass layers remain on ski slopes), which affect late seral associated species, such as Pacific marten, northern goshawk, California spotted owl, and spotted skunk; (2) high human disturbance during daytime on ski slopes may create barriers to habitat use and between-habitat patch movement for diurnal species; (3) changes in forest cover and human disturbance may create “sink” habitat for Pacific marten; (4) night lighting and grooming on ski slopes may interfere with the behavior of nocturnal species; and (5) losses of snags in forested areas between ski runs owing to hazard tree removal can locally reduce wildlife habitat quality”. While martens do occupy portions of

many ski areas in the LTBMU, female martens appear to exhibit a higher sensitivity to forest fragmentation from ski-run creation than males, avoiding areas highly fragmented by ski runs (Slauson and Zielinksi unpublished data). Furthermore, while males occupy more highly fragmented portions of ski areas than females, male survivorship appears to be lower in sites with higher fragmentation (Slauson and Zielinksi unpublished data). Furthermore, there appears to be a highly skewed sex ratio of 2:1 in favor of males at certain ski resorts in the LTBMU, indicating that high quality reproductive habitat is limiting at these ski resort areas. Snow compaction from grooming alters surface consistency making it easier for larger-bodied carnivores (e.g., coyotes [*Canis latrans*]) which, unlike martens are not adapted for deep, soft snow, to expand their winter ranges and compete with or prey on martens. Skiers and staff are active during the majority of the day at high densities and during the night conducting grooming activities, creating a higher likelihood for marten-human encounters and their associated disturbances (e.g., decreased frequency of prey captures due to interruptions while hunting). Finally, ski resort effects are not limited to winter, as permanent effects (e.g., fragmentation) are present year-round, and because many resorts are developing summer recreation (e.g., hiking, mountain biking). Alternative A proposed nearly twice as much potential expansion of ski areas and slopes as any other alternative. It should also be noted that under the current direction (Alternative A) LOPs for old forest dependent species such as marten do not apply to recreation areas.

The addition of Dardanelles and Freel Peak as Wilderness designations can contribute to long-term positive trends in habitat conditions and species productivity. However, there is also a possibility for long term negative trends. The Freel Peak area includes old-growth forest stands as well as a variety of ecological important streams and montane riparian areas. Designation as a wilderness can benefit species by precluding management activities (i.e., timber harvest) and limiting potentially adverse human activities such as mountain biking and OHV use. This conservation approach has long been employed to help protect natural resources from degradation associated with human actions. However, climate change has been associated with and will continue to influence shifts in ecological processes and patterns, and species ranges, movements, and phenologies (Bradley et al. 1999, Cole and Yung 2010, Safford et al. 2012) among other newly emerging patterns. Biotic communities may shift but not shift together and newly formed communities may be comprised of new and different species assemblages with potential for new predatory and/or competitive interactions (Stralberg et al. 2009). Furthermore, the concept of ecosystem management represents a shift in conservation ecology in that it takes on a view of “nature in flux, rather than balance” and aims to protect ecosystem structure and function through adaptive management to maintain both biodiversity as well as adaptive capacity (Kalamandeen and Gillson 2007, Grumbine 1994, 1997 as cited in Kalamandeen and Gillson 2007). Therefore, while wilderness designation can benefit terrestrial wildlife species in these areas, protection of species and community assemblages may be limited to a snapshot in time and may not be protective in the future if natural processes aren’t sufficient to maintain habitat conditions due to factors such as climate change, risk od stand-replacing fire, non-native species invasions (e.g., barred owl), insect outbreaks and other pathogens, among others.

Access to NFS Roads and Trails

The most pronounced negative effect on habitat condition and species productivity is expected to occur under Alternative C because of the combined increase in mechanized, OHV, and motorized trails under this alternative and the types of dispersed recreation activities that can occur on these trails. All species have the potential to be affected under Alternative C although species such as willow flycatcher, bald eagle, spotted owl, osprey, peregrine falcon, northern goshawk, and marten are expected to experience the most pronounced negative effect.

Roads and trails in the LTBMU traverse various upland and riparian habitats and have the potential to adversely affect wildlife habitat and species. Newly created trails and roads lead to permanent habitat fragmentation, degradation, and loss. For example, nest predation in willow flycatchers has been shown

to increase with habitat fragmentation and disturbance (Wilcove and Robinson 1990 as cited in Mathewson et al. 2009), and increased habitat edge provides favorable habitat for brown-headed cowbirds that parasitize willow flycatcher nests. “Trails or other paths created through meadows may expose willow flycatcher nest sites, reduce substrate for insects, diminish foliage cover that provides protection for adults and fledglings from predators and could potentially encourage adults to abandon nests or relocate” (Mathewson et al. 2007). Fragmentation can also lead to isolation of individuals and populations that can cause a reduced carrying capacity of the habitat, inability of individuals to find mates, and/or lead to the habitat becoming a sink habitat in which the reproduction rate does not offset the rate of population decline (i.e., emigration, death, low reproductive rates). Associated infrastructure such as culverts can disrupt or alter hydrology and contribute to desiccation of meadow systems, alteration of stream and creek flow, and consequently alter vegetation condition and the wildlife associated with these systems. Upgrades and maintenance of existing roads and trails have the potential to temporarily displace individuals and or alter normal behavior during implementation of these ground disturbing activities.

In addition to the roads and trails themselves and associated infrastructure, human use of the trails and roads for dispersed recreation activities (e.g., driving, hiking, mountain biking, OHV and OSV use) can lead to direct mortality and injury in the form of vehicle strikes; temporary and permanent displacement of wildlife; alteration of normal behavior and activities by wildlife species (e.g., foraging, nesting, denning, etc.); and spread of noxious weeds. Prolonged or consistent use of trails and roads can lead to permanent displacement of individuals from territories, nest or den abandonment, and/or alteration of foraging behavior and species-specific effects can lead community-wide effects. “Higher trophic level species such as northern goshawk, California spotted owl, American marten” may be particularly vulnerable to disturbances from dispersed recreation activities (Manley et al. 2010) and impacts to these species could result in a cascading effect through lower trophic levels.

The type of dispersed recreation activities can vary by season and have varying degrees of impacts on terrestrial wildlife species although the variation in some of these effects is not well understood. Rock climbing can disturb cliff-nesting birds and crevice-roosting bats. Limited research has shown that the effect of hiking versus bicycling did not induce a different disturbance response (i.e., flushing) by bison, mule deer, and pronghorn antelope in Utah (Taylor and Knight 2003). However, hikers move more slowly on trails than bicyclists and it has been suggested that this longer residence time may pose a greater disturbance to sensitive species (Manley et al. 2010). Conversely, bikes move quickly through habitat but may pose a greater risk of physical impacts (Manley et al. 2010). Although OHV use is restricted to designated trails in the LTBMU, this activity can damage vegetation, disturb wildlife, impact nesting success of breeding birds, alter movement patterns of mammals, and cause a reduction in wildlife populations (Luckenbach and Bury 1983, Lovich and Bainbridge 1999). In a study of OHV trail use and songbirds in northern California, Barton and Holmes (2007) found that two of 18 species studied were less abundant at sites on OHV trails than at sites 250 meters from trails, and no species were more abundant on trails. In the winter, OSV (i.e., snowmobile) use compacts snow and creates noise. Some small mammals (i.e., voles) may have difficulty navigating through compact snow layers but some predators may use compacted snow for travel, changing the spatial pattern of their movements and predation (Manley et al. 2010). Data for one study conducted in the LTBMU found that OHV/OSV use did not affect marten occupancy or probability of detection and that overall OHV/OSV use in the study areas was low (1 OHV/OSV pass every 2 hours) and exposure occurred in <20% of a typical home range (Zielinski et al. 2008). Activities such as backcountry snowshoeing and cross country skiing are not expected to adversely affect wildlife because they are limited in spatial and temporal extent.

3.4.23.4. Analytical Conclusions

Comparison of Consequences by Alternative

Alternatives A and D would have the fewest consequences for species associated with late seral closed canopy forests because these alternatives focus heavily on the retention of this habitat type and associated elements (e.g., large diameter trees, canopy cover). And model output predicts that late seral closed canopy forest increases under these alternatives. However, limitations on vegetation treatments could result in increasingly dense stands that are further outside their range of natural variability and at a risk greater than the other alternatives to widespread die off from insect outbreak, drought, climate change effects, or high severity wildfires. Conversely, Alternatives B, C, and E focus on restoring forest structure and type and improving forest resiliency and in doing so, have greater flexibility to remove large diameter trees, reduce canopy cover (although E has retention levels), and create early seral openings which would have consequences for species associated with late seral habitat. However, model output predicts that late seral closed canopy habitat would not decrease under Alternatives B and E. Late seral closed canopy forest is predicted by the model to decrease slightly under Alternative C and this could challenge species associated with more mature forest characteristics such as spotted owl and marten. Mid seral closed canopy forest is predicted by the model to decrease under all alternatives and this could also have consequences for mature forest associated species unless mid seral is moving to late seral closed canopy habitat.

In terms of restoration, Alternative D would introduce fire back to the landscape as a primary means of restoration and this approach would be preferable. However, there is the potential for significant limitations in the applicability of this approach and the lack of options for conducting restoration where fire can't be used. Alternative D also doesn't continue the active watershed and aquatic restoration program proposed under the other alternatives following the completion of currently planned projects. Without restoration, habitats could deteriorate and no longer meet the life history requirements of associated species. These habitats and species communities could also be less able to adapt to changing climate conditions. The ability to continue restoration under Alternatives A, B, C, and E could improve condition for species associated with these habitats such as meadows and aspen stands.

The LTBMU is a heavily recreated area with vast opportunities for all-season activities. Often, recreation activities have adverse consequences for terrestrial wildlife through disturbance (e.g., noise, human presence, pets) and habitat degradation. More recreation opportunities could lead to an increase in human-wildlife conflict with species such as bears and mountain lions. Alternatives A and C propose to expand recreation sites, overnight accommodation units, and parking more than the other alternatives. Alternative A proposes to double the acreage of NFS lands open to ski areas and slopes which could have negative consequences for species associated with high elevation forested habitat such as marten (and possibly wolverine). Standardized LOPs for mature forest-associated species do not apply to recreation areas under any alternative and this lack of protection could have detrimental consequences for denning or nesting wildlife. Under Alternative D, the size of recreation sites and ski areas and slopes could be reduced, and this reduction could have positive consequences for species that occupy these areas, particularly martens that are known to occupy ski resorts in the LTBMU. However, challenges could occur where visitors continue to use decommissioned areas and/or shift recreation activities to previously unused or little used areas.

Overall, Alternative C could have the greatest potential for adverse consequences for terrestrial wildlife species productivity and habitat condition because this alternative proposes the most intense (most acres over shortest period of time) vegetation treatments, greatest expansion of developed recreation sites, overnight accommodation units, and parking, second greatest expansion of ski areas and slopes, as well as an expansion of road access to NFS lands.

How the Alternatives Maintain or Achieve the Desired Conditions

Alternatives A and D would trend towards achieving desired conditions for protection of PAC and HRCA habitat, connectivity of late seral habitat (OFEAs), and retention of elements associated with late seral habitat (e.g., canopy cover, large trees) (Table 3-81). However, these alternatives could struggle to improve PAC habitat where it is degraded or threatened and could have an increased risk (instead of decreased) to catastrophic wildfire, a major threat to California spotted owl and other late seral associated species. Conversely, Alternatives B, C, and E have the ability to improve the condition of PAC habitat where condition has deteriorated. However, Alternative C may not be able to achieve the desired condition for PAC habitat and late seral habitat because of the ability to conduct more rapid and intense vegetation treatments and the potential for increased recreation.

Many of the desired conditions are focused on habitat elements (e.g., snags, habitat connectivity, cliff or cave habitat) or broad types of biological resources (e.g., terrestrial habitat, warm water fishes, raptors, etc.) but not on specific species themselves. Alternatives B, C, and E would be better positioned with appropriate strategies, objectives, and standards and guidelines than Alternative A to achieve these types of desired conditions. Alternative D includes the same desired conditions and standards and guidelines as Alternatives B, C, and E but fails to follow the same restoration objectives and strategies to achieve these desired conditions.

Table 3 81. Comparison of Alternatives by Habitat Type and Special-status Species

Terrestrial Wildlife Resource Type	Alternative A	Alternative B	Alternative C	Alternative D	Alternative E
Terrestrial Wildlife Habitats					
Riparian Habitats (Wet meadows, Montane riparian, Lakeside marsh and shore habitat, Aspen)	Condition maintained with potential for positive trend from restoration and enhancement; potential risk from developed recreation expansion and limits on diameter of trees that can be removed (e.g., encroaching conifers).	Condition maintained with potential for positive trend more than Alternatives A and A from restoration and enhancement and vegetation treatments (including prescribed and managed fire) to improve structure and resiliency; potential risk from developed recreation expansion.	Similar to Alternative B but greater potential risk from recreation expansion and increase access to NFS lands.	Condition maintained with potential for positive trend from reduced recreation areas and access, and greatest use of fire; potentially greatest risk from wildfire, shifting or continued unmanaged recreation use, increased OHV access, and limits on diameter of trees that can be removed (e.g., encroaching conifers).	Similar to Alternative B.
Coniferous Forests (Jeffrey pine, white fir-mixed conifer, red fir, lodgepole pine, subalpine conifer)	Condition maintained; potential for decreasing trend in condition of mid and late seral stage; greatest potential risk from ski area expansion.	Condition maintained; potential for positive trend in condition of late seral stage and resiliency to stand-replacing fire and beetles more than Alternatives A and D.	Similar to Alternative B but potential risk from ski area expansion greater than Alternatives B, D, and E.	Condition maintained; potential benefit from reduced recreation sites and ski area operational boundaries; potential risk to resiliency from restricted restoration and risk of wildfire.	Similar to Alternative B but with added positive benefit from new and revised standards and guidelines for late seral closed canopy forest.
Montane chaparral	Potential for decreasing trend in condition where vegetation treatments aren't targeting creation/maintenance and habitat is becoming converted to forest.	Potential for increasing trend in condition more than Alternatives A and D where approach may create/maintain habitat.	Similar to Alternative B.	Potential for increasing trend in condition more than any other alternative where fire is allowed to burn and create this habitat.	Similar to Alternative B.

Terrestrial Wildlife Resource Type	Alternative A	Alternative B	Alternative C	Alternative D	Alternative E
Cliff, Cave, and Cave-Surrogate Habitat	Condition maintained; potential for decreasing trend without protection measures.	Condition maintained; potential for positive trend from measures to protect and restore one site.	Similar to Alternative B.	Similar to Alternative A.	Similar to Alternative B but with improved standard and guideline for LTBMU conditions.
PACs and HRCAs	Condition maintained; potential for decreasing trend in mid and late seral habitat condition and wildfire risk; potential risk from developed recreation expansion and greatest potential risk from ski area expansion.	Condition maintained; potential for positive trend in late seral habitat condition and resiliency from restoration more than Alternatives A and D; risk from removal of large trees and canopy reduction less than Alternative C and more than Alternatives A and D.	Similar to Alternative B but greater potential risk from more intense and rapid vegetation management approach, expansion of developed recreation, and increased access to NFS lands.	Condition maintained; potential benefit from use of prescribed fire, and reduced recreation sites and ski area operational boundaries; potential risk from restricted restoration and risk of wildfire.	Similar to Alternative B but with stronger and more relevant desired conditions and standards and guidelines.
Wildlife Species Protected Under ESA					
Pacific fisher	Species not expected to occur.	Same as Alternative A	Same as Alternative A	Same as Alternative A	Same as Alternative A

Terrestrial Wildlife Resource Type	Alternative A	Alternative B	Alternative C	Alternative D	Alternative E
Wildlife Species Proposed Under ESA					
Wolverine	If present, potential benefit from predicted increase in late seral closed canopy habitat (5M & 5D); potential risk where habitat deteriorates and is at risk to catastrophic disturbance (e.g., fire) and expansion of developed recreation, especially ski area operational boundaries greater than all other Alternatives.	If present, potential benefit from treatments that improve resiliency of habitat and predicted increase in red fir 5D; risk from predicted slight decrease in red fir 5M, and expansion of developed recreation less than Alternatives A and C.	If present, potential benefit from increase in red fir 5D; risk from predicted decrease in red fir 5M and overall late seral closed canopy habitat, expansion of developed recreation, especially ski area operational boundaries, and access to NFS lands.	If present, potential benefit from predicted increase in overall late seral closed canopy habitat (5M & 5D) and reduced ski areas; potential risk from moderate decrease in red fir 5M and where habitat deteriorates and is at risk to catastrophic disturbance (e.g., fire), and increased OHV access.	Similar to Alternative B but with added benefit from strategies and standards and guidelines to protect late seral close canopy habitat.
Forest Service Sensitive Species					
Western bumble and willow flycatcher	Potential for positive trend from meadow restoration; risk from grazing, developed recreation expansion, treatments to treat invasive species, and limits on diameter of trees that can be removed (e.g., encroaching conifers).	Similar to Alternative A but with less risk from developed recreation expansion (less than A and C); greater benefit from ability to remove larger encroaching conifers, greater use of prescribed fire, and objectives to improve meadow condition.	Similar to Alternative B but with greater potential risk from developed recreation expansion and more roads/trails; greater benefit from ability to remove larger encroaching conifers, more prescribed and managed wildfire, and objectives to improve meadow condition for willow flycatcher.	Potential for positive trend from meadow restoration, reduced recreation areas, and greatest use of prescribed and managed wildfire; risk from lack of restoration, greatest risk of wildfire, potential shifting recreation use, grazing, and limits on diameter of trees that can be removed (e.g., encroaching conifers).	Similar to Alternative B.

Terrestrial Wildlife Resource Type	Alternative A	Alternative B	Alternative C	Alternative D	Alternative E
Northern Goshawk and California spotted owl	Potential benefit from predicted increase in late seral closed canopy habitat (5M &5D); risk from predicted decrease in CWHR types 6, 4M and 4D; risk from potential post fire habitat restoration, decreasing trend in condition of PAC habitat (and increased risk of wildfire) due to lack of restoration, and expansion of developed recreation, especially ski area operational boundaries greater than all other Alternatives.	Potential benefit from restoration of degraded PAC habitat, overall static amount of late seral closed canopy habitat, and predicted increase in CWHR 5D; risk from predicted decrease in CWHR, 6, 4M, &4D, and predicted slight decrease in red fir 5M; risk from lower desired condition canopy cover for PACs and HRCAs, post fire habitat restoration less than A but more than D and E, loss of large trees, reduction in canopy cover, and early seral openings, and expansion of developed recreation less than Alternatives A and C.	Similar to Alternative B but greater potential risk from predicted slight decrease in late seral closed canopy habitat (especially red fir 5M), accelerated pace of forest vegetation treatments, and expansion of developed recreation (especially ski areas), and access to NFS lands.	Similar to Alternative A except potential benefit from reduced recreation areas, especially ski resorts and less emphasis on fuel reduction in burned forest habitat; risk from predicted decrease in red fir 5M and greatest risk of wildfire.	Similar to Alternative B but with added benefit from more stringent desired conditions and standards and guidelines for canopy cover, late seral habitat and key elements, and retention of burned forest habitat.
Bald eagle	Potential for positive trend from habitat restoration and predicted increase in late seral open canopy habitat (5S & 5P) and CWHR class 5D and 5M in white fir/mixed conifer and Jeffrey pine; risk from predicted loss of CWHR class 6 and from developed recreation expansion.	Similar to Alternative A but risk from developed recreation expansion less than Alternatives A and C and CWHR class 5M is predicted to increase only in Jeffrey pine.	Similar to Alternative A but with potentially greater risk from developed recreation expansion and CWHR class 5M is predicted to increase only in Jeffrey pine.	Potential for positive trend from increase in late seral open canopy habitat , and reduced access and developed recreation sites; potential risk from lack of restoration and increased wildfire potential, and potential shifting recreation use from inability to meet demand.	Similar to Alternative B.

Terrestrial Wildlife Resource Type	Alternative A	Alternative B	Alternative C	Alternative D	Alternative E
Great gray owl	Species not expected to occur.	Same as Alternative A	Same as Alternative A	Same as Alternative A	Same as Alternative A
Townsend's big-eared bat, Pallid bat, Fringed myotis	Potential for positive trend where restoration improves foraging habitat and prohibits removal of large trees (potential roosts); risk from predicted decrease in mid seral open and early seral foraging habitat (Pallid), from developed recreation expansion, and from lack of cave and cave-surrogate standards and guidelines.	Potential for positive trend from restoration and inclusion of cave and cave-surrogate standards and guidelines; potential risk from predicted decrease in early seral foraging habitat (Pallid), ability to remove large trees (potential roosts), and developed recreation but less than Alternatives A and C.	Similar to Alternative B except potential benefit from predicted increase in mid seral open foraging habitat (Pallid) and increased risk from developed recreation expansion.	Similar to Alternative A but potential benefit if abandoned recreation structures can be used as roosts; risk from lack of restoration and increased wildfire, and if roosts excluded from decommissioned recreation structures.	Similar to Alternative B but with improved standard and guideline for LTBMU conditions.
Pacific marten	Potential benefit from predicted increase in late seral closed canopy habitat (5M &5D); risk from predicted decrease in CWHR types 6, 4M and 4D; risk from potentially diminishing quality of habitat and risk of wildfire (at level less than Alternative D); risk from inapplicability of LOPs at recreation areas, expansion of developed recreation areas, especially ski area operational boundaries greater than all other alternatives.	Potential benefit from predicted increase in CWHR type 5D; risk from predicted decrease in CWHR types 6, 4M, &4D and predicted slight decrease in 5M in red fir; risk from loss of large trees, early seral openings, and reduction in canopy cover; risk from expansion of developed recreation especially ski areas and no LOP but at level less than Alternatives A and C.	Similar to Alternative B but greater potential risk from predicted slight decrease in late seral closed canopy habitat (especially red fir 5M), accelerated pace of forest vegetation treatments, greatest expansion of developed recreation (especially ski areas) and access to NFS lands.	Similar to Alternative A except potential benefit from reduced recreation areas, especially ski areas and less emphasis on fuel reduction in burned forest habitat and predicted increase in late seral closed canopy habitat; risk from predicted decrease in red fir 5M and greatest risk of wildfire.	Similar to Alternative B but with added benefit from more stringent desired conditions and standards and guidelines for late seral habitat and key elements, and retention of burned forest habitat.

