TABLE OF CONTENTS

3.0 AFFECTED ENVIRONMENT

List of Tables

List of Figures

3.1 Introduction

This chapter presents the existing condition of the physical, biological, social, and economic resources of the human environment that may be affected by the implementation of any of the alternatives. This chapter provides the baseline for comparison of the environmental impacts/consequences described in Chapter 4. The discussion is organized according to the order of the key resource issues identified during the scoping process (Section 1.9.2.2) and is as follows:

- Visual Resources
- Inventoried Roadless Areas, Unroaded-Undeveloped, and Suitable Wild and Scenic Rivers
- Recreation
- Fish and Wildlife
- Special Status Species (which includes threatened, endangered, proposed, candidate, Forest Service sensitive, and management indicator species)
- Water and Watershed Resources
- Soils and Geologic Hazards
- Vegetation
- Transportation
- Socioeconomic Resources
- Air Resources

A discussion of special areas (Resource Issue #13) is included in each section in which special areas occur. For example, national recreation trails are discussed in Section 3.4 (Recreation) and the Side Hollow Ponderosa Pine Provenance Study Area is discussed in Section 3.9 (Vegetation).

3.2 Visual Resources

3.2.1 Introduction

The Dixie National Forest occupies approximately 2 million acres across nearly 170 miles in southern Utah. Elevations vary from 2,800 feet near St. George to 11,307 at Brian Head Peak, Cedar City Ranger District. High altitude forests in gently rolling hills characterize the Markagunt, Paunsaugunt, and Aquarius Plateaus within the Forest boundary. Vegetation varies from sparse desert plants at low elevations, to pinyon pine and juniper forest at mid-elevations. At higher elevations, aspen, pine, spruce, and fir predominate (USFS 2000a).

The scenic beauty of the Dixie National Forest is one of the major attractions of this area. Zion National Park, Bryce Canyon National Park, Capitol Reef National Park, and The Grand Staircase-Escalante National Monument are adjacent to the Forest, while Cedar Breaks National Monument lies within the Forest boundaries (USFS 2000a). These parks and monuments include scenic overlooks that include views of Dixie National Forest lands.

Scenic resources are a composite of basic terrain, geologic features, water features, vegetative patterns, and land use effects that typify an area and influence the visual appeal that area may have to people. The opportunity to experience the landscape and interpret scenery and visual change is dependent upon the degree of public access and use of an area (JBR 2004).

Five scenic byways and four scenic backways have been formally designated within the Dixie National Forest since 1986. The Utah State and National Forest Scenic Byways include Highway 14, Highway 143, Highway 148, and Highway 12. Highway 89 from Panguitch to Kanab has been designated a Utah State Scenic Byway. The four Utah State Scenic Backways include Posey Lake Road, Griffin Top Road, the Dry Lakes/Summit Canyon Road, and the East Fork of the Sevier Road (USFS 2000a).

Scenic Byway Highway 12 is also part of the National System of America's Byways, a collection of 126 diverse routes designated by the US Secretary of Transportation representing the depth and breadth of scenery in America. Utah's Scenic Byway 12 – A Journey Through Time – received the All-American Road designation from the Federal Highway Administration in 2002. According to the National Scenic Byways Program website, Scenic Byway 12 is an exceptional 124-mile route, which "negotiates an isolated landscape of canyons, plateaus, and valleys ranging from 4,000 feet to 9,000 feet above sea level...a showcase of sandstone sculpted by nature (USDOT 2007)."

It has been shown that high-quality scenery can enhance people's lives and benefit society, particularly natural scenery such as is associated with National Forests (USFS 1995h). It is primarily through their visual sense that most visitors perceive the Forest and its interrelated components. Benefits derived from scenic settings include identity, self-image of communities and individuals, and enhanced quality of life. Sightseeing, driving for pleasure, and outdoor photography are among the nation's leading recreational activities and as demand continues, the need to preserve high quality visual resources will also increase (USFS 2003a).