Terrestrial Wildlife Resource Type	Alternative A	Alternative B	Alternative C	Alternative D	Alternative E
TRPA Special Interest Species					
Waterfowl	Potential for stable or improved productivity with restoration of aquatic habitat; challenges from increased developed and dispersed recreation.	Potential for stable or improved productivity with restoration of aquatic habitat; challenges from increased developed and dispersed recreation but at level less than Alternatives A and C.	Similar to Alternative A but greater risk from greater expansion of developed recreation.	Similar to Alternative A but with potential for declining trend where habitat restoration not implemented.	Similar to Alternative B
Golden eagle	Potential for stable or improved productivity with restoration of foraging habitat and protection of nesting habitat.	Similar to Alternative A	Similar to Alternative A	Similar to Alternative A but with potential for declining trend where habitat restoration not implemented.	Similar to Alternative A
Osprey	Potential for stable or improved productivity with restoration of meadow and riparian habitat; challenges due to disturbance from increased developed and dispersed recreation.	Potential for stable or improved productivity with restoration of meadow and riparian habitat; challenges due to disturbance from increased developed and dispersed recreation but at a level less than Alts A and C.	Potential for stable or improved productivity with restoration of meadow and riparian habitat; challenges due to disturbance from increased developed and dispersed recreation.	Potential for stable or improved productivity with restoration; potential for diminished productivity without restoration; challenges due to increased dispersed recreation (e.g., OHV).	Similar to Alternative B
Peregrine falcon	Potential for stable or improved productivity from restoration of foraging habitat and protection of nesting cliffs from rock climbing.	Potential for stable or improved productivity from restoration of foraging habitat; protection of nesting cliffs; and objective to remove anthropogenic disturbance from a cliff (or cave) site.	Similar to Alternative B.	Potential for stable or improved productivity from cliff protection measures and restoration of foraging habitat; potential for diminished productivity where future restoration not implemented.	Similar to Alternative B.

Terrestrial Wildlife Resource Type	Alternative A	Alternative B	Alternative C	Alternative D	Alternative E
Mule deer	Potential for stable or improved productivity with restoration of meadow and riparian habitat; challenges from increased developed and dispersed recreation.	Potential for stable or improved productivity with restoration of meadow and riparian habitat; challenges from increased developed and dispersed recreation but at level less than Alts A and C.	Potential for stable or improved productivity with restoration of meadow and riparian habitat; challenges from increased developed and dispersed recreation.	Potential for stable or improved productivity with restoration of meadow and riparian habitat; challenges where restoration not implemented and habitat condition diminishes, potential for positive trend where fire is introduced to meadow systems to restore condition.	Similar to Alternative B.
Migratory birds	Improved habitat conditions with watershed and aquatic restoration; challenges from increasingly dense forested conditions and increased developed and dispersed recreation.	Improved habitat conditions with watershed and aquatic restoration as well as forest restoration; challenges from increased developed and dispersed recreation.	Improved habitat conditions with watershed and aquatic restoration as well as forest restoration; challenges from increased developed and dispersed recreation.	Improved habitat conditions with watershed and aquatic restoration; challenges from lack of future habitat restoration; increasingly dense forested conditions and increased dispersed recreation.	Similar to Alternative B

3.4.24. Water Quality and Soil Erosion

3.4.24.1. Introduction

Water quality is a key component and indicator of watershed condition. Degradation of other components of watershed condition (i.e., soil quality, SEZ and stream channel condition) are often reflected in water quality condition.

Fine sediment (<20 microns) transport to Lake Tahoe, and its effect on lake clarity is a primary water quality concern in the Lake Tahoe Basin. Nutrient inputs (nitrogen and phosphorus) are also a concern, particularly as they affect near shore clarity. Invasive species in the forms of both aquatic plants and mollusks have also been recently identified as a major contributor to adverse impacts on near shore clarity.

Soil erosion is the primary process for fine sediment and associated nutrient transport to the Lake. Other aspects of soil quality (i.e., soil productivity) are addressed in Section 3.4.22 - Soils. Erosion processes include sheet, rill, gully and channel erosion. The USFS has a variety of qualitative and quantitative techniques for assessing the scope and scale of management activity impacts on soil erosion and sediment transport at the project scale. Assessment of impacts at the programmatic scale presented in this Forest Plan relies primarily on qualitative assessment of past project scale analysis.

Methodology

The following indicators are utilized to describe current conditions and water quality impacts from forest management activities:

- Current Lake Tahoe Interagency Monitoring Program (LTIMP) Tributary Monitoring data for suspended sediment and nutrients.
- TMDL milestones for reduction of fine sediment and nutrient loading to Lake Tahoe from Upland and Stream Channel source areas.
  - BMPEP Implementation and Effectiveness scores
  - WEPP Analysis, utilizing measurements of soil attributes
  - Roads and Trails Water Quality Risk Assessment Scores
  - Stream Condition Inventory, Monitoring, and Assessment Data
- State Water Quality Standards

LTIMP Tributary water quality data is available on the USGS website, and is scheduled for presentation in the Tahoe Regional Planning Agency 2011 Lake Tahoe Threshold Evaluation Report. The methodology for assessing impacts of Forest management activities in achieving TMDL milestones is based on results from past Forest monitoring reports for the subset of indirect indicators identified above. This includes annual USFS Regional BMPEP evaluation reports, soil quality monitoring reports related to fuels reduction practices (including WEPP analysis), roads and trails BMP upgrades monitoring reports, stream channel/floodplain restoration effectiveness monitoring reports, and existing Watershed Analysis and Ecosystem Assessment reports.

Assumptions

- Past water quality monitoring in the basin has proven to be largely inadequate to detect measurable adverse impacts to water quality specifically related to Forest Service management

activities, such as roads and timber harvest. The Forest Service has developed other qualitative and quantitative methods that provide a better direct measurement of ecosystem impacts from Forest Management activities that have the potential to impact water quality

- Under all the alternatives, proposed changes in recreation infrastructure will consider impacts as they relate to the ecological values of riparian areas and wetlands (SEZs). Under all the alternatives, opportunities to protect and restore the ecological function of SEZs will be identified and considered, as part of future proposed actions related to increase recreational opportunity and capacity.

3.4.24.2. Overview of the Affected Environment

Water Quality

Past analysis of water quality monitoring data indicates that in general, forested lands do meet the current state regulatory standards; however, there are exceptions.

Watersheds that have experienced significant past disturbance, and have large sections of unstable stream channels frequently exceed state standards for sediment and nutrients (Blackwood, Trout Creek, and Upper Truckee River are a few examples). The total phosphorus standard is frequently exceeded in many more watersheds; however, water quality analysis indicates this standard is frequently exceeded in undisturbed watersheds, and may need to be revised.

The only WQ monitoring the Forest has done related to human health impacts is limited to fecal coliform monitoring at the Baldwin and Meiss grazing allotments, and a site investigation and remediation effort at the old Meyers Landfill site.

Although research in other parts of the country indicate established water quality standards are frequently not exceeded in water bodies within and adjacent to grazing, in situations where grazing use is not concentrated, this has not been the case in Lake Tahoe. Because the size of grazing allotments and capable grazing acres in the Lake Tahoe Basin are relatively small, forcing concentrated use, the California state fecal coliform standards (fecal coliform concentration during any 30-day period shall not exceed a log mean of 20/100 ml, nor shall more than 10 percent of all samples collected during any 30-day period exceed 40/100 m) have frequently been exceeded in Lake Tahoe within and downstream of grazing allotments. In general, violations are rarely documented prior to presence of livestock, but have been frequently documented during periods of active use.

Fecal coliform was monitored at two of the three grazing allotments permitted within the LTBMU, from 1999-2001 at the Meiss Grazing Allotment in the Upper Truckee watershed, and from 1999 through 2007 at the Baldwin Allotment in the Tallac watershed. Water quality data was collected throughout the grazing season as part of the Annual Operating Instructions. When a given allotment or pasture reached the allowable-use, including water quality, that allotment or pasture was rested from grazing for the remainder of the season. Because the data was used as a management tool, no annual reports analyzing the results were composed. However, information regarding the impacts to water quality was used in both the Meiss Allotment Decision Notice and the Baldwin Allotment Decision Memo (USFS, Meiss DN, 2009). The Baldwin Allotment is closed and the Meiss Allotment is vacant.

The Meyers landfill investigation has detected a significant plume of vinyl chloride (VC). This VC contamination is not currently affecting drinking water sources, and remediation and cost recovery efforts are currently in progress.

Past water quality monitoring in the basin has proven to be largely inadequate to detect measurable adverse impacts to water quality specifically related to Forest Service management activities, such as

roads and vegetation management. The interagency basin wide tributary monitoring program (LTIMP) was designed to collect data on overall watershed responses, but was not designed to separate out the impacts of individual land uses. Past water quality monitoring performed by the Lake Tahoe Basin Management Unit related specifically to forest service management activities (such as roads and vegetation management) resulted in the eventual conclusion that in-stream water quality monitoring was a poor measure to detect impacts because when they occur, they tend to be episodic in nature, and difficult to capture through typical stream monitoring programs. (Norman, 2000; Norman, 1997; Norman, 1996; Norman, 1996).

The Forest Service has developed other qualitative and quantitative evaluations that provide a better direct measurement of ecosystem impacts from Forest Management activities that have the potential to impact water quality. The discussion below described current conditions and trends related to water quality at the watershed scale, as measured through a Basin wide tributary monitoring program, as well as the results of past USFS initiated monitoring efforts.

The Lake Tahoe Basin has a long data record of tributary water quality data, provided through the LTIMP. This program is funded through TRPA and USGS, and recently has also been supported with funds through the USFS Erosion Control Grants program (for almost 1/3 of the cost of the program).

From this data, the State of California currently lists 8 tributary water bodies as impaired, and the State of Nevada lists seven tributary water bodies as impaired under Section 303(d) of the Clean Water Act (2010 List). These tributaries are located within the Lake Tahoe Basin boundary; therefore most of the tributaries mentioned include both USFS and private lands. The receiving water body, Lake Tahoe is listed by both states.

Two of the California streams currently have approved Total Maximum Daily Load (TMDL) targets related to sediment, (Heavenly Creek, 2002 and Blackwood Creek, 2008) and TMDLs are scheduled to be developed for the other water bodies and constituents. The Lake Tahoe TMDL approved by the EPA in 2011, is a joint effort between CA and NV. The Lake Tahoe TMDL requires the USFS to track and report on efforts to reduce loading from National Forest lands.

Most of the California streams (Table 3-82) and Lake Tahoe are listed because of sediment and nutrient loading to Lake Tahoe and subsequent impacts to Lake Tahoe clarity. However based on the TMDL analysis, upland sources (the forested non-urban portions of the watersheds) are estimated to contribute only 9% of the total fine sediment loading to the Lake, with atmospheric (15%) and urban sources (72%) the largest contributors. Forested non-urban sources are currently estimated to contribute 26% of the phosphorus and 15.5% of the nitrogen loading to the lake.

The six Nevada streams are listed (Table 3-82) because of zinc, iron, and in one instance pathogen violations. Two of the California streams are listed because of pathogens. The 303(d) listed waterbodies, other than Lake Tahoe, are listed below along with the pollutants causing listing.

Table 3 82. Listed 303(d) stream segments in the Lake Tahoe Basin (2010)

Segment	Measured Impact
California	
Blackwood Creek	phosphorus, nitrogen, sediment, iron
Cold Creek	nitrogen
General Creek	iron, phosphorus
Heavenly Valley Creek	phosphorus, chloride, sediment
Tallac Creek	pathogen
Trout Creek	phosphorus, nitrogen, pathogen , iron
Upper Truckee	iron, phosphorus
Ward Creek	phosphorus, nitrogen, sediment, iron
	Note iron and chloride WQ stds may be revised*
Nevada	
Second Creek	zinc
Wood Creek	pathogen
Third Creek	zinc
Incline Creek	iron
Glenbrook Creek	iron
First Creek	zinc

Reporting of current water quality conditions and trends reported through Forest monitoring has been presented in the Forest Monitoring Program Annual Report for 2004/2005 through 2009/2010. The only analysis of water quality data that has been completed and presented in these reports during this time period is for Heavenly Ski Resort and the Marlette Creek, Blackwood Creek, and Cookhouse Meadow Restoration projects.

Water quality data indicates significantly improved conditions within the Heavenly Ski Area, with the water quality well below the TMDL standard for Heavenly Creek. There are still persistent exceedances of standards for iron (which appears to be natural causes) as well as chloride at all three Heavenly creek WQ sites, however these were also exceeded at the undisturbed reference site on Hidden Creek. State effluent standards for the California Lodge parking lot, Edgewood Creek, and below the Boulder parking lot are also typically exceeded. Heavenly has recently completed new BMPs at both these facilities, and is continuing to investigate and improve the performance of these BMPs.

Monitoring at the dam removal and stream restoration project at Marlette Creek indicates that the new channel has been continuing to adjust after restoration, with evidence of continued bank erosion and channel scour and deposition. Water quality data has not proven to be a useful measure of project effectiveness, compared to instream channel measurements and photopoints. Therefore water quality monitoring has been discontinued, and future monitoring at this site will rely on channel measurements

and photopoints, repeated at 3 year intervals to track channel adjustments and determine whether future restoration efforts are necessary. Based on this monitoring, deficiencies in the restoration design approach of this project have been identified, and have resulted in improved integration of geomorphic principles in later projects.

Water Quality monitoring was conducted at the Cookhouse Meadow/Big Meadow Creek and Blackwood creek restoration projects, during implementation only. This monitoring was required as part of State NPDES permitting, to determine whether state standards were maintained during project implementation. This monitoring indicates that state standards for turbidity (no more than 10% exceedance over background levels) are frequently exceeded during implementation of in-channel stream restoration projects. However because background levels are typically very low (between 0.1 and 2 NTUs), the level of exceedances has usually stayed below 5 NTUs. There are exceptions when major precipitation events, and/or diversion failures have occurred during implementation; however, these have been of relatively short duration and magnitude. The LTBMU is continuing to learn from past experience, to improve the timing, implementation, and maintenance of construction BMPs at these projects. Ongoing monitoring at both of these projects indicates there has already been substantial water quality benefits at both sites, as evidenced by measurements of more frequent and longer duration overbank flows, sediment deposition in the floodplain, and reduced channel erosion (Norman, 2009 and Oehrli, 2009)

Desired conditions and attributes for water quality as described in the 1988 Forest Plan have been refined through the Pathway 2007 process. The intent of the original desired condition statements has not been substantially changed through this refinement, but rather reflects an attempt to provide a better organized and uniform approach. The proposed attributes for pollutant load reduction related to lake clarity however do reflect a major change in how attainment of water quality desired conditions are measured through the development of the Lake Tahoe Basin Total Maximum Daily Load Model by the Lahontan Regional Water Quality Control Board. The TMDL model has assigned sediment and nutrient load reduction milestones for every watershed for each pollutant sources within that watershed, in order to meet the total load reductions needed to protect Lake Tahoe clarity. A crediting program is being developed to assign regulatory targets for achieving pollutant load reduction targets for urban sources.

There is no crediting program related to USFS sources, however the USFS will be required to report annually on actions taken to achieve TMDL milestones, for upland and stream channel source categories on USFS managed lands. TMDL regulatory agencies (Lahontan and NDEP) will use select metrics within the Tahoe Regional Planning Agencies Environmental Improvement Program (EIP) performance measures tracking and reporting program to evaluate progress for upland and stream channel sources. The LTBMU will continue to provide data to the EIP performance measure tracking and reporting program.

EIP performance measures will be used in conjunction with current state water quality standards to measure attainment of desired conditions and regulation of management activities to protect the beneficial uses for waters within the Lake Tahoe Basin as identified in the Lahontan Basin Plan. (LRWQB, 2005)

All the management activities contained within the TMDL model are assigned disturbance coefficients that estimate their degree of impact on water quality. The Forest will continue to adapt its monitoring program to provide better information to inform and validate the parameters used in the TMDL model related to Forest Management activities. The Forest monitoring program is anticipated to focus primarily on parameters related to soil quality, stream channel geomorphic condition, and BMP effectiveness. As requested by TMDL regulators, the LTBMU will routinely provide key findings (and citations) developed through its internal monitoring programs, that provide useful information for evaluation of TMDL implementation.

Region 5 has developed guidance for management prescriptions and practices to protect water quality through the Region 5 Water Quality Management Program. This is described more fully in the Soil Erosion section presented below.

And finally, a Draft "Stream Condition Assessment of the Lake Tahoe Basin in 2009 and 2010 using the River Invertebrate Prediction and Classification System (RIVPACS)" report, conducted through a SNPLMA research agreement with Humboldt State University, in coordination with the Tahoe Regional Planning Agency, indicates that overall the majority of Tahoe Basin streams are in good to excellent condition as it relates to the macroinvertebrate community (O'Dowd and Stubblefield, in prep). Macroinvertebrates are widely being accepted and utilized as a valuable indicator of water quality.

Groundwater Quality

In May 1975, leachate discharge was detected associated with the Meyers Landfill site. Volatile organic compounds (VOCs) and vinyl chloride were detected in the ground water beneath the landfill. These substances also reached nearby Saxon Creek. In the decades since, a plume of contaminated ground water has migrated thousands of feet offsite and poses a potential threat to domestic water supplies. An interim remedy is nearing completion which stabilizes the landfill and prevents rainwater from infiltrating into the landfill waste and thereby feeding more contaminated leachate to the ground water. The final remedy will determine the best means of controlling and removing the ground-water contamination.

Soil Erosion

Soil erosion is the primary process driving water quality impacts from forest management activities. Maintaining functional characteristics of soils such as hydrologic function, soil cover, and soil porosity, and soil productivity, are essential to maintaining overall watershed condition as it relates to erosion processes that effect water quality. The clarity of Lake Tahoe, the primary water quality concern in the Lake Tahoe Basin, is inextricably linked to controlling inputs of fine sediment to the lake, as well as nutrients bound to sediment particles. Therefore maintaining soil quality is a critical component of the Forests water quality protection program.

The Forest Service has developed a number of protocols to evaluate the potential for Forest management activities to adversely impact water quality, including evaluations of standard Forest Service Best Management Practices (BMPs). Forest Service BMPs have been systematically evaluated through the Region 5 Best Management Practices Evaluation Program (USDA Forest Service 2000) at randomly selected sites since 1992.

Monitoring through the Regional Best Management Practices Evaluation Program (BMPEP) has demonstrated an increase in implementation and effectiveness of BMPs employed for erosion control since the inception of the program. An extensive set of Forest Service Regional BMPs are prescribed for projects in all program areas, and additional project-specific BMPs are often prescribed. The annual BMPEP monitoring reports discuss monitoring results in detail, and are posted on the LTBMU external website; this data is presented in Table 3-83.

Table 3 83. Comparison of overall Best Management Practices Evaluation Program Ratings

Year of Evaluation	# eval	Implemented & Effective (%)	Not Implemented & Effective (%)	Implemented & Not Effective (%)	Not Implemented & Not Effective (%)
1992-2002	194	72.2	11.3	11.3	5.2
2003	45	80	0	13.3	6.7
2004	66	78.8	7.6	12.1	1.5
2005	39	94.9	2.6	2.6	0
2006	33	78.8	6.1	9.1	6.1
2007	32	78.1	6.25	9.4	6.25
2008	39	95	2.5	2.5	0
2009	30	90	7	3	0
2010	37	90	5	5	0
2003-2010	321	85	5	7	3

As can be seen in the table above, there has been a 13% improvement in overall BMP implementation and effectiveness ratings in for period between 1992 through 2002, and the period 2003 through 2010. In 2011, a new “at risk” category was added to the rating system, which describes those BMPs in between an effective and not effective rating. In 2011, 95% of the 38 BMPs scored were rated as effective, with 2 BMPs (5%) rated “at risk”. In 2012, 94% of the 35 BMPs scored were rated effective, with 2 BMPs (6%) rated ineffective. The Forest objective is to maintain 100% implementation and 95% effectiveness ratings.

Effectiveness deficiencies that historically seemed to recur persistently appear at roads crossings, recreation facilities and the Baldwin grazing allotment. As reported in Regional reporting of BMP implementation and effectiveness integrating results from all Region 5 forests, the most serious deficiencies occur when BMPs are not implemented as prescribed, or maintained, prior to significant storm events, as recently described in the 2009 LTBMU BMPEP report. Through regular reporting of the success of BMP implementation and effectiveness the Forest has become more responsive in correcting deficiencies.

TRPA BMPs are also prescribed and implemented where appropriate. The Special Uses Program required implementation of erosion control BMPs for owners of summer cabins on NFS land; and implementation of these BMPs was completed between 2005 and 2010.

Road and trail monitoring has been effective in identifying areas where runoff or off-road use has caused erosion. Inter-department communication of repair needs has improved, facilitating more timely repairs. In addition the LTBMU has also developed a water risk assessment for roads, which is utilized in conjunction with a watershed erosion prediction model to predict erosion potential (WEPP). The Forest completed a three-year evaluation of the Forest Roads Retrofit program in 2007, evaluating the effectiveness on retrofits implemented between 2003 and 2005 (USFS, 2007). Using a qualitative road risk assessment, this evaluation indicates that there has been a reduction in the number of high and medium risk road segments through the roads retrofit program. The water quality risk assessment

estimates that the majority of the Forest Service system road network presents virtually no risk to water quality, because of the location, grade, and proximity to stream channels of these roads. However there are approximately 11 miles of water quality risk road segments located adjacent to stream crossings, or exhibiting chronic erosion features, that will continue to have sediment loading potential. These water quality risk road segments will require more frequent maintenance and monitoring of BMPs, and may require more aggressive design measures to lower water quality risk. An addendum to this report was produced in 2009 that performed the same type of evaluation for the 4.2 miles of road that were retrofitted between 2006 and 2008.

An evaluation of a subset of these surveyed road segments (approximately 2/3) utilizing the WEPP runoff and erosion prediction model estimates a reduction in sediment yield from Forest Roads, from 23 tons per year, to 2 tons per year as a result of BMP upgrades. The WEPP model provides an estimate of annual erosion rates, and the model state that based on a comparison between measured and estimated results, WEPP has approximately 50% accuracy. Even with the limitations in the accuracies of WEPP modeling, it is clear that reducing the hydrologic connectivity of roads has had a substantial impact on reducing the water quality impacts from Forest roads.

Design strategies include limiting unpaved parking areas, limiting foot traffic in sensitive areas, reducing the area where foot traffic occurs, and providing hard surfaces in intensively used areas. Systematic monitoring of campsites in Desolation Wilderness began in 2008, as a joint project with the Eldorado National Forest and is still ongoing. This program describes environmental impacts to campsites and identifies campsites where visitor use has decreased plant cover and vegetative litter, compacted soil, and resulted in the creation of multiple trails. The program also identifies other impacts not related to soils.