3.2.2 Visual Resources Management on the Dixie National Forest

The National Forest Scenery Management System (SMS) is the process used for planning and design of the visual elements of multiple use land management. Scenery management is based on the criteria and guidelines in the Landscape Aesthetics Handbook for Scenery Management, US Department of Agriculture (USDA) Handbook Number 701 (USFS 1995h). This system was implemented in 1996, superseding the Visual Management System (VMS). The Visual Management System was first published as a handbook in 1974 - National Forest Landscape Management, Vol. 2, USFS Handbook Number 462 (USFS 1974) and provided the direction for the management of scenic resources on National Forests for over 20 years. The Visual Management System was based on a series of Visual Quality Objectives (VQOs) ranging from Preservation to Maximum Modification, according to the mechanics of viewing landscapes, and the importance of aesthetics.

The Scenery Management System began with the basic premises established in the Visual Management System, but has been expanded to better accommodate ecosystem management and the realistic time frames of natural systems. This system also places greater importance on establishing which scenic elements Forest users value most, and identifying ways to maintain or improve on those qualities.

Full implementation of the new Scenery Management System was intended to occur with Forest Plan revision, although case by case application on the project level was directed for instances where a plan revision was years out. Because the Visual Management System was the basis for the 1986 Dixie National Forest Land and Resource Management Plan (USFS 1986), the Land and Resource Management Plan required an update in order to efficiently apply the Scenery Management System. The Dixie National Forest prepared an amendment to the Land and Resource Management Plan in April 2000 to apply the Scenery Management System Scenic Integrity Objectives (SIOs) "within the context of the goals, objectives, and management direction of the current Forest Plan." The Environmental Assessment (USFS 2000a) prepared to analyze this plan amendment provides a detailed comparison of the Visual Management System and Scenery Management System. Scenery Management System values were preliminarily assigned to Dixie National Forest lands based upon the soils database, bridging to Forest Plan direction. Scenery Management System values include buffers on Concern Level 1 and 2 roads (See Section 3.2.5).

The Scenery Management System Amendment to the Land and Resource Management Plan provides specific direction on SIO in all management areas except for Management Area 1, General Direction. For most of Management Area 1, SIO is unassigned. The Amendment states that, when a specific project is proposed in Management Area 1 with unassigned SIO, a visual analysis will be completed and the project will comply with the SIO that results from this analysis.

Specific Management Areas ranging from '1A – Developed Recreation' to '10B – Municipal Watersheds' (see Table 3.2-2) are assigned a Landscape Theme, and SIO. The General Management Areas fall into the category listed below in Table 3.2-1 as 'SIO Unassigned'. In these areas, if outside of Concern Level 1 and 2 travelways and use areas, the SIOs are designated during project planning according to the following scenario: Class A scenic attractiveness (distinctive) – minimum of High SIO; Class B scenic attractiveness (common or typical) – minimum of Moderate SIO; Class C scenic attractiveness (indistinctive) – minimum of Low SIO (USFS 2000a). In essence, the label of 'SIO Unassigned' does not indicate a lack of scenic quality; it merely indicates that SIO will be determined when a specific project is proposed.

3.2.3 Scenic Integrity Objectives

Scenic integrity indicates the current status of a landscape – the degree of intactness and wholeness of the landscape character (USFS 1995h). It is determined on the basis of visual changes that detract from the scenic quality of the area (USFS 1995h). The SIO refers to the degree of acceptable change or alteration of the valued Landscape Theme (USFS 2000a). Under the Scenery Management System, higher SIOs represent highly valued natural landscapes where management activities would result in little or no deviation from those values. Greater modification to the landscape is acceptable in low SIO landscapes. According to the 1986 Land and Resource Management Plan, the Dixie National Forest is divided into the visual management categories shown in Table 3.2-1 below. The original VQOs are generally comparable to the SIOs, as noted. The SIOs for the Dixie National Forest are shown on Figure 3.2-1.

Very High Scenic Integrity (Very High SIO) is generally reserved for designated Wilderness and Research Natural Areas, but may apply to additional areas of the Forest as well, where the valued landscape character is intact, and there is no evidence of apparent modification. High Scenic Integrity (High SIO) applies to an area that appears unaltered; where the valued

landscape character appears intact, and any structures or surface effects are designed to blend with the natural landscape. Moderate Scenic Integrity (Moderate SIO) may appear slightly altered but alterations are visually subordinate to the overall landscape. In Low Scenic Integrity (Low SIO) areas, deviations may begin to dominate the landscape view.