Prescribed fire has been largely successful in reducing fuels without significantly impairing soil productivity. There have been instances where fire has burned too hot and a reddening of the soil suggests a possible altering of soil physical and chemical properties, but these have been rare and their spatial extent has been small.

To minimize soil disturbance, over the snow logging was recommended in the 1988 plan, but weather patterns have severely limited the feasibility of this practice in the Lake Tahoe Basin. In recent years, low ground pressure equipment has been used in fuels reduction projects as a means to minimize soil disturbance. This equipment has been run on rubber tires instead of tracks, which limits soil displacement and compaction. There has been a large variety of research conducted in other parts of the nation, which indicates that this type of equipment can have minimal impacts on soil quality when operated under appropriate soil moisture conditions (Han et al. 2007). Due to the high level of concern related to the potential for soil quality degradation in the Tahoe Basin, and resulting impacts to Lake Tahoe, the LTBMU decided to initiate a soil quality monitoring program to evaluate the impacts of this technology specifically on Tahoe Basin soils.

Between 2006 and 2009, the LTBMU collected data on soil quality parameters at three separate fuel reduction projects around the Basin, which utilized low ground pressure harvesting equipment. These projects represent a range of soils types around the Basin from west shore (Ward Unit 5, 2007) , south shore (Heavenly SEZ, 2008) and east shore (Roundhill, 2009). The Heavenly SEZ fuels reduction project was a pilot project to evaluate mechanical treatments on soils classified as SEZ. The full monitoring reports for these three projects are posted on the LTBMU website.

Measured soil quality parameters include soil moisture, hydraulic conductivity (Ksat), bulk density, and soil cover. This data was then analyzed to determine pre and post project differences and whether regional soil quality guidelines were met. Measured soil quality data, as well as other specific site characteristics (i.e., slope, % canopy cover, and soil composition) were then input into the WEPP Hillslope model to

determine to what degree measured changes in soil quality resulted in predicted changes to erosion response. The following conclusions can be drawn from these monitoring efforts:

- Regardless of where you are in the Tahoe Basin, soils consist primarily of coarse sandy loams with naturally high infiltration capacities. Therefore even though hydraulic conductivity was reduced by 27% to 62% as a result of management activity, median Ksat measurements between the three projects post-project were still 3.7 in/hr (Ward), 2.4 in/hr (Heavenly SEZ), and 2.08 in/hr (Roundhill). In one of the Roundhill units, post project Ksat measurements actually indicate an increase. We believe this result indicates that our sampling size (n=60) was not adequate to overcome the inherent variability that exists in this parameter in nature, and assume that this result means that there was no real change in Ksat in that particular unit.

- CTL harvester/forwarder equipment has not resulted in ecologically significant effects on the variety of Tahoe Basin soils evaluated, under the soil moisture conditions in which project operations occurred (5 to 11% soil moisture content). Soil cover after treatments averaged around 90%, and soil porosity decreases were less than 5%. With the combination of robust soil cover, very small decreases in porosity and infiltration capacities still ranging from 2 to 3.7 in/hr post project; soil stability, soil hydrologic function, and soil productivity are not adversely impacted.

- WEPP modeling further indicates no ecologically adverse effects related to changes in runoff, erosion rates, or sediment transport as result of fuels reduction treatments. Among all three projects predicted sediment yield post project, using a 20 to 30 year climate simulation, ranged from 0.0 to 0.1 ton/acre/year.

Seasonal gate closures have been effective in limiting damage to roads and trails, which in turn limit off-road erosion (USDA Forest Service 2003, 2005a). LTBMU policy for timing gate closures favors resource protection through a conservative approach. Limiting off-highway vehicles to established routes and snowmobiles to designated areas has further prevented soil resource damage, but effectiveness is somewhat limited by law enforcement resources. As mentioned above, project design on developed recreation sites is being employed to limit disturbance from foot traffic to smaller areas and less sensitive areas. Hardened surfaces are provided on the most heavily used pathways and in parking areas.

Legacy compaction from logging activities in the 1950s and 1960s is still evident in many areas, but there are no visible or measurable effects on ecosystem condition as it relates to erosion and increased peak flows, or effects on vegetation).

Many stable disturbance features from the Comstock logging are now preserved for their historic value. Most of these roads, flumes, railroad grades, and other features have stabilized, so they no longer represent erosion sources.

Soil condition as it relates to soil erosion on NFS lands can generally be considered to be within desired ecological condition. The Forest has a relatively small and maintained road and trail network, and BMPs have and are being implemented at all dispersed and developed recreation facilities. The Forest has three grazing allotments (Trout Creek, Meiss, and Cold Creek)), but all are currently in vacant status (Section 3.4.18 – Range Resources). Restoration efforts have increased soil cover on ski slopes at the Heavenly Ski Area by an average of 20% between 1991 and 2003. However much of this cover is in the form of grass that requires ongoing irrigation and efforts are continuing at the resort to implement more sustainable soil restoration techniques, that do not require irrigation, at specific ski slope locations that have high connectively to water bodies.

The LTBMU anticipates having adequate funding to provide effective erosion control and soil restoration where new planned (and unplanned) soil disturbance is an issue, and to continue a program for monitoring impacts to soil condition as well as the Regional Best Management Practices Evaluation Program (BMPEP). Soil monitoring will continue to focus on impacts related to the use of mechanical equipment to treat vegetation as well as prescribed fire impacts. Regional Soil Quality Standards adopted in 1995, providing more detailed direction for assessing soil resource conditions than the Forest Plan, and were the starting point for developing the LTBMU soils monitoring program, as documented in the LTBMU soil monitoring plan, which is updated annually.

Ongoing monitoring of roads and trails will also continue, as the Basin continues to maintain its roads and trails network. Recent monitoring results from trails indicates that because of the low erosion and sediment delivery potential for these features, monitoring can be limited to routine visual surveys. Roads monitoring will continue to utilize a more intensive approach that relies on formal condition assessments, and WEPP modeling.

Stream Channel and Stream Environment Zone (SEZ) Condition as it affects Soil Erosion and Reduction of Fine sediments and nutrient loading.

The term stream environment zone (SEZ) was created by the Tahoe Regional Planning Agency, and is unique to the Lake Tahoe basin. It is a term used to attempt to define ecotypes that are heavily influenced by the presence of groundwater and/or surface water during at least part of the year, for the purposes of developing regulatory policies and standards related to these ecotypes. SEZs include ecotypes that lie adjacent to stream channels, and lakes, as well as those that are not directly connected to surface water bodies. SEZs include perennial, intermittent, and ephemeral stream channels, and lands typically termed as wetlands/fens/marshes (which have relatively high connectivity to water) as well as dryer ecotypes that have a lesser degree of connectivity to surface and groundwater (such as dry meadows and aspen stands). SEZs include a wide variety of wetland and riparian ecotypes which are addressed through numerous existing federal (USFS, EPA, FWS) and State planning and guidance documents and initiatives, even though the term SEZ is not used in these documents. SEZs should be considered to be a subset of ecotypes that lies within the zone described in the 2004 SNFPA ROD as Riparian Conservation Areas (RCOs). There is tremendous overlap between these two concepts of defining this ecotype.

These ecotypes are considered to be high value as it relates to a variety of ecosystem functions including water quality. As such, stream environment zones are a critical subcomponent of overall watershed condition as described above, and are the areas where degraded watershed function is most apparent. Maintaining functional characteristics of stream environment zones such as stream channel floodplain connectivity, vegetative cover, and soil hydrologic function are essential to maintaining overall watershed condition.

In the 1988 Forest Plan, goals and desired conditions for SEZs were included in the water quality desired conditions. These goals and desired conditions were expanded and given more of an ecosystem context by the Sierra Nevada Forest Plan Amendment (USDA Forest Service 2004a),

In 1996, the Sierra Nevada Ecosystem Project (SNEP) was completed. This document described and analyzed available knowledge, observations, and data with respect to riparian areas, wetlands, and stream channel conditions throughout the range. The results of SNEP suggested land use impacts in riparian areas, wetlands, and stream channels are greater than are seen in any other portion of the landscape. The study also enlightened management's view in that conditions in these ecotypes are often a reflection of watershed condition as a whole and suggested a more comprehensive approach to watershed management. The Sierra Nevada Forest Plan Amendment was, in part, a response to these findings. Proposed in 2001 and completed in 2004, the amendment has specific standards and guidelines for

Riparian Conservation Area (RCA) management, and is directly applicable to ecotypes referred to as SEZs in the Lake Tahoe Basin. The SNFPA amendment directs Forests throughout the range to take actions and restore physical processes in RCAs that lead to healthy, self-sustaining ecosystems. Applicable direction from the SNFPA has been incorporated into all alternatives.

A presidential visit in 1997 led to the creation of the Lake Tahoe Restoration Act in the year 2000, which authorized funding for actions to restore and enhance the Lake's clarity, which includes efforts to restore SEZs. From 2005 through 2012, the Southern Nevada Public Lands Management Act has provided the funding for this work, and enabled the LTBMU to take a multi-disciplinary approach to the restoration of ecosystem processes at a watershed scale, to estimate how ecosystem conditions have deviated from natural trajectory, and then develop and implement projects to restore watersheds to a more natural trajectory. It is believed that this approach will lead to healthier functioning, self-sustaining ecosystems.

The LTBMU has initiated and completed several watershed-scale ecosystem analyses and has already begun to implement large-scale projects to meet LTBMU ecosystem restoration goals. Goals are largely defined by guidance provided in the SNFPA. Although SNFPA did not use or recognize the term SEZ, it did describe goals, objectives, strategies, and standards and guidelines for Riparian Conservation Areas. The definition and criteria for delineating RCAs is different than that for SEZs, however the management guidance is directly applicable to both.

Movement towards these desired conditions is accomplished through prevention and restoration of resource damage. Restoration is discussed below; prevention is largely accomplished through BMP implementation, and is discussed in the water quality and soils sections of this chapter.

In 1988, the Watershed Restoration program's primary goals were to reverse the downward trend in the quality of water flowing into Lake Tahoe from tributary streams on national forest lands,(as was demonstrated by data collected from the LTIMP tributary monitoring at the time), enhance and protect natural riparian function, and maintain and protect soil productivity and character.

The program completed a Watershed Improvement Needs (WIN) Inventory that identified many of the basin's erosion and potential water quality problems. Standards and Guidelines (S&Gs) focused on actions that included stream bank stabilization, controlling erosion at road crossings, and structural and non-structural habitat improvements for cold-water fish species. Floodplains have unique sediment filtering and nutrient recycling capabilities; therefore restricting disturbance and restoring floodplain connectivity to stream channels is a priority. Additionally, recommended restorative actions for existing disturbances in SEZs and riparian areas, identified in the WIN, is also a priority. The Plan also supports the conservation of soils as an underlying strategy for maintaining vegetation and preventing further degradation of water quality.

Over a 12-year period (1988-2000), approximately 500 acres of SEZ lands were treated.

Many treatments were small in scale and most were site specific i.e., stabilization of an excessively eroding stream bank. Most treatments have exhibited some degree of success with respect to meeting program goals.

Between 2000-2010 Watershed and SEZ restoration was planned and implemented at a larger scale. As described in the previous section under watershed condition, based on a variety of resource inventories the LTBMU contracted numerous watershed assessments between 2001 and 2004. These assessments reflect a fundamental shift in watershed management philosophy as reflected in the SNFPA, and identified restoration needs and opportunities for SEZs within those watersheds. The LTBMU also identified degraded conditions on a few discrete areas on the landscape that did not warrant a full-scale watershed analysis, but were addressed through smaller scale environmental assessments.

The following identifies the SEZ restoration projects implemented as a result of watershed assessments and environmental analysis conducted during this period:

2002 – Ward Creek fill removal and floodplain enhancement (3 acres)

2003 – Blackwood Phase I (Fish Ladder Removal) (2 acres)

2003 – Reconstruction on Lonely Gulch Creek (3 acres)

2003 – Dam removal on South Fork Marlette Creek (6 acres)

2005 through 2007 – Big Meadow Cookhouse channel construction (20 acres)

2006 – Blackwood Phase II (Barker Pass Bridge, culvert replacement) (4 acres)

2008 through 2009 -Blackwood Restoration IIIB, Reach 6 (40 acres)

2010 -2012– Blackwood Phase IIIA, Reach 1 (30 acres)

2010- 2012- Cold Creek in High Meadows Restoration, (100 acres)

Monitoring conducted to date on these projects indicate that restoration efforts have been measurably successful in restoring ecosystem function in terms of reducing stream channel erosion and improving floodplain connectivity. Monitoring results and analysis are documented in numerous reports which are available on the LTBMU external website). These reports have also identified where restoration efforts have fallen short and the importance of incorporating sound principles of geomorphic function in restoration designs. Long term monitoring programs are in place to track effectiveness of existing and future efforts, and to inform adaptive management of the restoration program.

Current Forest Plan direction adopts TRPA and Lahontan RWQCB direction for SEZs, for all lands in the Lake Tahoe Basin. The USFS SNFPA added a wealth of guidance for Riparian Conservation Areas (RCAs), which are similar in definition to SEZs, but usually include much broader buffer zones. The guidance however is directly and appropriately applicable to both SEZs and RCAs.

Unlike current SEZ regulations, management activities are not prohibited in RCAs if analysis is conducted that shows that the project will meet the Riparian Conservation Objectives (RCOs) and the RCA standards and guidelines. The RCO analysis process is very sound and needs little change to meet the LTBMU's needs for Forest Plan revision. The RCA desired conditions and objectives were incorporated into the SEZ desired conditions in the Pathway 2007 process. At this time, the Forest Plan does not specifically reflect the changes in watershed resource management thinking since 1988.

The local State Water Resources Control Board has developed a Total Maximum Daily Load (TMDL) model for Lake Tahoe. This model estimates that 3% of total fine sediment to Lake Tahoe comes from stream channel erosion. Projects to stabilize degraded stream channels and restore floodplain connectivity will play a relatively small but important role in achieving TMDL load reduction targets for both stream channel erosion, as well as "treating" runoff from upland contributing source areas. The TMDL identified the Upper Truckee, Blackwood Creek, and Ward Creek as the three most significant contributors of stream channel erosion to Lake Tahoe. Along with the projects identified in the previous section, future projects planned on USFS lands in the Upper Truckee and Blackwood watersheds are expected to result in measurable improvements to sediment loading over time in these watersheds. A geomorphic based TMDL was also established specific to the Blackwood watershed, which identifies TMDL targets based on geomorphic parameters (sinuosity, vegetation cover, and slope). All large scale opportunities for stream channel restoration actions have been completed in the Blackwood watershed,

and LTBMU monitoring programs are in place to measure attainment of the Blackwood TMDL targets over time.

As described above, many of the major stream channel floodplain restoration projects identified on National Forest lands have been completed, and several others are in progress in the Upper Truckee River watershed). Many of these projects are also expected to provide substantial benefits to biological resources, as aquatic habitat is improved in stream channels, and riparian habitat in adjacent floodplains, and for some of these projects these biological benefits are the main driver for project prioritization.

Smaller scale stream channel restoration projects to restore stream channel function will continue to be tracked through the Watershed Improvement Program, described in the previous section under Watershed Condition.

Many future SEZ restoration projects on the LTBMU will focus more on the biological components of SEZ, such as meadow and aspen stand restoration through thinning and prescribed fire.

Additionally, restoration analysis identified that cessation of natural fire regimes in and adjacent to some SEZs is a potential threat to ecosystem function. Similar to the vegetation and fuels management strategy in the rest of the LTBMU, natural disturbance processes in SEZs need to be mimicked by using vegetation manipulation and prescribed fire. The drought and subsequent bark beetle infestation in the late 1980s and early 1990s resulted in high rates of Lodgepole pine mortality in riparian areas. Many of the affected riparian areas are within the wildland-urban interface and constitute a fire hazard. Limited handwork has been done to reduce fuel accumulations, but until recently local regulations adopted by LTBMU have prohibited the use of methods other than hand cutting and over-snow logging, so the vast majority of these areas remain untreated at present.

The LTBMU recently implemented a pilot treatment project (Heavenly SEZ Fuels Reduction project) to test the effects of using low impact mechanical harvest equipment to treat fuels on SEZ soils. Monitoring results from this project are documented in the Heavenly SEZ Fuels Reduction Monitoring Report, 2008, and indicate that low PSI forwarder harvester equipment can be used in these areas under appropriate soil moisture regimes without causing adverse ecological impacts to soils, or hydrology. From these results an SEZ sensitivity rating protocol has been developed to identify SEZs within the boundaries of future projects that also indicate this level of resiliency. Wetter SEZ types, that do not exhibit dry moisture soil conditions, would still be limited to hand treatment or over the snow treatments.

Thinning and prescribed burn treatments are likely to be a desired management practice to utilize in SEZs well into the future to reduce fuel loads, and restore desirable riparian vegetation communities (and associated animal species) and subsurface/groundwater interactions within meadows and Aspen stands. Current restrictions on mechanical equipment used in SEZs needs to be removed and replaced with management standards and guidelines presented for RCA in the SNFPA in the new Forest Plan. The biological aspect of SEZ restoration is described further in the Section 3.4.3 – Aquatic Wildlife.

Climate Change

The affected environment for climate change would be the same in this section and the water quantity and watershed sections.

As described in Appendix C – for Climate Change Trend Assessment, the changes in temperatures and amounts and timing of precipitation due to climate change have led to earlier peak streamflows in most Sierra Nevada streams, with higher spring flows and lower summer flows. Streamflow data show that peak snowmelt in the LTB is occurring 2½ weeks earlier today than at the beginning of the 1960's. Spring flows may not necessarily be higher in the Tahoe Basin, but peak flows may occur more

frequently, i.e., several peak flow spikes may occur throughout the winter and spring runoff due to rain on snow events, or extended periods of warm weather.

3.4.24.3. Environmental Consequences

Watershed Health and Aquatic Habitat Management

Under all the alternatives, the LTBMU would continue to implement to the USFS Watershed Improvement Program (WIP), and soil and water BMP program, The BMPs provide water quality protection from current and new activities, while watershed restoration actions under the WIP addresses adverse effects of past land uses. Soil and water protection BMP guidance is provided through recently updated US Forest Service Regional guidance (R5 FSH 2509.22, Chapter 10 Water Quality Management Handbook, 2011) and recently completed US Forest Service National guidance (USDA, National Best Management Practices for Water Quality Management on National Forest System Lands, 2012). A critical component of improving conditions in Lake Tahoe watersheds is implementation of stream channel restoration projects where under current conditions, stream channels exhibit unstable channel banks, and have eroded and incised to the point that they are no longer hydrologically connected to adjacent floodplains. Restoration projects currently in progress (defined as in planning phase currently and/or implementation has been funded and initiated) would be implemented under all of the alternatives. These currently planned projects address the bulk of the unstable channel reaches that have been identified on NFS lands in the Lake Tahoe Basin.

Under alternatives A, B, and C, and E the LTBMU would continue planning for implementation of both large and small scale restoration projects to restore degraded stream channels, beyond those projects for which planning and implementation has already been initiated. Under alternative D, future projects would not be planned to actively restore degraded stream channels. Some implementation of the National Watershed Improvement Program would occur, through removal of existing active stressors on these systems, (such as poorly designed stream channel crossings or hydrologic diversions). However systems that are out of equilibrium (as exhibited by headcuts, incision, accelerated bank erosion) as a result of past land use practices, climate change or other stressors not under the control of the USFS management, would be allowed to adjust through natural processes

Under all the alternatives, currently planned USFS stream channel and watershed improvement restorations are expected to be achieved within the next 15 years, and the benefits of this work measured through assessments of watershed and stream channel condition, and contributions to achieving TMDL milestones. However under Alternative D, the achievement of longer term TMDL stream channel milestones and geomorphic equilibrium from reaches on NFS lands, may take several decades longer than could be achieved through active restoration.

Vegetation Management

All the alternatives propose to utilize a variety of vegetation treatment options to reduce wildfire risk and improve forest health. Wildfire can result in significant impacts related to water quality and soil erosion, as documented in numerous studies across the country, which have been synthesized in the following document, Wildland fire in ecosystems; effects of fire on soils and water (Neary et al. 2005).

Although the focus treatment types and vegetation prescriptions vary between the alternatives, all the potential treatment options proposed in the alternatives pose some level of short term risk of soil erosion and subsequent impacts to water quality. These risks will be managed by a variety of established BMPs, and the standards and guidelines presented in the Revised Forest Plan. Therefore at the programmatic scale there are no differences among any of the alternatives as they affect water quality and soil erosion, in relationship to vegetation management activities. Vegetation management activities will not adversely

affect current 303d listings, or impact the forests ability to achieve TMDL milestones for upland source areas.

However alternative D does create a greater risk to water quality with a reduction in vegetation management activities, because with limited active fuels management there is a subsequently greater risk of catastrophic wildfire. A synthesis of research on the impacts of wildfire on water quality was published by the Rocky Mountain Research Station of the US Forest Service (Neary et al. 2005). The results from this synthesis conclude that the magnitude of effects on water quality is driven primarily by fire severity, which is a qualitative term, describing the amount of fuel consumed. Wildfires are more severe than prescribed fire, and as a result are more likely to produce significant effects on water quality in terms of sediment and nutrients. Canopy-consuming wildfires are expected to be the greatest concern to managers because of the loss of canopy coupled with the destruction of soil aggregates. These losses present the worst-case scenario in terms of impacts to water quality, particularly if followed by heavy rains on recently burned lands. In addition a synthesis of research specific to promoting resiliency in Sierra Nevada ecosystem was prepared by the Pacific Southwest Research Station in 2013. As described in various sections of this document, fuels management (through mechanical treatment and prescribed fire) as well as wildfire can have a wide variety of adverse impacts to soil and water quality. However the Effects of Wildfire section in Chapter 5 of this report states as a general conclusion, that management strategies that reduce the potential for uncharacteristically severe wildfires in Sierra Nevada forests will help limit erosional losses and conserve essential soil functions (Long J. et al, 2013).

The most significant risk to water quality as it relates to vegetation management practices are those associated with both permanent and temporary roads utilized as part of vegetation management projects. This is because roads can create linear conduits for concentrating flows and eroded sediments, if BMPS are not properly implemented and maintained.

Sustainable Recreation

The scale and nature of proposed activities related to management of recreation facilities and opportunity, including management area designations, also do not vary substantially in terms of potential effects to water quality between alternatives. Once again established standards and guidelines and BMPs to protect soil and water quality will be part of any proposed changes in recreation infrastructure or opportunities.

Snowmobile use will continue to be allowed in all areas that are not designated as closed in the OSV use maps, under all the alternatives. There has been much concern expressed by the public regarding the potential impacts of this use on water quality. There are two potential concerns related to this permitted use as it relates to hydrology, soils, and water quality. First is potential for ground disturbance, if sufficient snow cover is not maintained on travel routes. This concern is addressed in the Section 3.4.22 – Soils of this FEIS.

The second is the impacts of vehicle emissions on water quality, as exhaust emissions (VOCs and PAHs and nitrogen) are discharged and accumulate within the snowpack. There has been limited research conducted on water quality impacts from snowmobile emissions, primarily in Yellowstone and Grant Teton National Park. The results of this research indicate that although these emissions have been documented in the snowpack, there has been no evidence of exceedance of water quality standards in adjacent water bodies, related to VOCs and PAHs (Arnold 2006, Reah 2005, and NPS 2011). Limited data collection of PAHs related to snowmobile use was also conducted 2006 in Blackwood Creek in Lake Tahoe as part of a Phd thesis (McDaniels Phd Thesis, 2013). Similar to the National Park research, this research also documented increasing accumulation of PAHs in the snowpack adjacent to areas utilized by snowmobiles, as well as increases in PAH flux in Blackwood Creek during the two week time period in May when samples were collected. Although the McDaniels thesis was silent regarding the levels of

PAH contamination relative to EPA standards, further investigation by the USFS determined that measured levels were far below current EPA drinking water standards for these compounds, as well as levels at which detrimental impacts to aquatic life have been documented.

The incremental amount of OSV contributions to nitrogen loading is relatively small, but could be important if total loading is close to or exceeds a critical load of nitrogen (NPS 2011). According to the Tahoe TMDL, the amount of total nitrogen loading in the Tahoe Basin (largely from out of basin atmospheric sources) is such that Lake Tahoe is considered to be largely phosphorus limited, in terms of effects on lake clarity.

It is also important to note that existing research was conducted during a time when the majority of snow mobiles in use were utilizing 2-stroke engines, which produce much more of these pollutants, then 4-stroke engines that are becoming much more prevalent and are required to meet current EPA standards for emissions. Hydrocarbon and carbon monoxide emissions are reduced by 50% and 30% respectively when comparing average 2 stroke engines to current EPA snowmobile requirements (NPS 2011). See Section 3.4.2 – Air Quality for further discussion of snowmobile emissions.

Based on an analysis of the existing research, we conclude that continued OSV use, as proposed under all the alternatives, will result in negligible impacts to water quality.

Under all the alternatives, proposed changes in recreation infrastructure will consider impacts related to the ecological values of riparian areas and wetlands (SEZs). Under all the alternatives, opportunities to protect and restore the ecological function of SEZs will be identified and considered, as part of future proposed actions related to increased recreational opportunity and capacity.

The most significant difference that may exist between alternatives in this regard, may relate to the economic cost. For example, under alternatives B, C, and E it is proposed to expand developed and dispersed recreation capacity by increasing facility capacity. This may require more expensive design options to be able to achieve both an increase in recreational capacity, while at the same time mitigating or even restoring ecological function in areas where facilities exist within lands classified as SEZ

Under alternatives C and D the Dardanelles and/or Freel Peak Roadless areas are proposed for wilderness designation (See *FEIS Map 10*). This designation would result in limitations on any future watershed restoration activities that would involve the use of mechanical equipment. There currently are no known restoration needs in these proposed areas, and in the absence of the potential for human disturbance it is not anticipated there will be future needs identified in these areas. Future active restoration beyond currently planned projects is not proposed under Alternative D.

Access and Travel Management (ATM)

Similar to recreation facilities as described in the section above, the scale and nature of proposed activities related to management of forest roads, trails and associated access facilities also do not vary substantially in terms of potential effects to soil erosion and water quality. Once again, established standards and guidelines and BMPs to protect soil and quality will be part of any proposed changes in these components of forest infrastructure. In addition, under each of the alternatives the LTBMU will continue to pursue opportunities to retrofit, relocate, or decommission roads and trails to reduce potential sediment and nutrient loading to Lake Tahoe, as part of the Uplands Forest TMDL management strategy.

As described in the affected environment section, a large volume of the potential opportunities in this regard has already been accomplished over the past decade. However there will continue to be improvements where opportunities still exist, such as the in areas of recent land purchases.

Climate Change

The stream channel and floodplain restoration efforts planned under all the alternatives will result in these systems being more resilient to any hydrologic adjustments that occur due to future climate change. Geomorphologically stable stream channels and floodplains that exist in a state of dynamic equilibrium are better able to adjust to climate change impacts to hydrology, without resulting in adverse impacts to aquatic habitat, water quality, or water quantity. Hydrologic adjustments resulting from climate change occurs at a relatively slow rate as compared to hydrologic changes caused by human disturbance.

3.4.24.4. Analytical Conclusions

Comparison of Consequences by Alternative

Under all the alternatives, the LTBMU would continue to implement to some degree the USFS Watershed Improvement Program (WIP), and soil and water BMP program, The BMPs provide protection from current and new activities, while watershed restoration actions under the WIP addresses adverse effects of past land uses.

Under Alternatives A, B, C and E, the LTBMU would continue planning for implementation of both large and small scale restoration projects to restore degraded stream channels, beyond those projects for which planning and implementation has already been initiated. Under Alternative D, future projects would not be planned to actively restore degraded stream channels. Some implementation of the National WIP would occur, through removal of existing active stressors on these systems, (such as poorly designed stream channel crossings or hydrologic diversions). However systems that are out of equilibrium (as exhibited by headcuts, incision, accelerated bank erosion) as a result of past land use practices, climate change or other stressors not under the control of the USFS management, would be allowed to adjust through natural processes.

Under all the alternatives USFS stream channel and watershed improvement restorations are expected to be achieved within the next 15 years, and the benefits of this work measured through assessments of watershed and stream channel condition, and contributions to achieving TMDL milestones. However under Alternative D, the achievement of longer term TMDL stream channel milestones and geomorphic equilibrium from reaches on USFS lands, may take several decades longer than could be achieved through active restoration.

There is no substantial difference in consequences to water quality between all the alternatives based on planned Forest Management activities related to Vegetation Management, Recreation, or ATM

Because vegetation management treatments are primarily concentrated in a “ring” around lake Tahoe adjacent to urban areas (the WUI) , there is little to no potential for adverse consequences related to cumulative watershed affects under any of the alternatives, except as it relates to achieving overall reductions in pollutant loading affecting Lake Tahoe clarity as presented in the TMDL. Watersheds in Lake Tahoe are generally characterized by some level of urbanization in the lower third of the watersheds, with primarily stable forested uplands in the upper 2/3 of the watershed. Regardless of the specific type and scale of treatment options used as described under all the alternatives in the WUI, implementation of BMPs are expected to result in neutral environmental consequences as it relates to achievement of TMDL milestones, stream channel condition, or watershed hydrologic response.

All the strategies and objectives proposed under all the alternatives will not change the LTBMUs goal of doing its part to achieve the Lake Tahoe Basin TMDL milestones related to stream channels and forest uplands. The TMDL milestones for these two pollutant sources are a 12% reduction in fine sediment from Forest Uplands, and a 53% reduction of fine sediment from stream channels. As described in the TMDL water quality control plan, it is anticipated that these reductions will be achieved through past

actions as well as through implementation of strategies as currently described under all the alternatives including implementation of BMPs, facilities roads and trails retrofits and decommissioning, implementation of currently planned restoration projects, and removal of existing stressors.

These efforts will be reported and tracked annually, as part of the LTBMUs contribution to the Lake Tahoe TMDL management strategy.

How the Alternatives Maintain or Achieve the Desired Conditions

Implementation of BMPs are expected to be successfully in protecting soil and water resources, and maintaining state water quality standards, as part of implementation of forest management actions proposed under all the alternatives.

Under all the alternatives, all planned USFS stream channel and watershed improvement restorations are expected to be achieved within the next 15 years, and the benefits of this work measured through assessments of watershed and stream channel condition, and contributions to achieving TMDL milestones. However under Alternative D, the achievement of longer term TMDL stream channel milestones and geomorphic equilibrium from reaches on USFS lands, may take decades longer than could be achieved through active restoration, as this is the time scale at which geomorphic equilibrium is re-established through natural processes after disturbance.

3.4.25. Water Quantity

3.4.25.1. Introduction

This section evaluates and discloses the potential environmental consequences on surface and groundwater quantity that may result with the adoption of a revised land management plan. It examines, in detail, all of the alternatives for revising the 1988 Land and Resources Management Plan (as amended) for the LTBMU (1988 Forest Plan).

Surface waters and ground waters are vital components of watersheds. Functional quantities of water flowing above ground in rivers, streams, springs, lakes, ponds, and marshes, and below ground in aquifers and underground rivers, must be maintained through management of water uses. Conjunctive-use management explicitly recognizes the interdependence of ground water and surface water within a watershed and is the framework within which water uses are best evaluated.

Methodology

Metrics

- Water quantity- General discussion of current water uses, consumptive and non-consumptive- including in stream flow requirement based on water rights and uses inventory and LTBMU Groundwater study.

Assumptions

- While groundwater demand is expected to continue increasing, at this time it appears that ground-water quality and quantities are sufficient to support use throughout the Lake Tahoe Basin by private, municipal, and commercial users within and adjacent to National Forest System lands.

- At this time, it appears that surface water users in the Lake Tahoe Basin are not exceeding their allocated amounts and there are no potential illegal diversions or withdrawals

3.4.25.2. Overview of the Affected Environment

Groundwater

As the current Forest Plan predicted, there has been an increased demand for ground-water usage. While the demand is expected to continue increasing, at this time it appears that ground-water quality and quantities are sufficient to support use throughout the Lake Tahoe Basin by private, municipal, and commercial users within and adjacent to National Forest System lands. The US Geological Survey produced a report in 2007 which presents a compilation of existing hydrogeologic data and other information needed to determine the extent and characteristics of the aquifers in the Tahoe Basin (USGS, 2007).

The potential for overuse of ground water in the Basin is significant, however, as water demands generally mirror population increases and ground water is looked upon as a more stable supply than surface water. Ground-water levels appear to have stayed within historic ranges, with sufficient recharge rates to meet the demands of users; there have been no reports of wells drying up or of declining trends of water levels

The sufficiency of ground water to meet the natural resource needs of National Forest System lands in the Basin is presently not known (e.g., to maintain springs, stream baseflows, wet meadows, marshes, fens, bogs and other ground-water dependent ecosystems). However, it is important that sufficiency be determined to facilitate management of these natural resource needs. In the absence of such information,

wise use of the resource requires that rather than using forest waters, the use of water sources located off NFS lands will be preferred when the water will actually be used off-forest (FSM 2542). Land use fees will be collected for ground water extraction, injection, or water pipeline operations authorized as special uses in accordance with FSM 2715 and FSH 2709.11, Chapter 30.

Another important consideration is that water shortages may be created by contamination of ground water, both in direct loss of the purity of the affected ground water, and in consequent loss of purity of springs or streams replenished by the affected ground water. The largest volume of ground water affected by contamination in the Basin is associated with the Meyers Landfill, where a plume of ground-water contamination has migrated offsite several thousand feet over decades. Although there have been reports of several small ground-water contamination incidents associated with fueling locations and underground storage tanks in the Basin, no other large-scale contamination incidents have been discovered. In the past, it was assumed that the desired conditions of preventing ground-water shortages and water quality degradation were being met in NFS lands within Lake Tahoe Basin; that assumption will be tested through ongoing inventories of ground-water uses, localized studies associated with discoveries of ground-water contamination, and water needs assessments of ground-water dependent ecosystems.

Surface Water

At this time, it appears there are no potential illegal diversions or withdrawals, Adjudication of water rights within the Basin continues, however, and this underscores the need to thoroughly evaluate any proposal to withdraw water from surface waters to determine the potential environmental impacts. The points of diversion (POD) and points of use (POU) have been verified for water rights held on NFS lands in the Basin. Water quantities will be verified as part of these ongoing water rights verification efforts in the Lake Tahoe Basin.

The LTBMU regulates runoff at Fallen Leaf Lake dam to prevent flooding along the lake and to delay peak runoff into Taylor Creek. Through the regulation of dam releases, channel degradation can be prevented and habitat integrity maintained.

Current Conditions and Trends

Management of Ground Water

Users of ground water on National Forest System lands include forest uses (e.g., administrative facilities, developed recreation sites, fire support, snow- and water-related recreational activities, and instream enhancement of fish and wildlife) and special use permits for ski resorts, concessionaires, and recreation residences. Measurement and reporting of the quantity of water utilized is required for all ground water withdrawals from high-capacity wells located in NFS lands; however, withdrawals do not have to be measured or reported from wells equipped only with a hand or windmill pump. The details of most groundwater withdrawals (e.g., location, depth, flowrate) under special use permit have not yet been verified; these are being handled during special use permit renewals at this time. A comprehensive water rights verification and monitoring program for ground-water withdrawals is underway and will be ongoing, and that may increase the pace at which all forest uses of ground water are characterized.

In addition to water rights verification, ground-water resources and ground-water dependent ecosystems in the Lake Tahoe Basin will be inventoried and characterized. The LTBMU is in the process of developing a program for inventory and characterization of ground water and ground-water dependent ecosystems in the Lake Tahoe Basin.

Management of Surface Water

In the past, the USFS has measured streamflows to characterize water quantity at various locations in the Basin, in conjunction with water-quality monitoring efforts to evaluate management impacts. The USGS and TRPA fund a Basin-wide monitoring program (Lake Tahoe Interagency Monitoring Program, LTIMP) that continues to monitor water quantity and quality at numerous tributaries throughout the Basin.

The Engineering Department of the LTBMU operates a data logger that takes hourly stage measurements at Fallen Leaf Lake and a data logger on Taylor Creek downstream of the Fallen Leaf Lake dam that takes hourly flow measurements. In addition, the Engineering Department takes occasional flow measurements on Glen Alpine Creek above Fallen Leaf Lake. The LTBMU Engineering Department is also responsible for regulating flows at Fallen Leaf Lake dam. This is the only location in the Lake Tahoe Basin where the USFS is responsible for such duties.

The LTBMU maintains existing water rights and obtains new water rights with land acquisitions and when other opportunities arise to put water to beneficial use for ecosystem conservation. Flow measurements are taken for water rights purposes as part of the Proof of Beneficial Use process of acquiring water rights in the State of Nevada. For the State of California, Statements of Diversion and Use are filed every three years concerning existing USFS water rights in California. The LTBMU is also preparing documentation to apply for conversion of existing consumptive water rights to riparian water rights, where previous consumptive uses of water have been discontinued. Existing reserve and riparian water rights are being maintained.

3.4.25.3. Environmental Consequences

Watershed Health and Aquatic Habitat Management

Under all the alternatives, the LTBMU will continue to follow national direction as it relates to management of surface water and groundwater quantity (and quality), to ensure beneficial uses for ecosystem conservation are maintained, while providing for essential consumptive use related to Forest Service administrative and recreation facilities.

In summer 2005, the importance of water rights on NFS lands was escalated to the Regional level that resulted in high priority direction to all forests in Region 5. Forests of Region 5 were directed to make water rights a high priority by doing a more thorough job of managing water rights, verification of water use, and the purchasing and exchange of water rights. At this time the Points of Diversion and Points of Use of all of the water rights in NFS lands in the Lake Tahoe Basin have been verified.

Groundwater

The Forest will follow national direction regarding ground-water management issued July 2011.

Surface Water

There are numerous water right holders on NFS lands in the Lake Tahoe Basin. Nationally, increased focus on water rights has necessitated verification of water rights usage on NFS lands. Completion of a comprehensive water rights verification exercise on NFS lands in the Lake Tahoe Basin is planned during the life of this Forest Plan in all alternatives.

Vegetation Management

The scale and nature of proposed activities related to vegetation management do not vary substantially in terms of potential effects to water quantity between alternatives. Established standard and guides and

best management practices to protect soil and water quality will be part of any proposed changes in these components of forest infrastructure.

Sustainable Recreation

The scale and nature of proposed activities related to management of recreation facilities and opportunity, including management area designations, also do not vary substantially in terms of potential effects to ground and surface water quantity between alternatives. Established standard and guidelines and BMPs to protect soil and water quality will be part of any proposed changes in recreation infrastructure (see discussion in previous section).

Access and Travel Management (ATM)

Similar to recreation facilities as described in the section above, the scale and nature of proposed activities related to management of forest roads, trails and associated access facilities also do not vary substantially in terms of potential effects to water quantity between alternatives. Established standard and guidelines and BMPs to protect soil and water quality will be part of any proposed changes in these components of forest infrastructure.

Climate Change

The stream channel and floodplain restoration efforts planned under all the alternatives will result in these systems being more resilient to any hydrologic adjustments that occur due to future climate change. Geomorphogically stable stream channels and floodplains that exist in a state of dynamic equilibrium are better able to adjust to climate change impacts to hydrology, without resulting in adverse impacts to aquatic habitat, water quality, or water quantity. Hydrologic adjustments resulting from climate change occurs at a relatively slow rate as compared to hydrologic changes caused by human disturbance.

3.4.25.4. Analytical Conclusions

Comparison of Consequences by Alternative

Under all alternatives, the LTBMU would continue to follow national direction as it relates to management of surface water and groundwater quantity, to ensure beneficial uses for ecosystem conservation are maintained, while providing for essential consumptive use related to forest service administrative and recreation facilities in all alternatives.

How the Alternatives Maintain or Achieve the Desired Conditions

Under all alternatives, the LTBMU would continue to follow national direction as it relates to management of surface water and groundwater quantity, to ensure beneficial uses for ecosystem conservation are maintained, while providing for essential consumptive use related to forest service administrative and recreation facilities in all alternatives.

3.4.26. Watershed Condition

3.4.26.1. Introduction

This section evaluates and discloses the potential environmental consequences on Watershed Condition that may result from Alternatives A, B, C, D, and E.

National protocols have recently been developed (USFS, 2011) for assessing and rating Watershed Condition. This protocol evaluates a wide array of attributes, including physical, aquatic, and terrestrial resource metrics, to develop an overall rating of Watershed condition. These attributes are listed below, and further detailed descriptions of the environmental consequences related to these attributes are addressed throughout this chapter, organized by resource area. This narrative focuses on the overall impacts on Watershed Condition, and includes subsections that discuss the physical resource attributes such as water quality, water quantity, and natural hazards.

Methodology

Forest Service Watershed Condition Classification Technical Guide, July 2011.

Assumptions

None.

3.4.26.2. Overview of the Affected Environment

Lake Tahoe Basin Watershed Condition

An assessment of watershed conditions considers physical resource values such as water quality, water quantity, soil condition, and stream channel and stream environment zone geomorphic condition. However watershed condition also considers biotic values related to species and their habitats. In short watershed condition integrates the entire ecological function of a land area contained within a given hydrologic boundary. For the LTBMU, existing assessments describe watershed condition primarily as it relates to the upper watersheds in the Lake Tahoe Basin that are within Forest Service Management, and not lower watersheds and intervening areas that are largely not under Forest Service Management and are impacted by urban development.

The Forest Service Manual (FSM) uses three classes to describe watershed condition (USDA Forest Service 2004, FSM 2521.1):

Class 1 watersheds exhibit high geomorphic, hydrologic, and biotic integrity relative to their natural potential condition.

Class 2 watersheds exhibit moderate geomorphic, hydrologic, and biotic integrity relative to their natural potential condition.

Class 3 watersheds exhibit low geomorphic, hydrologic, and biotic integrity relative to their natural potential condition.

The FSM classification defines watershed condition in terms of “geomorphic, hydrologic and biotic integrity” relative to “potential natural condition.” In this context, integrity relates directly to functionality. Geomorphic functionality or integrity can be defined in terms of attributes such as slope stability, soil erosion, channel morphology and other upslope, riparian and aquatic habitat characteristics. Hydrologic functionality or integrity relates primarily to flow, sediment and water quality attributes. Biological functionality or integrity is defined by the characteristics that influence the diversity and abundance of aquatic species, vegetation, and soil productivity. In each case, integrity must be evaluated

in the context of the natural disturbance regime, geoclimatic setting and other important factors within the context of a watershed. The definition encompasses both aquatic and terrestrial components because water quality and aquatic habitat are inseparably related to the integrity, and therefore the functionality, of upland and riparian areas within a watershed.

Within this context, the three watershed condition classes are directly related to the degree or level of watershed functionality or integrity: These three classes relate directly to watershed functionality, and therefore watershed condition, as:

Class 1 = Functioning Properly;

Class 2 = Functioning at Risk; and

Class 3 = Impaired Function.

In March 2011, the Forest Service assessed the condition of all 6th field hydrologic units on all NFS lands using protocols recently developed by the Washington Office headquarters staff, at intervals of approximately 5 years (Forest Service Watershed Condition Classification Technical Guide, July 2011).

The watershed condition classification system described in this Technical Guide uses twelve (12) indicators comprised of attributes related to watershed processes. The indicators and their attributes are surrogate variables representing the underlying ecological functions and processes that affect soil and hydrologic function. For the majority of the indicators, the FS can take direct action, or cause actions to be taken by others that can contribute to maintaining or improving watershed condition (i.e., functionality). This provides for a direct linkage between the classification system and management or improvement activities the FS conducts on the ground. Because of this linkage, when a sufficient number of properly designed and implemented restoration and/or management actions occur within a watershed, the outcome can be expressed as a change in condition class and the information used for performance accountability purposes. Management activities that effect the watershed condition class are not limited to soil and water improvement activities, but include a broad array of resource program areas from hazardous fuel treatments, invasive species eradication, abandoned mine restoration, riparian area treatments, aquatic organism passage improvement, road maintenance and obliteration, and others. To achieve a change in watershed condition class will in most cases require changes within a watershed that are significant in their scope and include treatments from multiple resource areas. Sound management or improvement to management practices can often be as effective as implementing restoration projects and must not be overlooked. In order to demonstrate improvement in condition class activities will need to be tracked at the smallest feasible watershed unit, the 6th level HUC or Hydrologic Unit Code (typically 10,000 to 40,000 acres in size).