Table 3.2-1 Acres of SIO categories on the Dixie National Forest

Ranger District	SIO Very High	SIO High	SIO Moderate	SIO Low	SIO Unassigned	TOTAL
	VQO Preservation	VQO Retention	VQO Partial Retention	VQO Modification		
Pine Valley	Pine Valley Wilderness: 49,994 Other 1,974 **Total: 51,969**	54,003	160,747	60,179	135,815	462,712
Cedar City	Ashdown Gorge Wilderness: 6,932 Other: 264 **Total: 7,195**	Brian Head 1,457 Other: 109,069 **Total: 110,527**	99,165	Brian Head: 74 Other: 36,370 **Total 36,444**	99,091	352,423
Powell	Red Canyon Natural Area: 531	88,725	138,701	130,341	25,480	383,778
Escalante	Box-Death Hollow Wilderness: 25,557 Antone Bench & Areas 2, 3, 4 & 5: 3,224 Other: 1,444 **Total: 30,226**	148,860	140,529	66,171	45,921	430,706
Total Acres Per SIO Percent of Forest lands	89,921 6 %	402,115 25 %	539,142 33%	293,135 18 %	305,307 19%	1,629,619

3.2.4 Landscape Theme

The landscapes of the Dixie National Forest are described according to Landscape Themes. **Developed Recreation** is a Landscape Theme characteristic of areas with developed recreation facilities such as campgrounds and picnic areas. In these areas, the recreation facilities are a dominant feature in the landscape. The **Natural Appearing** Landscape Theme applies to areas where the existing landscape character has been influenced by human activities, but appears natural to the majority of viewers. Natural elements such as native trees, rock outcrops, and streams or lakes dominate the views. In a **Natural Evolving** Landscape Theme, the natural landscape character originates primarily from natural disturbances and ecological succession, with only subtle changes due to indirect human activities. In these areas, natural events such as forest fires, drought, or deforestation due to insect infestations may dramatically change the views (USFS 2000a). The Land and Resource Management Plan Management Areas and associated Landscape Themes and SIOs are listed in Table 3.2-2.

3.2.5 Concern Levels

Concern Levels categorize the importance to forest visitors of landscapes viewed from travelways and use areas. Concern Level 1 roads and use areas are primary public travel routes through the National Forest including designated scenic highways and byways, or primary recreational areas such as campgrounds, visitor centers, vista points, and others. Highway 12 through the towns of Escalante and Boulder, and through portions of the Dixie National Forest has been formally designated a National Scenic Byway and thus qualifies as a Concern Level 1 road. Concern Level 1 viewsheds adopt the Landscape Theme of the Management Area in which they occur. Outside of Concern Level 1 areas, assignment of SIOs is based upon the Landscape Theme.

Travelways on the Dixie National Forest have been assigned a Concern Level according to the criteria in the Scenery Management System. Concern Level 1 and 2 travelways adopt the Landscape Theme of the management area in which they occur. Concern Level 1 travelways are managed at a level of at least high scenic integrity. Concern Level 2 travelways are managed at a level of at least moderate scenic integrity. The guideline for specific management areas including those listed above states that resource management activities should not be permitted to reduce the scenic integrity levels below the prescribed objectives (JBR 2004).

Concern Level 1 viewsheds include areas seen from: Honeycomb Rocks, Upper and Lower Enterprise Reservoirs, Pine Valley community, Pine Valley Recreation Area, Cedar Breaks National Monument, Brian Head Peak, Panguitch Lake, Navajo Lake, Bryce Canyon National Park, Powell Point, Tropic Reservoir, Hell's Backbone Bridge, Highway 12 overlooks between Teasdale and Boulder, and Capitol Reef National Park. Critical viewsheds are listed as such because they receive intensive recreation use that is sustained in nature and/or there is a very high concern for scenic resources (USFS 2000a).