The suite of watershed condition indicators includes:

1. Water Quality,
2. Water Quantity,
3. Aquatic Habitat,
4. Aquatic Biota,
5. Riparian/Wetland Vegetation,
6. Roads and Trails,
7. Soils,

8. Fire Regime or Wildfire,

9. Forest Cover,

10. Rangeland Vegetation,

11. Terrestrial Invasive Species, and

12. Forest Health.

The Lake Tahoe Basin HUC 6 watersheds contain several HUC 7 level watersheds that lie adjacent to each other. They all drain to Lake Tahoe, but are not hydrologically connected to each other. Therefore it is possible to have one or more HUC 7 watersheds within a HUC 6 watershed that exhibit poor ecological integrity, adjacent to highly functioning watersheds. For the purposes of this Forest Plan, watershed condition will be discussed as several scales, HUC 5, 6, and 7 levels.

The Lake Tahoe Basin constitutes one HUC 5 watershed and includes all the land that drains into Lake Tahoe. Condition of this HUC 5 watershed is best characterized by the TMDL evaluation report completed by the Lahontan Regional Water Quality Control Board, further described in the water quality section of this EIS (Lahontan, 2010). The Lake Tahoe Watershed is named on the EPA's 303d List as an impaired water body based on water quality.

The condition of HUC 6 watersheds on the LTBMU were assessed in March of 2011 (Figure 3-89). The results of this assessment indicate that 2 watersheds were rated as Class 1, 8 watersheds as Class 2, and no watersheds as Class 3.

Figure 3-89 is a map of the nine HUC 6 watersheds defined in the Lake Tahoe Basin, and their current watershed conditions ratings. The rating and watershed names are presented as:

1-Lake Tahoe-East Shore Frontal / North Half

1-Lake Tahoe-East Shore Frontal / South Half

2-Upper Truckee River –Angora

2-Upper Truckee River - Trout Creek

2-McKinney Creek-Bliss-Eagle Creek Frontal

2-Cascade Creek-Tallac Creek-Taylor Creek Frontal

2-Burton Creek-Watson Creek-Tahoe Vista Frontal

2-Ward Creek-Blackwood Creek-Eagle Rock Frontal

2-Stateline Point-Third Creek-Incline Creek Frontal

To describe watershed condition at the HUC 7 level we relied on existing survey and assessment information. This more informal assessment does rely on the same kind of data and analyses identified in the draft National protocol, but the qualitative assessment described below does not follow this specific protocol.

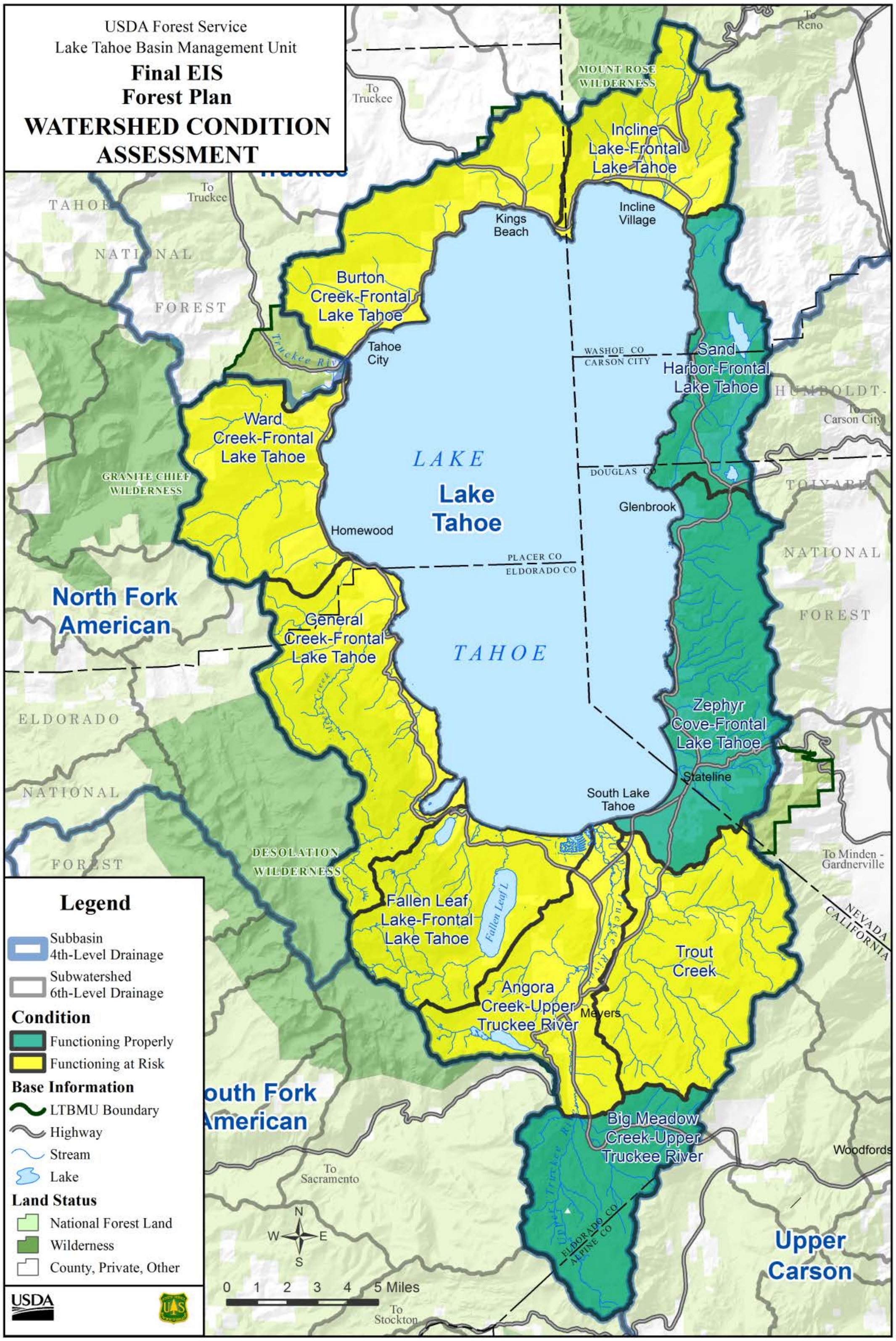


Figure 3 89. Map of HUC 6 Watersheds Defined in the Lake Tahoe Basin

Between 1993 and 2004 the LTBMU conducted watershed improvement needs (WIN) inventories throughout the Lake Tahoe Basin. During these inventories hydrologists visited every road, trail and stream channel to identify areas of accelerated erosion, and opportunities for restoration. During this time every stream in the Basin was also classified using the Rosgen Channel Typing protocol, as well as fish habitat typing. This information was used to identify stream reaches exhibiting unstable geomorphic channel characteristics and poor aquatic habitat quality.

In addition, a comprehensive Road Condition Assessment was conducted in 1998 to further identify roads in need of BMP retrofits, as well as roads that should be obliterated. Other assessments that helped assess overall watershed condition, included site specific stream condition inventories (SCI) on 16 reaches between 1993 and 2008, both on reference streams, as well as those that were identified for future restoration. In addition, macroinvertebrate sampling has been conducted since 1993 as part of SCI and other selected project monitoring plans

From information gathered through these various efforts a large number of smaller stream channel restoration projects were implemented, as well as a comprehensive BMP retrofit of system roads (154 miles) and decommissioning of approximately 100 miles of road. System trails in the Basin are currently undergoing a similar assessment and retrofit program, but are not considered to present the same degree of water quality threat as the road network.

The Basin has completed a substantial amount of work associated with water rights verification, covering USFS water rights in the Basin. A number of relatively small issues including non-compliance have been identified, and are currently being resolved. However, currently no significant problems affecting water quantity and associated riparian beneficial uses have been identified.

From these past inventory and assessment efforts, and subsequent management response, many of the Forest legacy issues that may affect overall watershed condition, in terms of erosion, water quality, and water quantity have been addressed in the upper watersheds managed by the LTBMU in the Lake Tahoe Basin.

However, these efforts also identified a small number of HUC 7 watersheds (or subwatersheds) as needing a more intensive level of watershed assessment to characterize current geomorphic, erosion, and hydrologic processes, and assess the need for larger scale stream channel restoration efforts to address channel reaches that had lost optimal stream channel and floodplain geomorphic function. Detailed watershed assessments were conducted for these watersheds, which include the Upper Truckee River (TRCD, 2003; Swanson 2004), Cookhouse/Big Meadow, Blackwood Creek, Cold Creek (tributary of Trout Creek), Meeks Creek, Ward Creek, and Taylor/Tallac Creeks (see Figure 3-90).

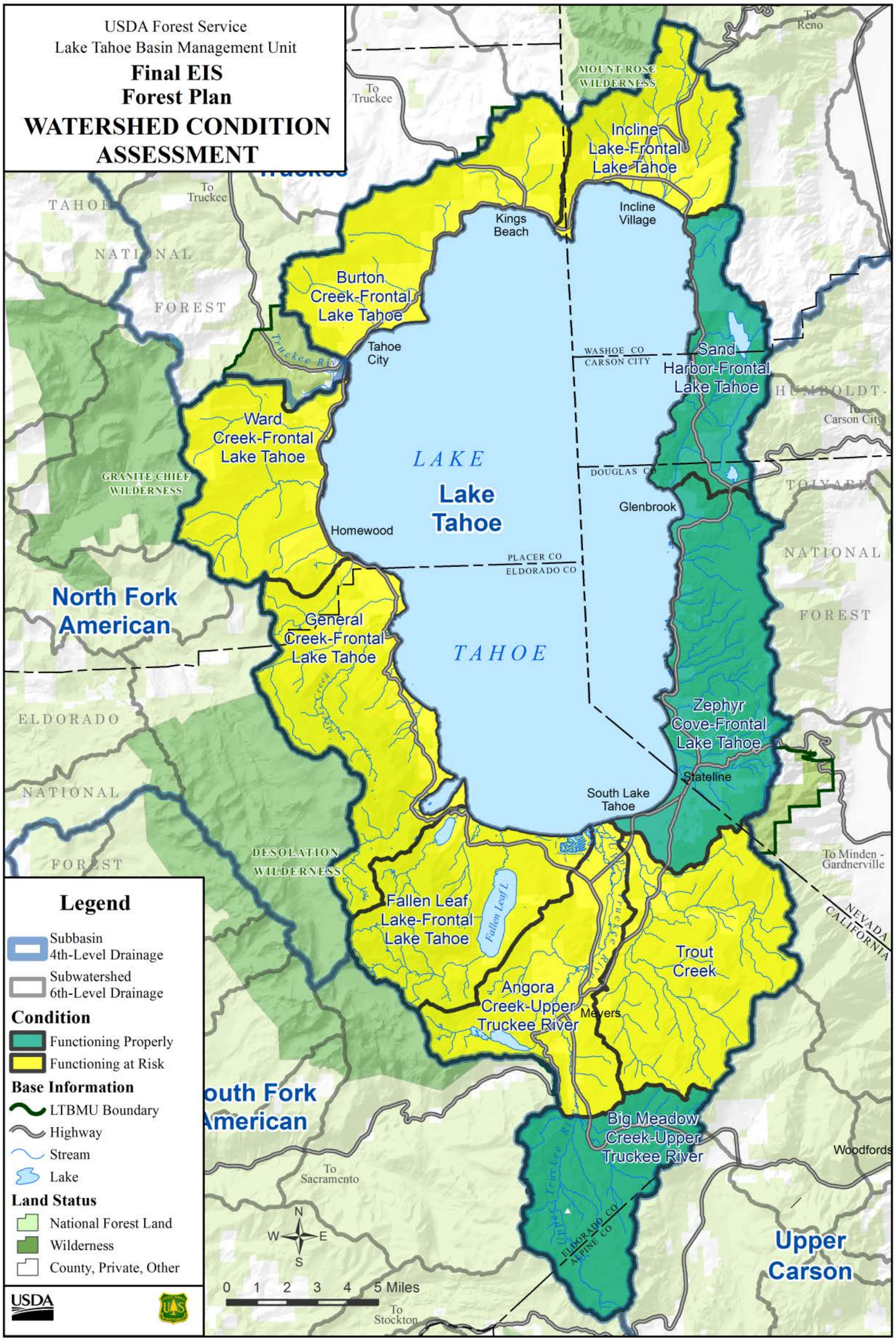


Figure 3 90. HUC 7 Watersheds and Subbasins Defined in the Lake Tahoe Basin

The condition of these watersheds that precipitated the need for a more intensive level of assessment effort included evidence of poor stream channel and floodplain function, indicated by incised and eroding channel reaches, the lack of “wetter type” riparian vegetation along stream channels and adjacent floodplains, and in some cases observations of significant disconnection of hydrology due to manmade diversions and structures. The more comprehensive ecosystem/watershed assessments completed for these watersheds documents the nature of historic disturbance, current management activities, and man-made structures and their effects on natural processes. Based on these assessments large scale stream channel, floodplain, and meadow restoration projects have been identified in these watersheds, and restoration projects have and are being implemented to restore impaired watershed functions. These are further described in the section below for stream environment zones and stream channels.

There are also a few other stream channels in the Basin that are considered to be in degraded condition as documented in the USFS watershed improvement tracking (WIT) database. While full scale watershed assessments have not been conducted, these creeks contain reaches of channel on NFS lands that are currently not in geomorphic equilibrium. This includes reaches within Incline Creek, Burke Creek, and Angora Creek.

There is one other watershed on LTBMU lands that has gone through extensive monitoring and evaluation. The Heavenly Valley Creek watershed, primarily affected by the Heavenly Ski resort, has been addressed through its own analysis, monitoring and planning efforts in conjunction with the Heavenly Mountain Resort Master Plan Amendment and the resort special use permit. While early data suggested that the watershed was impaired, the resort has implemented a substantial number of efforts to reduce sources of sedimentation and erosion. Comprehensive analysis of monitoring data from 1993-2004 (Norman and Greene 2004) indicates the resort has achieved substantial improvements in watershed condition, including water quality in Heavenly Creek.

Watershed Condition Assessments, using the National Protocol will be used to help identify and prioritize opportunities for restoration through an ongoing Watershed Improvement Program (WIP) at the broad scale. In addition the National Watershed Improvement Tracking Database (WIT), initiated in 2010, will be used to document current watershed needs, and track restoration efforts, and is expected to play a role in funding prioritization. The discussions below provide a more detailed description of specific ecosystem components that affect and are integrated into an evaluation of overall watershed condition.

3.4.26.3. Environmental Consequences

Watershed Health and Aquatic Habitat Management

Under all the alternatives, the LTBMU would continue to implement to some degree actions designed to improve the health of the physical resource and aquatic habitat attributes used to evaluate overall watershed condition. Therefore at the programmatic scale all the alternatives propose actions that would maintain or improve current watershed condition ratings.

The discussion of these actions related to specific attributes of watershed condition is presented in separate sections within this chapter as referenced below.

Vegetation Management

All the alternatives propose to utilize a variety of vegetation treatment options to reduce wildfire risk and improve forest health. Although the focus treatment types and vegetation prescriptions vary between the alternatives, all the potential treatment options proposed in the various alternatives pose some level of short term risk to soil, water, and air quality. These risks will be managed by a variety of established BMPs, and the standards and guidelines presented in the draft Forest Plan. Therefore at the programmatic scale all the alternatives propose actions that would maintain or improve current watershed condition ratings.

There will continue to be a risk of adverse resource effects associated with wildfire under each of the alternatives, which could result in degradation of overall watershed condition. The relative difference in wildfire risk between alternatives is described in Chapter 2. Because of the extreme unpredictability of either wildfire occurrence or level of effects, it is not useful to speculate regarding the level of effects on resources attributes that could occur under the various alternatives as a result of wildfire. However it can be assumed that there is a parallel level of risk of adverse effects on resources, associated with the level of risk of catastrophic wildfire.

Sustainable Recreation

The scale and nature of proposed activities related to management of recreation facilities and opportunity, including management area designations, also do not vary substantially in terms of potential effects to watershed condition between alternatives. Once again established standards and guidelines and BMPs to protect resources will be part of any proposed changes in recreation infrastructure.

The most significant difference that may exist between alternatives in this regard, may relate to the economic cost. For example, under alternatives B, C, and E it is proposed to expand developed and dispersed recreation capacity by increasing facility capacity. This may require more expensive design options to be able to achieve both an increase in recreational capacity, while at the same time mitigating or even restoring ecological function in areas where facilities exist within lands classified as SEZ.

Under alternatives C and D, an increase in wilderness area designations is proposed in Dardanelles and/or Freel Peak Roadless areas (see DEIS Map 10). This would result in limitations on any future watershed restoration activities that would involve the use of mechanical equipment. There is currently no planned stream channel and floodplain restoration using mechanical equipment in these proposed areas, and in the absence of the potential for human disturbance it is not anticipated there will be future needs. Future active restoration beyond currently planned projects is not proposed under Alternative D.

Access and Travel Management (ATM)

Similar to recreation facilities as described in the section above, the scale and nature of proposed activities related to management of forest roads, trails and associated access facilities also do not vary substantially in terms of potential effects to watershed condition resource attributes between alternatives.

Once again established standards and guidelines and BMPs to protect soil and water quality will be part of any proposed changes in these components of forest infrastructure. In addition, under each of the alternatives the LTBMU will continue to pursue opportunities to either retrofit, relocate, or decommission roads and trails to reduce potential sediment and nutrient loading to Lake Tahoe, as part of the Uplands Forest TMDL management strategy, although the scale of this work is not likely to change existing watershed condition ratings for the road and trail metric.

As described in the affected environment section, a large volume of the potential opportunities in this regard has already been accomplished over the past decade. However there will continue to be improvements where opportunities still exist, such as in areas of recent land purchases.

Climate Change

The stream channel and floodplain restoration efforts that have already been completed, and are currently planned under all the alternatives will result in these systems being more resilient to any hydrologic adjustments that occur due to future climate change. Geomorphologically stable stream channels and floodplains that exist in a state of dynamic equilibrium are better able to adjust to climate change impacts to hydrology, without resulting in adverse impacts to aquatic habitat, water quality, or water quantity. Hydrologic adjustments resulting from climate change occur at a relatively slow rate as compared to hydrologic changes caused by human disturbance.

3.4.26.4. Analytical Conclusions

Comparison of Consequences by Alternative

Actions to improve conditions related to various watershed condition attributes are planned under all the alternatives.

There is no method to provide a pre-implementation quantitative evaluation of when and to what degree these actions may improve current watershed condition ratings in watersheds currently rated as functioning at risk. Watershed Condition assessments are scheduled to be repeated every 3 to 5 years, according to the National protocol. Effects of management actions, as well as natural events (such as wildfire, extreme floods, climate change) will all determine the results of these assessments, as reflected by the current condition of the 12 watershed attributes during the assessment.

How the Alternatives Maintain or Achieve the Desired Conditions

Current watershed condition ratings are not expected to change under any of the alternatives, as rated through the National watershed condition assessment protocol, within the next 5 years. It is hopeful that through the implementation of currently planned work, some of the watersheds that are rated as Class 2, functioning at risk, may improve to a Class I rating –Properly functioning, over longer time periods. Management actions to reduce forest fuels and fire risk, restore aquatic and terrestrial habitats, forest health, stream channel stability, disturbed soils, and manage invasive species are expected to result in improved desired conditions for the twelve attributes of watershed condition identified at the beginning of this section. The two priority watersheds for management actions are Blackwood and the Upper Truckee. There is no measurable difference between the alternatives in this regard.

3.4.27. Wilderness

3.4.27.1. Introduction

This report evaluates and discloses the potential environmental consequences on wilderness resources that may result with the adoption of a revised land management plan. It examines, in detail, the four alternatives described in Chapter 2.

Methodology

Effects will be assessed by how forest management activities influence the quality and quantity of wilderness resources as determined by the measurement indicators discussed below.

Issue and Indicators

Issue

Public participation and collaboration identified "the amount of land with wilderness designation" as a key issue as discussed in Chapter 1, Recreation Issues.

Amount of Wilderness

Indicators

Measurement indicators respond to the Issues and allow for an analysis of the Wilderness Resource:

1. **Recommended Wilderness -** Acres of newly recommended Wilderness will be used to compare alternatives.
2. **Wilderness Access –** Miles of trails available to access recommended wilderness areas.

These recreation indicators are displayed in detail in Table 3-84.

Table 3 84. Wilderness Indicators - Recommended Wilderness Acres and Trails by Alternative

Wilderness Acres	**Unit of Measure**	**Existing Wilderness Acres**	**Alternative A**	**Alternative B**	**Alternative C** **Dardanelles Roadless**	**Alternative D'**[2] **Dardanelles and Freel Roadless**	**Alternative E**
Recommended Acres	Acres	24,665	No Change	No Change	14,229	14,229 +15,352 = 29,581	No Change
Existing and Recommended Acres		24,665	24,665	24,665	38,894	54,246	24,665
Wilderness Trails		**Existing Wilderness Trails**					
Existing and Recommended Miles of Wilderness Trails	Miles of Trail	55.85	No Change	No Change	20.4	*Dardanelles 20.4* *Freel* *+25.6* =46 miles	No Change
Wilderness and Recommended Wilderness Miles		55.85	55.85	55.85	+76.25	+101.85	55.85

Assumptions

Wilderness Acres – Current wilderness designations will remain constant for all alternatives.

Wilderness Managed to Primitive Standards – Recommended wilderness areas will be managed to primitive standards as described by the Recreation Opportunity Spectrum (ROS) notwithstanding their classification as Semi Primitive Non-Motorized in the ROS criteria.

3.4.27.2. Overview of the Affected Environment

The LTBMU shares management of three congressionally designated wilderness areas with three other National Forests (Table 3-85). Desolation Wilderness is co-managed with the Eldorado National Forest, Granite Chief with the Tahoe National Forest and Mt. Rose Wilderness with the Humboldt-Toiyabe National Forest. Both Granite Chief and the Mt. Rose Wilderness are managed primarily by the other forests. There are 55.85 miles of trails in the combined wildernesses.

As described by congress in the Wilderness Act of 1964:

"A wilderness, in contrast with those areas where man and his own works dominate the landscape, is hereby recognized as an area where the earth and its community of life are untrammeled by man, where man himself is a visitor who does not remain. An area of undeveloped Federal land retaining its primeval character and influence, without permanent improvements or human habitation, which is protected and managed so as to preserve its natural conditions, has outstanding opportunities for solitude or a primitive and unconfined type of recreation…"

The desired condition for managing wilderness areas within the basin is to protect and perpetuate the wilderness character and values of these areas as directed in the Wilderness Act and subsequent Wilderness designating legislation. This includes providing opportunities for solitude, education, physical and mental challenge, inspiration, scientific study and primitive recreation. Wilderness ecosystems are the result of natural succession and natural processes with as little human intervention as possible while retaining wilderness character. There should be little evidence of visitor use and low interaction among users. The few trails and associated facilities present are retained primarily to protect the wilderness resources. No motorized use is permitted. The Forest Plan provides specific standards for management of the various resources and activities that are or could potentially occur in the wildernesses including, recreation, fire, lands, minerals, fish and wildlife, insects and disease, research, search and rescue, special uses, and hydrology.

Table 3 85. Wilderness lands located within the Lake Tahoe Basin Management Unit

Name	Year Established	Total Acres	LTBMU Acres	LTBMU Trail Miles
Desolation Wilderness	1969	63,960	22,038	51
Granite Chief Wilderness	1984	25,680	46	0.5
Mount Rose Wilderness	1989	28,121	2,580	4.8
Total LTBMU			**24,664**	**55.85**

Desolation Wilderness – Though relatively small, the 63,960 acre Desolation Wilderness is one of the premier wilderness areas in the United States, both in terms of its qualities and its popularity. It is one of the most heavily used wilderness areas for its size in the nation due not only because of its inherent beauty, but also because its proximity to major population centers and its relative ease of access.

There are 22,038 acres that lie on the LTBMU with the remaining 41,922 on the El Dorado National Forest. Total use exceeds 120,000 visitors per year and includes both day use hiking and equestrian and overnight backpacking. Within the LTBMU portion of the wilderness, the average overnight use is estimated at 5,100 visitors and 82,500 day users per year. There are 51 miles of trails on the LTBMU side of the wilderness.

In managing the Desolation Wilderness, the LTBMU and the Eldorado National Forest have substantially achieved the Forest Plan goal of preserving its wilderness character, as intended by Congress. In 2006, the LTBMU and the El Dorado National Forest were awarded the Aldo Leopold Award for outstanding stewardship of the Desolation Wilderness.

In 1976 the Forest Service imposed restrictions on the numbers of overnight visitors, and currently there are area quotas for overnight camping that aim to distribute visitors and their impacts throughout the wilderness to protect popular areas from overuse.

In 1997, the Desolation Wilderness was added to a new national pilot program, the Fee Demonstration (Fee Demo) program. Both the LTBMU and the Eldorado NF collaborated to develop a Business Plan, conduct public meetings, and develop an Operations Plan for the assessment of user fees to manage and maintain the environmental integrity of Desolation.

In 2005, a revised fee act was passed by Congress, changing the initial program to reflect national concerns. The new fee legislation for the Desolation Wilderness is known as the "Recreation Enhancement Act," or REA. The fee amount for Desolation has not been altered with the new act; however, the fee basis is different. The fees collected are co-managed with the Eldorado NF, and (except for a mandated 5% Agency Fee) all of the funds are returned to the Desolation. These funds are used to pay for maintaining trails, trailhead signing, conducting resource benefiting projects in the wilderness, and funding for wilderness rangers.

Forest fee collection station for hikers entering Desolation Wilderness from the Eagle Falls trailhead, located adjacent to the Emerald Bay parking lot and lookout.

Granite Chief Wilderness– Located on the west shore of Lake Tahoe, the Granite Chief Wilderness is managed primarily by the Tahoe National Forest. With only 46 acres and 0.5 miles of trail in the Lake Tahoe Basin, the LTBMU does not play an active role in its management. This 25,680 acre wilderness offers valley meadows and spectacular 9,000 foot granite peaks. It was designated a Wilderness area in 1984 because of its pristine nature, natural beauty, and primitive, non-motorized recreational opportunities.

Mt. Rose Wilderness– The Mount Rose Wilderness encompasses a total of 28,121acres of which 2,580 acres lie on the northern rim of the LTBMU. There are only 4.8 miles of trail in the LTBMU portion. The Mount Rose Wilderness is managed primarily by the Humboldt Toiyabe National Forest but the LTBMU often plays an active role in management issues. The wilderness is part of the larger Carson Range which stretches from Luther Pass southeast of Lake Tahoe to the Truckee River northwest of Reno, Nevada. The highest mountain in the wilderness is Mount Rose at 10,776'. Mount Rose is the only mountain in the wilderness that can be considered "alpine" or "above tree line" but only by about 100 feet. The primary issues that the LTBMU manage involve degrading nonconforming uses (e.g., OSV/mountain bike intrusions), and unregulated visitation that diminishes the opportunities for solitude and a semi-primitive experience.

In 2009 an evaluation of areas for potential wilderness was conducted on the LTBMU. (Please see Appendix B “Evaluation of Areas for Potential Wilderness”, for more details on areas evaluated for wilderness characteristics). At the time the LTBMU did not administratively recommend any new areas for wilderness consideration, though the Dardanelles and the Freel Inventoried Roadless Areas (IRA) did have enough wilderness attributes to merit recommendations for wilderness status.

3.4.27.3. Environmental Consequences

Consequences Related to Wilderness

In this analysis, those management activities that may have the most effect on wilderness resources are:

- New Recommended Wilderness Designations
- Access - Dispersed Recreation
- Aquatic Invasive Species Management
- Species Recovery Habitat Restoration

Current wilderness designations will not be reduced or eliminated in any alternative and Alternatives A, B, and E do not propose any new wilderness recommendations. Two inventoried roadless areas however, the Dardanelles and the Freel Peak, were identified in the 2009 Wilderness Evaluation (See Appendix B) as having enough wilderness attributes to merit recommendations for wilderness status in Alternative C and D of this report.

Dardanelles Inventoried Roadless Area - The Dardanelles Roadless Area (14,227 acres), commonly known as "Meiss Country," lies in the southernmost tip of the Lake Tahoe Basin and is the headwaters of the Upper Truckee River. The area sees prolific hiking, equestrian use, overnight backpacking, and in recent years increased mountain bike use. The area has long been closed to motorized summer and winter use. There are 20.4 miles of trail in the area that includes 8.1 miles of the Pacific Crest Trail which is closed to mountain biking. Popular trailheads include Echo Summit, Big Meadow, Carson Pass, Christmas Valley and Sayles Canyon.

Dardanelles is second only to Desolation Wilderness in popularity for non-motorized backcountry recreation that includes dispersed overnight backpacking. An estimated 15,000 visitors enjoy this area annually. The Dardanelles has been used as an alternative destination for the Desolation Wilderness area for years because of its easy accessibility and semi-primitive natural condition. The historic Meiss Cabin and Barn structures and historic dams are also present in the Meiss Meadow area.

A 7 mile stretch of the Upper Truckee River that flows through the center of the Dardanelles roadless area was determined to be eligible as a Wild and Scenic River in 1999 (USDA Forest Service 1999, ROD). Interim protection for that segment was provided as an amendment in the 1988 Forest Management plan to ensure that its eligibility is maintained. Interim protection requires that all projects proposed on NFS lands maintain the free-flowing status and that the Outstandingly Remarkable Values listed for this river is protected or enhanced. (See Appendix A, Wild and Scenic River Evaluation, for more information).

Freel Inventoried Roadless Area - The Freel IRA (15,341 acres) lies in the southern portion of the Lake Tahoe Basin. Freel Peak (10,881ft.) is the highest point in the Basin and is the dominant feature in the Carson Range rising over South Lake Tahoe and Meyers. With 25.6 miles of trails, summer use levels are steadily increasing with the area being more accessible to mountain bikers, and hikers and backpackers due to completion of the Tahoe Rim Trail (TRT). An estimated 12,000 visitors access this area annually. Overnight camping is now only allowed within a 300 ft. corridor of the TRT and by Star Lake. Popular mountain bike trails include Saxon Creek and Armstrong Pass. The Saxon Creek trail is now one of the most popular mountain bike trails on the south shore and gained region-wide popularity among this user group. Winter use includes snowmobile and backcountry skiing. Currently snowmobiles are allowed on 9,084 acres of the Freel IRA that includes the Saxon Creek and Hell Hole drainages. The segment of roadless area north of Freel Peak including High Meadows and the south side of Heavenly ski area is currently closed to motorized use.

New Recommended Wilderness Designations

Alternatives A, B, and E will maintain the existing 24,660 wilderness acres managed in the basin between the Desolation, Granite Chief and Mt. Rose Wildernesses.

Alternative C would add the Dardanelles Roadless Area (14,229 acres) for wilderness recommendation, and Alternative D would add both the Dardanelles and the Freel Roadless area (15,341 acres) for a total of 29,581 acres of new wilderness recommendation (see Table 3-66). Alternative C would increase the number of acres available in the basin for wilderness recreation by 60%. Alternative D would increase the number of acres available for wilderness recreation by 123%.

With wilderness designations, the Dardanelles and Freel areas would be managed to standards as prescribed in the 1964 Wilderness Act. Though it is not anticipated that the new wilderness areas will need the intensive management prescriptions now utilized to manage Desolation Wilderness, the additional acres of wilderness designation will increase administrative responsibilities. Though some additional visitors may be attracted to these areas because of the wilderness designations, the current use by mountain biking visitors will stop when that use is prohibited. Increasing wilderness acres will not increase the total miles of trails available for hiking and equestrian use, but it would provide an increase in opportunities for visitors who desire trails in a wilderness setting. The Freel Wilderness recommendation in Alternative D will also increase the acres in the Basin available for dispersed camping.

In Alternative C, there will be a total 38,894 acres of wilderness and recommended wilderness in the LTBMU to be managed to wilderness standards. The Dardanelles area will continue to be patrolled on a regular basis by rangers and volunteers who contact and educate the public on ‘Leave No Trace’ backcountry ethics and regulate user impacts such as user created trails, campfires, litter, and sanitation. Since this area is already classified as Semi Primitive Non-Motorized, there will be no change to the existing ROS classifications. A wilderness designation in Alternative C could also adversely affect the historic Meiss Cabin and Barn structures and historic dams unless enabling legislation is allowed for their preservation.

In Alternative D, there will be 54,246 total acres of wilderness and recommended wilderness in the LTBMU to be managed to wilderness standards. The level of administrative effort to manage to standard in this area is anticipated to increase since overnight backpacking will be allowed throughout the entire Freel Peak area rather than in the narrow corridor along the Tahoe Rim Trail where it is currently permitted.

Access - Dispersed Recreation

Alternatives A, B, and E will maintain the existing miles of trail currently managed in the basin between the Desolation, Granite Chief and Mt. Rose Wildernesses.

Wilderness designations in Alternatives C and D will not increase the miles of trails in these areas, however because mechanized transportation (e.g., mountain biking) activities are prohibited in designated wilderness areas, the character of the recreation experience will change.

New wilderness designations may appeal to those backpackers, hikers, and equestrians who appreciate more primitive wilderness experiences and who have an aversion for meeting mountain bikes on the trails. Conversely, wilderness destinations will change the character of the experience for mountain bikers by prohibiting their use of some very popular riding trials. Satisfaction levels may increase for hikers and equestrians who desire a wilderness setting, but will be unsatisfactory for mountain bikers who will no longer have access to trails they are accustomed to using.

In Alternative C, the 14,229 acres of recommended wilderness would be managed to more primitive wilderness conditions. A wilderness recommendation will prohibit mechanized transport (bicycles) use on approximately 12.3 miles of popular trails in the Dardanelles Inventoried Roadless Area. This will include the trail from Big Meadow through Round Lake to the Pacific Crest Trail, the Dardanelles Trail, and the Christmas Valley Trail.

Alternative D will add 29,581 more acres of recommended wilderness which would be managed to more primitive wilderness conditions. A wilderness recommendation will prohibit mechanized use on 25.6 miles of trails in the Freel area including popular rides such as Saxon Creek, Armstrong, portions of Tahoe Rim Trail, Star Lake, and Monument trails. Adoption of Alternative D, along with those miles in Dardanelles, would exclude mountain biking from a total of 37.9 miles of trails in these two areas. (See Access Section for a more detailed discussion of mountain biking trails available per each Alternative).

Also in Alternative D, 9,084 acres of the Freel IRA would be closed to OSV use if designated by Congress. OSV users displaced by the area closure would have to find other areas to participate in this activity, most likely in the nearby Hope Valley in the Humboldt-Toiyabe National Forest. Users from nearby neighborhoods would have to trailer their machines to other open areas.

Aquatic Invasive Species Management

Environmental consequences to wilderness resources generated from aquatic invasive species management are the same for all alternatives. Impacts to recreation are generated by actions that either improve or modify existing recreation activities. Removing non-native fish from lakes benefits the wilderness character by improving the recreation setting for those desiring a wilderness experience. In lakes where all fishing opportunities are eliminated for the protection of other species, displaced fisherman may move on to other lakes. Increased impacts may occur at these new locations. Removal of non-native species is consistent with policy, although some sport fishing opportunities may be gone.

Species Recovery Habitat Restoration

Species management actions are the same in all alternatives as they all propose to maintain one Sierra Nevada yellow legged frog sub-population and restore nine sub-populations.

3.4.27.4. Analytical Conclusions

Wilderness

Wilderness lands are managed to preserve natural conditions and to provide outstanding opportunities for solitude and primitive unconfined type of recreation experience. No motorized or mechanized transportation modes are allowed in wilderness areas. Though it is not anticipated that the new wilderness areas would need the intensive management prescriptions now utilized to manage Desolation Wilderness, the additional acres of wilderness designations in Alternative C and D would increase administrative responsibilities needed to manage the wilderness areas to standards as prescribed in the Wilderness Act.

- Alternatives A, B, and E are unchanged from existing conditions. Visitors will continue to enjoy the range of wilderness opportunities currently provided. Mountain bikers will continue to have access to popular riding trails in the Dardanelles and Freel Roadless areas. Both areas will continue to be managed to Inventoried Roadless Standards.

- The 7 mile stretch of the Upper Truckee River that has been determined to be eligible for a Wild classification in the Wild and Scenic River inventory will continue to be managed to preserve its eligibility in all alternatives.

- Wilderness designation in Alternatives C and D will not increase the miles of trails available to backpackers, hikers, and equestrians, however it will enhance wilderness recreation and dispersed non-motorized camping for visitors that seek a wilderness experience with opportunities for solitude and primitive conditions that wilderness designations would provide. .

- Alternative C will prohibit mechanized use on approximately 12.3 miles of popular trails in the Dardanelles IRA. This will include the trail from Big Meadow to the Pacific Crest Trail and also the Dardanelles and Christmas Valley Trails. Alternative D will prohibit mechanized use on an additional 25.6 miles of trails in the Freel IRA, including popular rides such as Saxon Creek portions of the Tahoe Rim Trail.

- A wilderness designation in Alternative C could also adversely affect the historic Meiss Cabin and Barn structures and historic dams unless enabling legislation is allowed for their preservation.

- In Alternative C, the 14,229 acre Dardanelles area will continue to be patrolled on a regular basis by rangers and volunteers who contact and educate the public on ‘Leave No Trace’ backcountry ethics and regulate user impacts such as user created trails, campfires, litter, and sanitation

- In Alternative D, the level of administrative effort is anticipated to increase since dispersed camping will be allowed throughout the entire Freel Peak area, rather than along the narrow corridor along the Tahoe Rim Trail that is currently permitted. User impacts such as those mentioned above will be extended to desirable areas such as stream sides and meadows. In Alternative D, OSV use of 9,084 acres of the Freel IRA will be prohibited. OSV users displaced by the area closure will have to find other areas to participate in this activity.

How the Alternatives Maintain or Achieve the Desired Conditions

A desired condition for Recreation is that “A spectrum of high quality recreational opportunities is provided, while Lake Tahoe Basin’s natural setting as an outstanding recreation destination is maintained” *(Pathway*). Another desired condition states that “Access to public lands is provided when consistent with user and management expectations.”

- Alternatives A, B, and E will maintain or achieve desired conditions by continuing to provide the existing mix of wilderness/ recreation opportunities available in the Tahoe Basin. As reported in the Recreation section of this FEIS (3.4.19), the recreation opportunities currently provided on the LTBMU have very high satisfaction ratings as reported by NVUM surveys. This supports the notion that the current mix of recreation opportunities is generally in balance with the public’s expectations. Alternatives A, B, and E will preserve some popular mountain biking opportunities by not recommending that the Dardanelles and Freel IRAs be changed to wilderness status. The Dardanelles and Freel areas will continue to be managed as Inventoried Roadless Areas and access to these areas will remain status quo. The 7 mile stretch of Upper Truckee River will continue to be managed to preserve its eligibility for Wild and Scenic River status.

- Alternatives C and D will still maintain and achieve the desired conditions, but by varying degrees and off-setting benefits. They will change the current spectrum of recreation opportunities in the Basin by increasing the amounts of recommended wilderness acres available for wilderness opportunities which will please some segments of our visiting population; however they will exclude mountain biking on total of 37.9 miles of popular riding trails. Wilderness designations in Alternative D will also displace OSV users from 9,084 acres in the Freel area to other areas to participate in this activity.

3.5. Cumulative Environmental Consequences

The Council on Environmental Quality (CEQ) regulations for implementing the procedural provisions of NEPA defines a cumulative impact as "the impact on the environment which results from the incremental impact of the action when added to the past, present, and reasonably foreseeable future actions regardless of what Agency (Federal or non-federal) or person undertakes such other actions" (40CFR S 1508.7). CEQ has also provided guidance in the publication: Considering Cumulative Effects under the National Environmental Policy Act (1997). This publication can be found at http://ceq.hss.doe.gov/publications/cumulative_effects.html/.

For cumulative impacts to accrue there must first be an impact from the action under review that can be added to the impact of other past, present or reasonably foreseeable future actions that affect the same resource.

The boundary for analyzing cumulative effects includes the 207,420 acres within the watershed boundary of Lake Tahoe. The LTBMU manages 154,830 acres of this land (approximately 75% of the land in the Tahoe Basin). Attempting to describe the cumulative effects of each and every past, present and reasonably foreseeable Forest Service project for the entirety of these lands is neither possible nor informative at the programmatic level. As noted by CEQ's guidance memorandum of June 24, 2005 and consistent with Forest Service NEPA Regulations (36 CFR 220.4(f)) (July 24, 2008), the effects of past actions can generally be captured by a description of the affected environment (Connaughton, 2005), which is detailed in each individual resource section of this chapter (detailed in Sections 3.5.2 and 3.5.3). Projects that are in the process of implementation and projects that have signed NEPA compliant decisions are enumerated in Appendix K – Previous Decisions That Remain In Place, and are accounted for in the environmental consequences for each resource.

The area of consideration for cumulative effects for most of the resources in this analysis includes the lands within the watershed boundary that defines the exterior boundary of the LTBMU. This includes the entire Lake Tahoe watershed. Some of the wildlife and plant resources have a boundary that extends beyond the watershed boundary of the Tahoe Basin and is defined further in those specific sections. At the programmatic level of planning the Lake Tahoe Basin is largely isolated from the surrounding National Forest's management activities. Where there are impacts that involve multiple out-of-basin jurisdictions they are managed by overarching documents (such as the Desolation Wilderness Plan) that are incorporated into the LTBMU Forest Plan. In resource areas such as air quality there is oversight over the effected larger landscape by another agency (e.g. California Air Resources Board). The timeframe for this cumulative effects analysis is 15-20 years from adoption of the new Forest Plan.

3.5.1. Non-Forest Service Lands

The LTBMU is uniquely situated in a highly regulated environment. Therefore since all actions on private, county, and state lands are guided by several layers of regulations, the assessment of the past, present, and foreseeable future has greater predictability than most National Forests, since every project or action of consequence on private, county, and state lands is regulated by the Tahoe Regional Planning Agency in addition to other typical state and local regulatory agencies. After NFS lands, approximately 15% of the land in the Tahoe Basin is managed by the Washoe Tribe, states (i.e. State Parks) and other government entities (i.e. utility districts, counties, etc.). The remaining land, accounting for approximately 10% of the land in the Tahoe Basin, is privately owned and mostly comprised of dense residential communities with interspersed commercial locations.

The Tahoe Regional Planning Agency (TRPA) was created by Public Law 96-551 (the Revised Tahoe Regional Plan Planning Compact). Often referred to as the Bi-State Compact, it is an agreement between the States of Nevada and California and the Federal government on goals for the Lake Tahoe Basin. Directed by the Compact, the TRPA established Environmental Threshold Carrying Capacities (thresholds) for the basin. The thresholds are the standards against which all projects and activities are measured for the achievement of the goals and polies of the compact (TRPA, 1986). Since the thresholds have fundamentally been in place since 1982, they have guided the environmental landscape in the Lake Tahoe Basin for nearly 40 years. The TRPA Regional Plan as expressed by the Code of Ordinances, Goals and Policies, Planning Area Statements, Rules of Procedure and Community Plans guides the attainment of the thresholds.

At the state level, the Lahontan Regional Water Board (California) and the Nevada Department of Environmental Protection (Nevada) have responsibility for enforcement of the Clean Water Act. Recently, both agencies completed the Lake Tahoe TMDL Report (Lahontan and NDEP, 2010) and it was approved by the U.S. Environmental Protection Agency for each State within the Lake Tahoe Basin. The TMDL identifies a cohesive strategy that will lead to the attainment of the applicable water quality standards for Lake Tahoe in Nevada and California. This TMDL, in combination with the Water Quality Control Plan for the Lahontan Region (State of California 1995) and the Water Quality Management Plan for the Lake Tahoe Region (TRPA 1988b) ensure that activities that occur on any lands within the Lake Tahoe Basin will meet stringent water quality standards.

Also there are land management agencies within the Basin such as the California and Nevada State Parks, the Nevada Division of Lands and the California Tahoe Conservancy that manage land under their own set of laws, regulations and policies to protect the environment in addition to adhering to the regulations imposed by the TRPA. The same is true for the state transportation agencies, CalTrans and NDOT, who maintain the public road system in the Basin.

3.5.2. Cumulative Effects by Resource Area

Access & Travel Management

Roads

There are 110 miles of state and federal highways in the Tahoe region (Tahoe Metropolitan Planning Organization (TMPO), 2012). These routes, managed by Caltrans and NDOT, form the backbone of the region's transportation system. Three major roads that ring Lake Tahoe include: US Highway 50, Nevada State Route 28, and California State Route 89. These three roads connect community centers around Lake Tahoe to each other, and serve as the principal links to outside regions in both states. As mentioned above, in addition to their important role as regional connectors, these roads serve as the 'main streets' of the region's largest community areas. Intersecting and supplementing these regional roadways are 619 miles of local streets (TMPO, 2012). These local routes include a range of facility types from urban-style arterial streets and roadways in South Lake Tahoe, California and Stateline, Nevada with sidewalks and bicycle facilities, to rural county roads outside of urban centers.