3.2.6 Night Skies

The night sky views in the vast expanse of southern Utah are recognized as an invaluable resource to many residents and visitors. Under ideal conditions a viewer might observe a night sky with more than 15,000 visible stars plus the Milky Way, which itself contains billions of stars (NPS 2004). The National Park Service has a Night Sky Team that is working in National Parks across the country to measure the effects of light pollution. Several southeastern Utah National Parks are included in the study and were some of the first to be visited by the Night Sky Team. "The amount of light pollution is measured with a camera that is capable of precisely measuring light levels. Mounted on a robotic Meade LX 200GPS telescope, the camera takes 104 images to capture the entire sky. These images are stitched together, and by subtracting the light emitted by known individual stars, researchers generate a value for night sky darkness (NPS 2006a)." Data has been collected since 2001 (NPS 2007a). An observation point at Canyonlands National Park is the site closest to the Dixie National Forest. Bryce Canyon National Park includes overlooks with expansive views, and it shares borders on both sides with the Dixie National Forest. The value of most units administered by the National Park Service lies in their continued naturalness, especially as humans increasingly develop lands outside the parks (NPS 2004).

At every park surveyed by the Night Sky Team, artificial light was detected, said Chad Moore, co-investigator and manager of the NPS Night Sky Team. Pristine night skies were once commonplace just a few decades ago, but have become increasingly rare under the advance of glary lights. Visitors are increasingly seeking out dark skies in places like national parks to rediscover the beauty of the night sky. By sharing our telescopes and enthusiasm for the night,

we help them celebrate that beauty, said Kevin Poe, Park Ranger at Bryce Canyon National Park, where stargazing programs were attended by 27,000 people last year (NPS 2006b). The Bryce Canyon National Park Management Plan reiterates the concern about night sky conservation, stating that minor increases in artificial light and air pollution can seriously jeopardize the night skies, and that continued increases in air pollution and artificial lights could have a serious negative impact on visitors' experience (NPS 1987).

3.2.7 Visitor Use and Access to the Forest

The value and enjoyment of scenic resources is intricately tied to access and use. Levels and types of use may in turn affect visitor experiences. The above described scenic backways and byways are highly accessible. Other scenic areas of the forest are accessible by unimproved roads available to motorized vehicles, or by non-motorized traffic, or by foot or pack animal only.

During 2006, the Dixie National Forest monitored 19 non-motorized trails and 5 motorized trails for use. Of the 19 non-motorized sites, 9 indicated increased use, 3 had decreased use, and 1 had no change; the remaining 3 were in first year monitoring. Of the motorized trail sites, 2 indicated increased use, 2 had decreased use, and 1 had no change. Most of the high use trails tend to be either scenic and/or mechanized. Across the Forest, use numbers remain stable: however, increased use is expected due to proximity to the fast growing city of Las Vegas, Nevada. In addition, the Forest provides many opportunities for motorized recreation, which is the fastest growing sport in the United States (USFS 2009a). The Recreation Specialist Report (3.0) further describes recreation uses on the Dixie National Forest. The Transportation Specialist Report (11.0) further describes road systems, traffic, and travel restrictions in place on the Forest.

Oil & Gas Leasing EIS on Lands Administered by the Dixie National Forest

FIGURE 3.2-1
Visual Resources
Scenery Management System

Horizontal Datum = NAD 83 Coordinate System = Zone 12N	1:590,000	1 in = 9 miles

Legend

- Cities
- Freeways
- Highways
- Minor Roads*
- Major Streams & Rivers
- Water Bodies
- County Boundaries
- State Boundaries

National Forest System Lands

- Dixie National Forest
- Wilderness Areas
- Fishlake National Forest

Other Land Administration

- Bureau of Land Management
- GSENM**
- National Park Service
- Private
- State of Utah
- Tribal

Scenery Management System

- Unassigned
- Low
- Moderate
- High
- Very High

0 4 8 12 16 Miles

N

Original data was compiled from multiple source data and may not meet the U.S. National Mapping Accuracy Standard of the Office of Management and Budget. For specific dates and/or additional digital information, contact the Forest Supervisor, Dixie National Forest, Cedar City, Utah. This map has no warranties to its contents or accuracy.

*Not all roads are shown. Only some roads are depicted for orientation purposes.
**Grand Staircase-Escalanted National Monument. Managed by the Bureau of Land Management.

3.2.8 Pine Valley Ranger District

The Pine Valley Ranger District occupies approximately 481,264 acres in Iron and Washington Counties. It is north of the city of St. George, and borders near the communities of Enterprise, Central, Leeds, New Harmony, and Newcastle. Included in this area are the Pine Valley Mountain Wilderness Area, Enterprise Reservoirs, the Bull Valley Mountains, and Pine Park. Rising above the communities of Enterprise and St. George, Utah, the Pine Valley Mountains are a striking compliment to the area's dramatic red rock scenery. There are three physiographic regions that meet in the Pine Valley Mountain area – the Mojave Desert, Basin and Range, and the Colorado Plateau region. The area features sage steppe and mountain brush, pinyon-juniper woodland, and isolated stands of coniferous forest on the wetter north-facing aspects. Scattered patches of ponderosa pine are found in the area. The unique volcanic and rugged scenery provides striking contrasts to the surrounding redrock country.

Several significant geological conditions are found within the Pine Valley Ranger District. A striking formation found in the district, known as the Racer Canyon Tuff, has created dramatic and fascinating white and gray-hued features. Wind and water erosion sculpted the formation in a series of scenic hoodoos, domes, and goblins. The Racer Canyon Tuff feature is most prevalent in the Bull Valley subsection in areas known as Pine Park, Racer Canyon, and Honeycomb Rocks (Utah Forests 2008).

On the south end of the district, landforms fall away to dramatic red, orange, and white sandstone outcrops and canyons, providing a striking contrast to the volcanic features of the main range. Scenic peaks and canyons give visitors a palpable feeling of solitude (Utah Forests 2008). The area contains a Forest Service Research Natural Area (RNA), known as Browse RNA. The entire region is well suited to horseback riding, hiking, backpacking, bird and wildlife watching, photography, and historical tourism.

Within this ranger district, 135,815 acres have not been assigned SIOs. The majority (about 50 percent) of the remaining SIO-assigned acreage in the Pine Valley Ranger District is designated Moderate SIO (See Table 3.2-1). The High SIO areas on this District include areas within ½ mile of Forest Service Road 006 (including the Upper Enterprise Reservoir and Honeycomb Campground), Forest Service Road 035 (road to Pine Valley Recreation Area), Cottonwood Road (Forest Service Roads 031 and 033), and Forest Service Road 032 to Oak Grove Campground (USFS 1995g, see Figure 3.2-1).

3.2.9 Cedar City Ranger District

The Cedar City Ranger District occupies approximately 404,283 acres in Iron, Garfield, and Kane Counties. This District lies just east of Cedar City and west of the communities of Panguitch, Hatch, and Alton. It includes Panguitch Lake, Ashdown Gorge Wilderness, the Markagunt Plateau, Navajo Lake, and the Duck/Swains area. Cedar Breaks National Monument is located within the District boundary.

The Cedar City Ranger District is located on the Markagunt Plateau, a gently sloping, eastward tilted earth block that has been modified by erosion, volcanism, and some glaciations. The plateau has many dead spruce trees - trees that have been killed by an epidemic of spruce bark beetles. Bordered by the beautiful pink limestone of the Wasatch formation (the same formation that forms the spires and landscape of Bryce Canyon National Park and Cedar Breaks National Monument), the District has some of the more spectacular scenery in the West. This panoramic tapestry becomes even more spectacular during the splendor of autumn's colors. Elevations

range from approximately 6,000 feet to 11,307 feet at Brian Head Peak. Volcanic knolls rise up to 800 feet above the plateau, and lava flows occupy the surface in numerous locations (USFS 2008a). Vegetation transitions from pinyon-juniper and sagebrush at the lower elevations, through ponderosa pine, mixed conifer, and aspen at the mid elevations, climaxing in spruce-fir, aspen and high alpine meadows.

Sharing the western and northern borders of the desert like Cedar Breaks National Monument, the 7,022-acre Ashdown Gorge Wilderness (Very High SIO) displays eroded, multicolored Wasatch limestone, meadows, and forestland including a significant stand of bristlecone pine, known as the Twisted Forest, in the northern corner. Bristlecone pines are among the oldest living life forms,

Within this ranger district, 99,091 acres have not been assigned SIOs. About 44 percent of the remaining acreage in the Cedar City Ranger District is designated High SIO, and 39 percent is Moderate SIO (see Table 3.2-1). The High SIO areas on the Cedar City Ranger District include areas within ½ mile of Scenic Byways 143, 148, 14, and 89, and Forest Service Roads 064 and 068 (between Scenic Byways 143 and 14), Forest Service Road 053 (road along south side of Navajo Lake), Forest Service Road 060 adjacent to Swains Creek and dispersed recreation areas around Brian Head Ski Area and areas surrounding the Ashdown Gorge Wilderness (USFS 1995g).