A comprehensive forest access plan is being developed in coordination with federal lands, the Tahoe Transportation District, CalTrans, NDOT, and local jurisdictions. The plan will include developed recreation sites, permitted recreation sites, and dispersed forest access to identify and prioritize access needs. This plan will illuminate opportunities to connect urban to forest trails and link transit. The plan will include and prioritize access for both summer and winter access and identify needs and opportunities for parking, transit, trails, signs, and other amenities. The access plan will also identify ownership and jurisdiction for partnership and funding opportunities.

Specific roadway projects include: US Hwy 50 South Shore Community Revitalization Project, State Route 89/Fanny Bridge Community Revitalization Project, Kings Beach Commercial Core Improvement Project, and the Incline Gateway Project, US 50 Corridor Project Phase II, Placer County State Route 89 Erosion Control, NDOT Water Quality Improvements.

Roads Conclusion

Under all alternatives, management of the forest road system would not add to the cumulative effects from these projects because forest roads are generally located off of the major roadways and local streets.

Trails

Currently, most of the region's larger communities have nearly completed networks of bicycle paths, lanes, and routes. Critical gaps in these more urban networks have been identified by local jurisdictions as high priority projects. At the regional level, there are major gaps in the bicycle network. The east shore has virtually no bicycle network, and while the west shore has an excellent, nearly continuous 10-mile separated path connecting parks and beaches to Tahoe City and beyond, the steep terrain near Emerald Bay has thus far been an obstacle in connecting the facility to the South Shore.

A wide range of pedestrian conditions currently exist in the Tahoe region. The major regional roadways, which were built as rural highways and designed to facilitate vehicle throughput, generally lack pedestrian facilities. Sidewalks and marked or signalized pedestrian crossings do exist on the regional roads to varying degrees in the region's largest communities (for example, along US 50 in Stateline; and along State Route 28 in Tahoe City and Incline Village).

Specific trail projects include: Nevada Stateline to Stateline Bikeway, South Tahoe Greenway, Sawmill Bicycle Path and Lake Tahoe Boulevard Enhancement Project.

Trails Conclusion

Under all alternatives, NFS land will likely be considered for these types of regional trails. These proposed trails will link the forest system trail network to the urban areas and trailheads around the basin, overall providing a positive cumulative effect in all alternatives. Alternatives A, B and E would not change management of the current forest trail system, and when combined with effects from these trails, bicycle paths, lanes and routes would provide a positive cumulative effect to access. Alternative C would provide the most positive cumulative effects by increasing maintenance levels on trails which would provide access to more visitors. Alternative D would provide the least amount of positive cumulative effect because trail maintenance levels would be reduced and trails could be removed for ecological restoration.

Transit

Transit contributes to reducing pollution and roadway congestion. The Tahoe City Transit Center south of the intersection of California State Routes 28 and 89 is located on NFS lands and is anticipated to be completed in the of spring 2012. Covering about 2.5 acres on a tract of public land west of SR 89, the center will serve as a hub for Placer County's TART buses. The center is adjacent to hiking and bike paths and improves access to transit as well as pedestrian and bicycle mobility in and around Tahoe City. Parking is provided for commuters and visitors at the transit center.

The Tahoe region's major existing transit services include:

- The Tahoe Area Regional Transit (TART) bus system serves the North and West shores with service to Tahoma, Tahoe City, and Incline Village; and a shuttle between Truckee and Tahoe City.
- The BlueGO bus system serves the South Shore, including El Dorado County and Douglas County with fixed-route, door-to-door, and flex-route service, as well as seasonal ski shuttles and the "Nifty Fifty" Trolley.
- Squaw Creek Valley Shuttles serves skiers and employees at the Squaw Creek Valley Resort.

Transit Conclusion

Alternative A does not actively promote transit opportunities but would also not deny any transit opportunities so would not have any cumulative effects to transit in the Tahoe Basin. Transit would be promoted in alternatives B, C, D and E through the development of multi-modal transit stops where feasible which would provide positive cumulative effects to the existing transit system by linking transit modes such as bicycles, walking, and busses.

Air Quality

A programmatic planning effort, such as this one, considers a large area that encompasses a wide array of environmental interactions, a number of which affect air quality but do not occur on NFS lands. Many of these environmental interactions will be most accurately disclosed as cumulative effects in site-specific project environmental analyses. As described below, the nature of air quality impacts makes it extremely difficult to confidently predict their occurrence.

Factors that influence cumulative impacts on air quality include the following:

- Motor vehicle emissions: Both tailpipe exhaust and re-suspension of particles are the primary source of several pollutants of concern. Although off-road vehicles are important contributors to air pollution, the high volume of on-road vehicles has resulted in increased focus on these vehicles as well.

- Residential wood burning stoves and fireplaces and other uses, such as campfires can impact air quality.
- The topography and climate: Locally emitted pollutants can build up at the surface due to thermal inversions, which prohibit the dispersal of surface-level pollutants and therefore can result in localized areas of high pollution levels.
- Pollutant transportation: Emissions from surrounding sources and ozone precursors (NOx and VOCs) may enter the Basin from outside areas, such as the Sacramento Valley and Bay Area.
- Wildfires: Past, present, and reasonably foreseeable activities were reviewed to determine cumulative effects to air quality. Because impacts to air quality in regards to smoke from past wildfires and prescribed fire activities are short-lived, past activities do not contribute to cumulative effects. Past activities do influence the amount of live and dead woody material available for consumption in the event of a future wildfire.

Because the timing and locations of actions or events that could contribute to potentially significant air quality effects in the Lake Tahoe Basin are unknown, a quantitative cumulative effects analysis is not possible. However, if weather conditions, combined with the actions and events described above were conducive, potentially significant adverse cumulative air quality effects could occur for days or possibly weeks under all alternatives. California and Nevada Smoke Management Programs (SMPs) govern all project level activities. The burners must obtain a burn permit and an authorization. As PFIRS and BlueSky models are utilized, cumulative impacts injurious to public health from prescribed burns are expected to be mitigated.

One objective of the plan is to prevent the occurrence of large uncontrolled, high intensity wildfires. Wildfires present a risk to the public health and result in damage to both the environment and property. Vegetation management treatments leading to fire resilient forests provide the opportunity on a long-term basis to reduce the magnitude of wildfire air quality problems.

Air Quality Conclusion

There is a risk of cumulative effects to air quality from all of the alternatives as each one includes prescribed fire as an activity. However, as the states of California and Nevada each regulate burning the risk of significant cumulative effects would be low.

Aquatic Wildlife, Terrestrial Wildlife and Botanical Resources

For the following species, the cumulative effects analysis includes an area broader than the boundary of the Lake Tahoe Basin: California spotted owl, Northern goshawk, American marten, Sierra Nevada Yellow-legged frog, bald eagle, and Sierra Nevada red fox. These species have a broader area considered for cumulative effects because they are known to inhabit both the Lake Tahoe basin and have home ranges or populations that overlap adjacent lands.

All past and present actions on NFS lands have also been highly regulated by the suite of local and state agencies. Therefore, it is assumed that actions on land managed by state and other government agencies are compatible with the habitat protection measures on NFS lands. In addition to the strict regulatory environment, past and present management actions on NFS lands have been largely motivated by terrestrial and aquatic ecological restoration needs. For example, the LTBMU continues to implement a number of watershed restoration projects focused on improving hydrologic and stream habitat conditions. Other projects are focused on restoring aspen stands, meadow communities, and reducing fuel loads in both the WUI and general forest. The overall goals of these projects are to improve the condition of sensitive habitat throughout the LTBMU.

The Forest Service is a member of the Lake Tahoe Aquatic Invasive Coordination Committee and participates on AIS Working Groups for aquatic weeds, non-motorized boat control/prevention, and warm

water fish. The LTBMU has one of the strongest and most comprehensive AIS programs in Region 5 (and possibly in the nation) and we are working with the many partner agencies and public groups to control, prevent, and treat AIS.

Outside of the Lake Tahoe basin, the majority of adjacent land is managed by other National Forests including the Tahoe National Forest, Humboldt-Toiyabe National Forest, and Eldorado National Forest. All of the Forest Service Region 5 sensitive species designated for the LTBMU are shared with the Eldorado and Tahoe National Forests, therefore, these forests have protection measures in place for these sensitive species including the California spotted owl, northern goshawk, American marten, and Sierra Nevada Yellow legged frog. The Humboldt-Toiyabe National Forest shares some of the sensitive species with the LTBMU including: Townsend's big eared bat, Northern goshawk, and bald eagle, and has protection measures in place for habitats where these species occur. Therefore, since all of these Forest's provide a consistent level of habitat protection in combination with the same National and regional direction. And, in the future each of their forest plans when amended will provide the ability to adapt and change over time if declining trends in habitat for sensitive species are observed.

Management by the Washoe Tribe and public agencies in the Tahoe Basin is guided by wildlife, conservation, and natural resource protection objectives. On private land, habitat is generally considered to be of low suitability for many terrestrial wildlife species because of the high level of human disturbance and extensive habitat degradation and fragmentation. However, some privately owned land along the Lake shore is valuable habitat for certain aquatic species such as Lahontan cutthroat trout and plant species such as Tahoe yellow cress and certain terrestrial wildlife lake-associated species such as bald eagle and osprey.

Regardless of ownership or habitat suitability, every project or action of consequence on private, county, and state lands is regulated by various state and local regulatory agencies as well as by the Tahoe Regional Planning Agency (TRPA). The TRPA established Environmental Threshold Carrying Capacities (thresholds) for the basin in 1982 (including terrestrial wildlife and fish/aquatic thresholds) that are the standards against which all projects and activities are measured for the achievement of the goals of the compact. The Goals and Policies (TRPA 1986) established two goals and five policy statements relative to maintaining terrestrial and aquatic habitat. The TRPA Code of Ordinances (TRPA 1987) also established provisions to protect and enhance terrestrial and aquatic habitats and protect special interest, threatened, endangered, and rare species. Because TRPA is involved in essentially all actions on private, county and state lands within the Lake Tahoe basin and have relatively stringent protection measures for terrestrial and aquatic habitat and species, there is a commonality of environmental protection that occurs on all lands in the Basin.

This evaluation assumes that all actions on non-NFS lands within the Lake Tahoe basin and NFS lands adjacent to the basin will not change across alternatives. Therefore, the only differences among foreseeable future actions across alternatives are those proposed by the LTBMU as part of the proposed Forest Plan revision. All alternatives will have varying degrees of pressures and benefits for special status terrestrial and aquatic wildlife species and habitat. The greatest short term pressures on terrestrial wildlife will come from forest health and fuel reduction approaches associated with Alternative C. Another impact will be from the expansion of recreation sites and access generally associated with Alternative C and to a lesser degree Alternatives A, B and E. Alternative D has the greatest potential for degradation of late seral habitat and loss of early seral stages, and is least able to adapt to climate change. Similarly, both Alternatives C and D have the potential for the greatest consequences for aquatic species due to the potential increase in recreation permit areas (C only) and the potential expansion of aquatic invasive infestations. For a more detailed comparison of the evaluation of effects of alternatives on terrestrial and aquatic wildlife species, see the *Terrestrial Wildlife* and *Aquatic* sections in Chapter 3. Regardless of these potential pressures, each alternative has design criteria (standard operating procedures and standards and guidelines) intended to avoid or minimize potential adverse effects on terrestrial and

aquatic wildlife species and their habitat. Finally, it is important to recognize that all site-specific future NFS projects would be evaluated under NEPA, NFMA, and Section 7 of ESA (where appropriate). These site-specific analyses would consider cumulative effects. In addition, updated monitoring information from either the regional or forest level would be available to show trends in cumulative effects.

Aquatic Wildlife, Terrestrial Wildlife and Botanical Resources Conclusion

The management direction proposed under all four Plan alternatives, when combined with past, present, and reasonably foreseeable future actions on all land ownerships within the Lake Tahoe basin is not expected to have an adverse cumulative effect on special status terrestrial and aquatic wildlife species or their habitat during the life of the Plan.

Management Indicator Species (MIS)

The Forest Service manages approximately 155,000 acres of land in the Lake Tahoe basin as the LTBMU. At the bioregional scale, the LTBMU is one of ten National Forests in the Sierra Nevada and represents fewer than 2% of the 11 million acres of Forest System lands in this region (Figure 1). Based on the relatively diminutive size of the LTBMU at the bioregional scale, potential adverse effects from management activities in the LTBMU would be functionally diluted at the bioregional scale and contribute minimally, if at all, to any cumulative consequences of activities in the Sierra Nevada on bioregional trends.

Not only would the potential for cumulative effects be minimized by the relatively small size of the LTBMU, but the management activities proposed as part of the Forest Plan revision are focused on protecting, enhancing, and restoring habitats and habitat components important to MIS. The LTBMU is unique among many National Forests in the Sierra Nevada in that a great deal of emphasis is placed on restoration of habitat and processes, as reflected in the revised Forest Plan objectives, and comparatively little to no emphasis is placed on mineral extraction, timber harvest, and grazing activities that often compromises the integrity of sensitive habitats and processes. Where recreation or forest vegetation management practices may affect MIS habitats or habitat components at the project-level, a number of standards and guidelines described in the revised Forest Plan are in place to avoid or minimize the potential for such effects.

All actions on private, county, and state lands within the Lake Tahoe basin are guided by several layers of regulations with the Tahoe Regional Planning Agency (TRPA) involved in essentially all actions. TRPA reviews all projects or actions on private, county, and state lands in the basin. The TRPA established Environmental Threshold Carrying Capacities (thresholds) for the basin; standards against which all projects and activities are measured for the achievement of the goals. These thresholds have fundamentally been in place since 1982 and have guided the environmental landscape in the Lake Tahoe Basin for nearly 40 years. In California, the Lahontan Regional Water Board and in Nevada, the Nevada Department of Environmental Protection also have responsibility for enforcement of the Clean Water Act. There are land management agencies within the basin such as the California and Nevada State Parks, the Nevada Division of Lands, and the California Tahoe Conservancy that manage land under their own set of laws, regulations and policies to protect the environment in addition to adhering to the regulations imposed by the TRPA. The same is true for the state transportation agencies, CalTrans and NDOT, who maintain the public road system in the Basin.

MIS Conclusion

Therefore, because the Lake Tahoe basin is in a highly regulated environment, is a relatively small portion of the Sierra Nevada, and proposes management activities focused on the protection, enhancement, and restoration of aquatic and terrestrial habitats, it is expected that the LTBMU Land and

Resource Management Plan will not alter the existing bioregional trend in habitats or ecosystem components, nor will it lead to a change in the distribution of the MIS across the Sierra Nevada bioregion.

Built Environment

In the Lake Tahoe Basin, the built environment is highly regulated by TRPA. TRPA uses the Bailey system to prohibit new development on some sensitive lands, and restrict the amount of coverage (i.e., pavement and building footprint) that can be placed on others. TRPA has built into its Code of Ordinances a program for the transfer of development rights to other, less sensitive parcels. In this way, development can be moved away from the most sensitive areas and property owners can still realize value from their land. See the soil cumulative effects section below for an analysis of coverage on NFS lands.

A few of the larger development projects on non NFS lands which are in the foreseeable future include: Sierra Colina, Boulder Bay and Homewood developments.

Built Environment Conclusion

Alternative D would lead to a reduction in the built environment (by about 5%) and would not add to the cumulative effects from these other developments. Alternative C would allow for a fifteen percent increase in the built environment which would increase coverage by 0.05% and would not add significantly to cumulative effects. The same is true for Alternatives A, B and E, which would add 5%, 10%, and slightly over 5% more coverage respectively.

Forest Vegetation, Fire and Fuels

Past and Future LTBMU Thinning, Fuel Reduction, and Prescribed Fire Treatments

Prior to the establishment of the Lake Tahoe Basin Multi-Jurisdictional Fuels Reduction and Wildfire Prevention Strategy (Strategy), the LTBMU had completed approximately 16,000 acres of fuels reduction and thinning treatments around the Basin. Under the Strategy the LTBMU has completed approximately 12,000 acres of thinning and fuel reduction.

Over the life of the Forest Plan, the LTBMU expects to treat approximately 25,000 acres using a combination of hand and mechanized thinning, followed in some cases by use of prescribed fire. These methods of treatment will continue to be used for reducing high tree densities and amounts of surface fuels within the Wildland Urban Interface (WUI).

The past and future acres to be treated on NFS lands within and around the communities represent about seventy-five percent of combined totals of acres to be treated in the WUI.

There are no differences between alternatives in the defense zone. However, there are diameter limits in two alternatives: alternative A the diameter limit is 30 inches throughout the WUI and in alternative D the diameter limit is 12 inches in the Threat Zone. Alternative D would not be consistent with the goals of the Strategy with the low diameter limit, since modeling has indicated that the fire type that would occur could carry an active crown fire, making wildfire adjacent to the communities difficult to safely suppress. Alternatives A, B, C and E would all permit accomplishment of the goals identified in the strategy.

Past and Future Non-Federal Thinning, Fuel Reduction, and Prescribed Fire Treatments

Prior to the strategy, State agencies had accomplished several thousand acres and local jurisdictions and fires protection districts had accomplished small acreages. With the Strategy and an influx of a variety of funding mechanisms and agreements, the amount of treatment acres has accelerated. The Tahoe Fire and Fuels Team, which collectively implements the non-federal portion of the strategy, had completed over 5,000 acres

Approximately 8,000 acres in the WUI will be accomplished by state agencies and local fire protection districts over the life of the plan.

The past and future acres to be treated on non-federal lands within and around the communities represent about twenty-five percent of the combined totals of acres to be treated in the WUI.

During implementation of the Forest Plan, the treatment of acres on non-federal lands would accomplish the goals identified in the strategy. Were these treatment acres subject to the limits of Alternative D, they would not be a factor as the number of acres of non-federal lands in the Threat Zone is miniscule.

Forest Vegetation, Fire and Fuels Conclusion

When the past and future thinning, fuel reduction and prescribed fire treatments that have been identified in the strategy are completed throughout the WUI, both on NFS and non-federal lands, a substantial step towards improved forest health and lower risk of catastrophic fire will have been achieved. This achievement will also provide benefits including, but not limited to: wildlife habitats, water quality, scenic integrity, public safety, and wildland fire fighter safety.

Heritage Resources

Heritage resources are managed through the California and Nevada State Historic Preservation Offices. Because every project on NFS land and non NFS land would need to be considered for heritage resources through these offices and project specific mitigation measures would be prescribed for each project; there would be no cumulative effects from any of the alternatives.

Interpretive Services & Conservation Education

There are no direct or indirect effects to Interpretive Services and Conservation Education from any of the alternatives so there would therefore be no cumulative effects.

Lands

There are no direct or indirect effects to lands from any of the alternatives so there would therefore be no cumulative effects.

Minerals

While the FS could approve plans of operations for mining, since TRPA would not permit the mining activity, the holders could not obtain the required state and county permits to actually start operations. Active mining is essentially precluded in the Lake Tahoe Basin; therefore, there would be no cumulative effects.

Natural Hazards

There are no direct or indirect effects from natural hazards from any of the alternatives so there would therefore be no cumulative effects.

Noise

All activities on the National Forest will contribute to expanded sound levels that will add to the Basins overall Cumulative Noise Event Level (CNEL), and the Single Noise Event Level (SNEL) thresholds adopted by the Tahoe Regional Planning Agency (TRPA). The Forest Service will work cooperatively under all alternatives to monitor and achieve the noise threshold standards, along with adhering to noise related enforcement of the Federal Code of Regulations (CFRs).

Alternatives B, C, and E expand acres and mileage for motorized recreation access and that would contribute to expanded noise levels generated from motor vehicles, Conversely, Alternative D with a

reduction in motorized access opportunities would generate less noise that the other alternatives, including alternative A. However, with TRPA enforcing the CNELs and SNELs thresholds, these alternatives would not add to the cumulative effects from noise.

Vegetation treatment activities would contribute noise from chainsaws and equipment operations. Under all alternatives, these types of operations would generally not start until after 7am and would end at 6pm (or as prescribed in specific projects) especially when taking place near residential areas. Therefore, both CNEL and SNEL noise levels would not be exceeded.

Under all alternatives, the LTBMU will adopt the best available technology to minimize noise exceedences along with applying management oversight over uses of and on the National Forest to ensure compliance with existing noise level standards and strive to ensure that noise levels are compatible with the primary use of the area. Also in all alternatives, prior to the issuance of a new use authorization or permit for an event or activity on NFS lands, an analysis of compliance with existing noise standards should be completed.

Increased demand for access and use of the National Forest under all alternatives is expected, and although managed access (acres and development levels) varies among the alternatives, there will be a projected increase in concentration of use for the areas that are open as population levels increase and that will affect overall noise levels (both CNELs and SNELs) generated over the life the Forest Plan.

Recreation

Other entities in the Basin that manage and/or provide outdoor recreation opportunities includes the California and Nevada State Parks, the TRPA, various counties and municipalities, and other private recreation providers.

Due to Lake Tahoe's proximity to major population centers and their increased population projections, visits to the Basin are anticipated to increase over the 15 to 20 year life of the plan despite prevailing economic conditions. As is the situation now, there will continue to be unmet demand in some developed recreation sites during peak periods in all alternatives. In other words, when sites are full, visitors must look elsewhere for other recreation opportunities. The other recreation providers in the Basin also acknowledge the reality of being unable to meet demand during peak periods. Like the Forest Service they also operate with funding constraints that inhibit their ability to provide services or to expand to meet future demand.

The indicators in Forest Plan analysis used to address demand were the amount of Overnight Accommodations, Day use Parking and Acres of Permit Boundaries provided per alternative. Alternative C offers the best opportunity to meet demand by allowing up to a 15% increase for each amenity; however it is also the most costly. In all alternatives, the Forest Service will continue to manage recreation resources to the highest standards attainable within the limits of available funding to maintain visitor satisfaction.

California State Parks has projected a "status quo" condition for the outdoor recreation opportunities they will provide over the next 15 to 20 years (Bran Barton, California State Parks, Lake Tahoe Superintendent). Though they do not anticipate long-term closures or facility expansion opportunities within the Basin over the life of the Forest Plan, they acknowledge the challenge of remaining economically viable in the face of reduced overall funding. Since the expansion of facilities is not in the foreseeable future, they are considering offering a different suite of opportunities including special events and business retreats that would encourage more visits to Lake Tahoe during the shoulder seasons when visitation is generally low.

Lake Tahoe Nevada State Park Superintendent Jay Howard projects that Nevada State Park budgets will generally remain the same into the future which currently characterized as “bare bones”. Though they do project a continued increase in demand, they do not project an increase in facility capacity over the life of the Forest Plan. Like California State Parks, Mr. Howard suggested that more services may be handled via concessionaire in the future but those services would still be available.