3.2.10 Powell Ranger District

The Powell Ranger District occupies approximately 388,603 acres in Garfield, Kane, and Piute Counties. It lies south of the communities of Circleville and Kingston, and east of Panguitch and Hatch, and is bordered by Bryce Canyon National Park on the southeast. The northern part of the Ranger District includes the Sevier Plateau, and the Paunsaugunt Plateau is to the south. The highly scenic Red Canyon, which contains several unique endemic plants, can be viewed from Scenic Byway 12. Perhaps the inspiration for the term "red rock," Red Canyon is one of the most scenic areas of the Claron Formation. Red limestone formations of Red Canyon rival those of Bryce Canyon National Park. Carved by wind and water, this colorful limestone formation is a popular spot for sightseers, photographers, hikers, horseback riders and bicyclists alike.

In 2006, the Powell Ranger District designated a series of dispersed campsites along the East Fork of the Sevier River south of Tropic Reservoir.

Within this ranger district, 25,480 acres have not been assigned SIOs. The majority of the remaining lands in the Powell Ranger District are assigned Moderate (30 percent) or Low (37 percent) SIOs, and about 25 percent are assigned High SIOs (See Table 3.2-1).

High SIO areas on the Powell Ranger District include those areas within ½ mile of Scenic Byway 12 to Bryce Canyon National Park including the Forest Service Red Canyon Campground and surrounding area, Scenic Backway – East Fork of the Sevier River (Forest Road 087) and dispersed recreation areas beyond the East Fork of the Sevier River Scenic Backway (USFS 1995g).

3.2.11 Escalante Ranger District

The Escalante Ranger District occupies approximately 436,610 acres in Garfield County. This ranger district shares most of its southern border with the Grand Staircase-Escalante National Monument and its northern border with the Fremont River Ranger District of the Fishlake

National Forest. Highway 12 Scenic Byway (Forest Concern Level 1 travel way) passes through this ranger district for a few miles south of Escalante and north of Boulder for 25 miles. This highly scenic area includes Boulder Mountain area, Griffin Top area, the Aquarius Plateau, Box Death Hollow Wilderness Area, and many miles of roads and trails.

Boulder Mountain is the name applied to the high plateau area, including the Aquarius Plateau, between Highway 24 (Loa/Torrey) and Highway 12 (Escalante/Boulder). The Boulder Mountain area is one of two major high-elevation lake areas in Utah; the other is the Uinta Mountains, in northeastern Utah. From the top of Powell Point, it is possible to see for miles into three different states. Boulder Mountain area and the many different lakes provide opportunities for hiking, fishing, and viewing outstanding scenery.

The Box Death Hollow Wilderness Area has Very High SIOs. High SIOs are applied to 39 percent of the Escalante Ranger District, with Moderate SIOs applied to 36 percent of those lands designated with SIOs. Within this ranger district, 44,921 acres have not been assigned SIOs.

High SIO areas include areas within ½ mile of Scenic Byway 12, Forest Service Road 153 (Hell's Backbone), Forest Service Road 140 (Backcountry Byway – Griffin Top Road), Forest Service Road 132 including the access road to Pine Lake and Pine Lake Campground, Forest Service Road 153 and 154 (Backcountry Byway – Posey Lake Road), Forest Service Road 149 (Barker Reservoir and surrounding area), and popular dispersed recreation areas including the trails and primitive roads and recreation areas including: Lower Reservoir, Round Lake, Green Lake, Deer Creek Lake, Chriss Lake, and Lake McGath (USFS 1995g).