The TRPA currently manages for Recreation Thresholds that are found in the Recreation Element of the Goals and Polices Plan. The Recreation Element primarily recognizes three general types of recreational sub-elements between Developed, Dispersed, (both the same as the Forest Service) and Urban. Examples of Urban facilities in this case are athletic fields, ice skating rinks, swimming pools and neighborhood parks. There are two indicators used by the TRPA to determine if the Recreation Threshold is in attainment: R-1 High Quality Recreational Experience & Additional Access, and R-2 Capacity Available to the General Public. As stated in the 2006 Threshold Evaluation Executive Summary, both indicators are in attainment and are showing a positive trend.

Counties, municipalities and private entities account for a small percentage of the overall outdoor recreation inventory in the Basin. Expansions or contractions of offerings within these sectors are not anticipated to largely impact overall Basin recreation opportunities over the life of the plan.

The amount of Wilderness acres available in the Basin would increase with the implementation of either Alternative C or Alternative D. As discussed in the analysis, the result of these designations would change the overall character of dispersed recreation opportunities in the Basin by increasing the acres available for hikers and equestrians who desire the outdoor experiences offered under wilderness protection. It would also decrease the miles of trail available to mountain bikers who value rides in those locations. This displaced use would most probably manifest itself elsewhere on the basin or in adjoining National Forests. Wilderness designations are not anticipated to effect the management of other national forests who would share boundaries. All areas would be managed to the standards required for specific land designations.

The adjacent Hope Valley area of the Humboldt-Toiyabe National Forest is considered for cumulative effects to OSV recreation. Under Alternatives A, B, C, and E, there would be no cumulative effects to snowmobile recreation because all existing areas and trails would remain open. Under alternative D, if the Freel Roadless area is designated by Congress as Wilderness, the area would be closed to snowmobiles. This would impact the Hope Valley area because it is the closest area open to snowmobiles. The effect would be that snowmobilers would be displaced from the Freel area to the Humboldt-Toiyabe NF. This would concentrate more users in that area and local users would have to trailer their machines, which could lead to a decrease in user satisfaction. However, it is not anticipated that any additional areas adjacent to the basin would be closed to snowmobiling so there would be no cumulative effects of incremental closures, only this indirect effect of displacing users.

Infrastructure and Social Resources Conclusion

When considering the effects of the Forest Plan alternatives and those foreseeable actions projected by other non-Forest Service recreation providers, Alternative C would best be able to meet demand for recreation cumulatively since it would allow for the largest increase in recreation facilities on NFS lands.

Scenic Quality

Effects on scenic resources are analyzed in terms of Scenic Integrity and Scenic Stability (See Scenic Resources Environmental Consequences analysis for discussion of these indicators). Both scenic integrity and scenic stability are affected by the considered alternatives combined with the effects of projects that implement these alternatives. Each alternative would likely result in short term scenic impacts within foreground views. Implementation of Alternative A and foreseeable future Forest Service

projects would result in the least scenic integrity. Implementation of Alternative D and its anticipated Forest Service projects would result in the greatest scenic Integrity. The effects of implementing Alternatives B and C fall between these two ranges with C representing a slight increase in scenic integrity compared to Alternative B.

Scenic stability would be greatest under Alternative C when considering the anticipated Forest Service project implementation. Alternative D would result in effects that produce the least scenic stability of the Alternatives considered. Alternatives A and B fall in between these ranges, with B slightly higher in scenic stability than Alternative A.

Past, present, and reasonably foreseeable project implementation on non-NFS lands within the project area are not anticipated to alter the general description of the environmental effects described above. NFS lands represent approximately 75% of lands within the Basin. The remaining 25% includes other public lands as well as private lands. Vegetation treatments on these lands are assumed to be consistent regardless of the Forest Plan alternative. Additional short term scenic impacts would be anticipated from these treatments which would be combined with anticipated short term impacts on NFS lands. Vegetation treatments on these lands have the greatest potential to alter the scenic character of the region; however the scale of reasonably foreseeable treatments in these lands is not anticipated to result in impacts to regional scenic integrity. The cumulative impact of these combined short term disturbances to scenic integrity is anticipated to be less than significant because of the limited duration and the maintenance of the valued scenic attribute of views of conifer forest. Scenic stability would be positively affected by these treatments, and would only improve overall landscape scenic stability described for each Forest Plan alternative.

Development of the built environment on private and non-NFS lands also has the potential to negatively affect scenic stability. Development of these lands is regulated in the Tahoe Basin, primarily by the Tahoe Regional Planning Agency, which results in controls of development scale and visual character. The impact of this development on regional scenic integrity is not anticipated to be significant when combined with the impacts from any of the Forest Plan alternatives.

Scenic Quality Conclusion

When considering the effects of the Forest Plan alternatives and those of the projects that implement the alternatives with effects of non-Forest Service projects there are no impacts to scenic resource integrity or stability that would be considered a significant impact.

Soils Resource

Soil Productivity

Cumulative effects to soil productivity in the project area are reflected in the current conditions. Lingering effects from past actions are primarily compaction on closed roads and old landings and skid trails. Ongoing disturbance is primarily found on unauthorized recreation trails and access routes for sewer lines and other utilities. Small areas of ongoing disturbance are associated with some developed recreation sites, especially those which have not yet received BMP upgrades.

Soil productivity is a site-specific attribute of the land; the soil productivity of one area is not dependent on the productivity of an adjacent area. For this reason, cumulative impacts to soil productivity would be small under all alternatives, because cumulative impacts are only present when previously disturbed areas are subjected to new disturbance before they recover naturally or are restored.

Impervious Cover

In addition to soil productivity, cumulative effects to soils can also be analyzed in terms of impervious surface or impervious cover. The TRPA soil conservation threshold is based on the amount of impervious cover in the Lake Tahoe Basin. The TRPA regulates impervious cover, and has assigned allowable percentages of impervious cover to nine land capability classes (Bailey 1974). The soil conservation threshold is considered in attainment when impervious cover is within the allowable percentage for the land capability class.

Impervious cover totals for NFS lands and non-NFS lands are compared using 2004 IKONOS data (Table 3-86).

Table 3 86. Impervious cover by land ownership in the Lake Tahoe Basin

Ownership	Total land acres*	Existing impervious cover acres	Allowable impervious cover acres	Allowable impervious cover percentage	Existing impervious cover percentage
NFS lands	148,721	465	5,019	3.4%	0.3%
Non-NFS lands	53,395	6,373	5,343	10.0%	11.9%
All lands	**202,116**	**6,838**	**10,362**	**5.1%**	**3.3%**

* Water bodies and data gaps are excluded

On NFS lands, all land capability classes are in attainment, ranging from 0.1% for class 1C to 4.2% for class 7 (Table 3-87). For all ownerships, impervious cover is in attainment in land capability classes 1A, 1C, 3, 4, 5, and 6. On Non-NFS lands, impervious cover is in attainment only in land capability classes 5 and 6. Differences between NFS and non-NFS lands are especially notable for land capability class 1B, most of which is SEZ, with 0.6% impervious cover on NFS 1B lands compared to 10.4% on non-NFS 1B lands.

Table 3 87. Impervious cover on National Forest System lands by Land Capability Class

Land Capability Class	Total NFS acres*	Existing impervious cover acres	Allowable impervious cover acres	Allowable impervious cover percentage	Existing impervious cover percentage
1A	59,723	126	597	1%	0.2%
1B	17,287	99	173	1%	0.6%
1C	48,587	38	486	1%	0.1%
2	3,281	21	33	1%	0.7%
3	6,161	17	308	5%	0.3%
4	3,407	26	681	20%	0.8%
5	6,842	99	1,710	25%	1.5%
6	2,875	13	863	30%	0.5%
7	558	24	168	30%	4.2%
Total NFS Lands	**148,721**	**465**	**5,019**	**3.4%**	**0.3%**

* Water bodies and data gaps are excluded

The accuracy limitations of the IKONOS data include a "user accuracy " or reliability rating of 87%, which means that natural cover was found to be included as impervious cover only 13% of the time over the entire basin (Minor and Cablk, 2004). Conversely, impervious cover was included as natural cover 3% of the time. Nonetheless, it is clear that Forest Service lands are not a major contributor to impervious cover in the Lake Tahoe Basin, and this situation is not projected to change significantly under any alternative.

The transportation network (roads and trails) is the largest source of impervious cover on NFS lands. No alternatives project a large increase in roads and trails, so any increases in impervious cover would be small.

Vegetation management activities have the potential to increase impervious coverage in the form of soft cover through soil compaction. Cumulative watershed effects analysis (CWE) is used to predict increases in impervious surfaces due to soil compaction resulting from timber harvest equipment and practices. The model currently used by the LTBMU predicts that using cut-to length harvester-forwarder operations, 7% of the harvest unit will be severely compacted such that the surface is effectively impervious to precipitation.

These predictions have not been confirmed by soil compaction monitoring, which found little or no decreases in soil porosity (increases in compaction) from pre-project or undisturbed conditions (USDA Forest Service 2008d, 2011, 2012). Post project conditions were far more similar to natural conditions than to an impervious condition. These results suggest a need to refine the CWE model to better reflect observed results.

The extent of compaction severe enough to be described as impervious cover is generally limited to landings that cannot be ripped due to high rock content and some main forwarder and skid trails, and

comprises a very small portion of the areas treated. Thus, vegetation management projects on NFS lands are not expected to result in hydrologically meaningful increases in impervious cover in any alternative.

Impervious cover associated with other activities, including utilities and recreation, is not expected to increase significantly under any alternative.

Soils Resource Conclusion

Total increases in impervious cover on NFS lands are expected to be small to non-existent under all alternatives. All alternatives include strategies that seek to decrease impervious cover where feasible, and no activities are expected to result in large increases to impervious cover. On non-NFS lands, impervious cover would increase largely on the relatively small area of undeveloped lands that remain in the urban areas. Thus, changes to impervious cover resulting from the alternatives in this analysis would not be significant when added to those on non-NFS lands.

Water Quality and Soil Erosion; Water Quantity; Watershed Condition

The LTMBU largely relies on the efforts of other agencies in the Lake Tahoe Basin to track and analyze metrics that would serve as measures of cumulative effects relative to lake clarity and tributary water quality.

The Lake Tahoe Basin has a long data record of tributary water quality data, provided through the Lake Tahoe Interagency Tributary Monitoring Program (LTIMP). This program is funded through TRPA and USGS, and from 2005 through 2012, has also been supported with funds through the USFS Erosion Control Grants program (for almost 1/3 of the cost of the program).

From this data, the State of California currently lists 8 tributary water bodies as impaired, and the State of Nevada lists seven tributary water bodies as impaired under Section 303(d) of the Clean Water Act (2010 List). These tributaries are located within the Lake Tahoe Basin boundary; therefore most of the tributaries mentioned include both USFS and private lands. The receiving water body, Lake Tahoe is listed by both states.

The Tahoe Regional Planning Agency has established seven thresholds related to Lake Tahoe Basin water quality that address Lake Tahoe, tributaries, stormwater runoff, groundwater, and other lakes. Based on LTIMP and other data provided to and utilized by the TRPA, none of these thresholds are currently in attainment with the exception of near shore turbidity (TRPA, 2006). One of the other seven thresholds (tributary water quality) is noted as having a positive trend, even though that threshold is not in attainment. Two of the thresholds related to Lake Tahoe clarity are noted as continuing to show a negative trend, with groundwater, other lakes, and stormwater runoff water quality metrics considered to show neutral trends.

Two of the California streams currently have approved Total Maximum Daily Load (TMDL) targets related to sediment, (Heavenly Creek, 2002 and Blackwood Creek, 2008) and TMDLs are scheduled to be developed for the other water bodies and constituents. The Lake Tahoe TMDL is a joint effort between the Lahontan Regional Water Quality Control Board in CA and the Nevada Department of Environmental Protection in Nevada NV. The Lake Tahoe TMDL was approved by EPA in August of 2011. The Lake Tahoe TMDL requires the USFS to track and report on efforts to reduce loading from NFS lands.

Most of the California streams (Table 3-88) and Lake Tahoe are 303(d) listed because of sediment and nutrient loading to Lake Tahoe and subsequent impacts to Lake Tahoe clarity. However based on the TMDL analysis, upland sources (the forested non-urban portions of the watersheds) are estimated to contribute only 9% of the total fine sediment loading to the Lake, with atmospheric (15%) and urban sources (72%) the largest contributors. In addition stream channel erosion is estimated to contribute 4% of the total fine sediment loading.

Forested non-urban sources are currently estimated to contribute 32% of the phosphorus and 18% of the nitrogen loading to the lake. Of the forested non-urban lands, the LTBMU is the primary land use manager, responsible for managing 75 % of the forested non-urban lands in the Tahoe Basin.

The six Nevada streams are listed (Table 3-88) because of zinc, iron, and in one instance pathogen violations. Two of the California streams are listed because of pathogens. The 303(d) listed waterbodies, other than Lake Tahoe, are listed below along with the pollutants causing listing.

Table 3 88. Listed 303(d) stream segments in the Lake Tahoe Basin (2010)

Segment	Measured Impact
California	
Blackwood Creek	phosphorus, nitrogen, sediment, iron
Cold Creek	nitrogen
General Creek	iron, phosphorus
Heavenly Valley Creek	phosphorus, chloride, sediment
Tallac Creek	pathogen
Trout Creek	phosphorus, nitrogen, pathogen , iron
Upper Truckee	iron, phosphorus
Ward Creek	phosphorus, nitrogen, sediment, iron
I	*Note* iron and chloride WQ stds may be revised*
Nevada	
Second Creek	zinc
Wood Creek	pathogen
Third Creek	zinc
Incline Creek	iron
Glenbrook Creek	iron
First Creek	zinc

Cumulative Watershed Effects of Alternatives

All the strategies and objectives proposed under all the alternatives will continue to support the LTBMU's goal of doing its part to achieve state water quality standards, TRPA water quality thresholds, and the Lake Tahoe Basin TMDL milestones related to stream channels and forest uplands.

The following is an excerpt from the Executive Summary of the 2011 TRPA Threshold Evaluation Report:

Water Quality Threshold Standard Goal: *To reduce nutrient and sediment loads for surface runoff, groundwater and atmospheric sources to meet 1967 to 1971 levels of algae and water transparency measured in Lake Tahoe.*

Findings and Conclusions: Water quality shows signs of improvement as well as areas of concern. The trend for winter average Secchi depth shows that the indicator is no longer declining and the Region is meeting interim targets established in 2006; additional improvements in lake clarity are needed to meet the adopted Threshold Standard. The annual average Secchi depth indicator is still considerably short of attaining both the interim target and adopted Threshold Standard, although the rate of Lake clarity decline has slowed since 2001. Summer clarity is showing declining trends and ongoing research findings are needed to understand why winter and summer readings are moving in seemingly opposite directions. The long-term trend in the phytoplankton primary productivity indicator continues to show a rapid decline, although the indicator has improved in the last two years. Research noted in the Lake Habitat Indicator Category (see Chapter 7: Fisheries) is underway assessing possible relationships of phytoplankton to other nearshore conditions. Long-term measurements of stream water quality indicate that the Region is not meeting state pollutant concentration standards, although improvements in sediment and phosphorus concentration are noted. Long-term data on pollutant loading indicates that there was little or no change in the amount of nitrogen, sediment, and phosphorus being delivered to Lake Tahoe annually via tributaries. Several information gaps related to indicators are noted and recommendations are forwarded to address this issue.

Recommendations: Proposed Regional Plan strategies for achieving the water quality thresholds include continuing the requirement to install permanent and temporary BMPs, maintaining growth management tools (e.g. use of development allocations, land coverage limitations, and urban boundary delineations), preserving and restoring stream zones, and prohibiting the discharge of wastewater, toxic waste, and solid waste into Lake Tahoe, its tributaries, and groundwater resources. Additional actions proposed in the Regional Plan Update are projected to accelerate water quality improvements include accelerating BMP implementation to help achieve TMDL goals through areawide approaches, reducing automobile use through new improvements to public transit and alternative transportation modes, greater flexibly in use of air and water quality mitigation funds to support priority water and air quality improvements and encouraging environmental redevelopment through the use of incentives associated with the transfer of development from sensitive lands.

The USFS role in achieving TRPA thresholds for water quality is directly tied to the TMDL 15 year milestones for stream channel and forest uplands, which are a 12% reduction in fine sediment from Forest Uplands, and a 53% reduction of fine sediment from stream channels. As described in the TMDL water quality control plan amendments (TMDL Plan), it is anticipated that these reductions will be achieved through past actions as well as through implementation of future strategies, as currently described under all the alternatives, including implementation of BMPs; facilities, roads, and trails retrofits and decommissioning; and implementation of currently planned restoration projects including removal of existing stressors. The TMDL plan goes on to state that the LTBMU is responsible for implementing forest fuels reduction projects to reduce the threat of wildfire in the Lake Tahoe basin, and these projects must include best management practices and appropriate monitoring to ensure fuels reduction efforts do not cause this source to exceed load allocations.

Because vegetation management treatments are primarily concentrated in a “ring” around lake Tahoe adjacent to urban areas (the WUI) , there is little to no potential for adverse consequences related to cumulative watershed affects under any of the alternatives relative to these activities. Watersheds in Lake Tahoe are generally characterized by some level of urbanization in the lower third of the watersheds, with primarily stable forested uplands in the upper two thirds of the watershed. Regardless of the specific type and scale of treatment options used, as described under all the alternatives in the WUI, implementation of BMPs are expected to result in neutral environmental consequences as it relates to achievement of TMDL milestones, TRPA thresholds stream channel condition, or watershed hydrologic response.

However alternative D does create a slightly greater risk to water quality with a reduction in vegetation management activities outside of the WUI. With limited active fuels management outside of the WUI,

there is a subsequently greater risk of catastrophic wildfire in the upper watersheds which could have the effect of not achieving the TMDL milestones.

SEZ Current Condition

The TRPA has also established a threshold for the preservation and restoration of naturally functioning SEZ lands. Currently no established set of uniform metrics have been developed for determining whether the ecosystem function of SEZ lands has been preserved or restored to “naturally functioning levels”. The Lake Tahoe Basin land management and regulatory agencies are currently working together to determine whether the California Rapid Assessment Methodology for Wetlands (CRAM) could be used in the Tahoe Basin for the purpose of evaluating attainment of this threshold.

In the meantime, TRPA has reported the number of acres in which restoration efforts have been implemented. Individual agencies rely on their own internal monitoring programs and protocols for determining the degree to which those efforts have been successful. The TRPA, 2006 threshold evaluation report documents that 378.9 acres have received restoration treatments within the urban boundary. Over a 12-year period (1988-2000), the LTBMU applied restoration treatments on approximately 500 acres of SEZ lands. Between 2000 and 2011 the LTBMU has completed an additional 78 acres of restoration on lands considered to be SEZ.

SEZ Cumulative Effects

The LTBMU manages a large amount of land that would be considered SEZ (Table 3-83). The LTBMU restoration program has identified a number of stream channel reaches and meadows where ecosystem function in terms of geomorphic stability and habitat quality can be enhanced, and this currently planned restoration is proposed equally in all four alternatives (Table 3-84). This planned restoration will continue to contribute to the TRPA threshold for restoring or enhancing SEZs to naturally functioning levels.

The impact of less active future restoration proposed in alternative D may result in a lower rate of restoration through natural processes of degraded SEZs that are not currently identified. However all of the large scale opportunities for SEZ restoration on lands managed by the LTMBU are already identified and restoration of these identified opportunities is proposed at an equal level under all the alternatives.

Water Quality and Soil Erosion, Water Quantity, Watershed Condition Conclusion

Since essentially all actions on private, county and state lands must pass through the multiple layers of regulation with TRPA involved in essentially all actions, there is a commonality of environmental protection that occurs in the Basin. Consequently while it is impossible to know the array of individual projects that might occur in the foreseeable future, it is reasonable to assume they will all meet the appropriate stringent regulations and therefore respond to threshold attainment. There is a high degree of integration between all the agencies that has the result that none of the planning documents work at cross purposes to each other.

The equation for cumulative effect is reached by taking the environmental consequences of each of the five Forest Plan alternatives presented in this FEIS for NFS lands in combination with the highly regulated actions of all other land owners/managers as guided by the TRPA Regional Plan and other regulatory agencies. As a result there is a common intent of maintaining or improving the environment on all lands within the Basin. With this common goal constraining all actions in the basin, there are no significant negative cumulative effects at the programmatic level, and in fact, for some resources and alternatives there are positive cumulative effects.

3.6. Environmental Justice

As required by Executive Order (EO) 12898, all federal actions must consider potentially disproportionate effects on minority or low-income communities. Proposed Land Management Plans are strategic and programmatic in nature, providing guidance and direction to future site-specific projects and activities. These Plans do not create, authorize, or execute any ground-disturbing activity, although they do provide for the consideration of certain types of activities. Site-specific activities will consider potential disproportionate effects on minority or low-income communities during project planning.

The Lake Tahoe Basin Management Unit Social and Economic Assessment (Appendix F) did not identify any disproportionate impacts resulting from the proposed management of the LTBMU because there are a wide range of opportunities, activities and services offered. In addition, collaboration on the Plan with local agencies and members of the public did not identify any concerns regarding disproportionate impacts to low-income or minority populations.

3.7. Relationship of Short-Term Uses and Long-Term Productivity

NEPA requires consideration of “the relationship between short-term uses of man’s environment and the maintenance and enhancement of long-term productivity” (40 CFR 1502.16). As declared by Congress, this includes using all practicable means and measures, including financial and technical assistance, in a manner calculated to foster and promote the general welfare, to create and maintain conditions under which man and nature can exist in productive harmony, and fulfill the social, economic, and other requirements of present and future generations of Americans (NEPA Section 101).

Overall, with all alternatives, projects developed would be designed using standards and guidelines and standard operating procedures that would ensure the long term productivity of NFS lands in the Lake Tahoe Basin.

3.8. Unavoidable Adverse Impacts

The land management plan provides a programmatic framework that guides site-specific actions but does not authorize, fund, or carryout any project or activity. Before any ground-disturbing actions take place, they must be authorized in a subsequent site-specific environmental analysis. Therefore none of the alternatives cause unavoidable adverse impacts.

3.9. Irreversible and Irretrievable Commitment of Resources

The land management plan provides a programmatic framework that guides site-specific actions but does not authorize, fund, or carryout any project or activity. Because the land management plan does not authorize or mandate any site-specific project or activity (including ground-disturbing actions), none of the alternatives cause an irreversible or irretrievable commitment of resources.