Table 3.2-2 Landscape Theme and SIOs for Management Areas of the Dixie National Forest

Code	Forest Plan Management Area	Landscape Theme	SIO
1	General Forest Management	Natural Appearing	Outside of Concern Level 1&2 areas, assigned based upon scenic attractiveness which is assigned according to scenery inventory during project planning
1A	Developed Recreation	Developed Recreation	High
1B	Winter Sports	Developed Recreation – Rural Interface (except for some areas visible from Cedar Breaks National Monument where Landscape Theme is Natural Appearing)	High
2A	Semi Primitive Recreation	Natural Appearing	High
2B	Rural/Roaded Recreation	Natural Appearing	Moderate
4A	Fish and Aquatic	Natural Appearing	High
4A	Fish and Aquatic (areas with developments for water-related recreation: Tropic Reservoir, Navajo Lake, Panguitch Lake)	Developed Recreation	High
4B	Wildlife Habitat, Management Indicator Species	Natural Appearing	Low
4C	Wildlife Habitat, Brush	Natural Appearing	Low
4D	Aspen	Natural Appearing	Low
5A	Big Game Winter Range	Natural Appearing	Moderate
5B	Big Game Winter Range	Natural Appearing	Moderate
6A	Livestock Grazing	Natural Appearing	Moderate
7A	Wood Production	Natural Appearing	Low
8A	Wilderness	Natural Evolving	Very High
8A1/8A2	Antone Bench, Box Death Hollow (adjacent to designated wilderness areas)	Natural Appearing	Very High (High if existing CO_2 leases are developed)
9A	Riparian	Natural Appearing	Moderate
9B	Intensive Riparian	Natural Appearing	High
10A	Research Natural Areas	Natural Appearing	Very High
10B	Municipal Watersheds	Natural Appearing	Low

3.3 Inventoried Roadless Areas, Unroaded-Undeveloped areas, and Suitable Wild and Scenic Rivers

3.3.1 Introduction

This section describes the Inventoried Roadless Areas (IRAs) and Unroaded-Undeveloped Areas on the Dixie National Forest and the general roadless characteristics and wilderness attributes of IRAs that could be affected by implementation of the alternatives described in Chapter 2. This section and the corresponding section in Chapter 4 do not present detailed information on the IRAs or analyze their suitability. Rather this section just presents the information necessary to understand the potential impacts of oil and gas leasing, which are described in Chapter 4. In addition to IRAs and Unroaded-Undeveloped Areas, this section also summarizes the process by which the Forest Service evaluates potential Wild and Scenic Rivers and describes the four streams on the Dixie National Forest suitable for inclusion in the National Wild and Scenic River System. Additional information on the 2001 Roadless Area Conservation Rule and the Wild and Scenic River Suitability Study for National Forest System Lands in Utah is available in Chapter 1 (Sections 1.8.2 and 1.8.3, respectively).

3.3.2 Inventoried Roadless Areas

On January 12, 2001, the Roadless Area Conservation Rule was issued. This rule provided protections for inventoried roadless areas (IRA). IRAs are those areas identified in a set of inventoried roadless area maps, contained in Forest Service Roadless Area Conservation, Final Environmental Impact Statement, Volume 2, dated November 2000, which are held at the National headquarters office of the Forest Service, or any subsequent update or revision of those maps.

In an increasingly developed and fragmented landscape, IRAs represent some of the largest and most extensive tracts of undeveloped land. To be classified as an IRA, areas must not contain constructed roads and generally are at least 5,000 acres. Areas containing less than 5,000 acres can also be classified as IRAs if they do not contain constructed roads and meet one of the following criteria: (1) areas can be preserved due to physical terrain and natural conditions, (2) they are self-contained ecosystems, such as islands, that can be managed as an individual unit of wilderness, or; (3) they are contiguous to existing wilderness, primitive areas, recommended wilderness, or potential wilderness in other federal ownership. The definition for a constructed road is a road where there has been mechanical surface grading and cut and fill slopes are present along with drainage structures. Two-track roads are permissible within an IRA if there is no evidence of mechanical construction.

There are 38 IRAs covering a total of approximately 570,559 acres, which represents approximately 35 percent of the analysis area (the Dixie National Forest) for this EIS. Seven of the IRAs are smaller than 5,000 acres, but were included in the initial Roadless Area Review and Evaluation process and later received protection under the 2001 Roadless Area Conservation Rule. Some of these IRAs are adjacent to larger tracts of wilderness, other IRAs, or adjacent to potential wilderness on land administered by the Bureau of Land Management (BLM). Table 3.3-1 lists the IRAs on the Dixie National Forest by ranger district and the total acreage associated with each. Figure 3.3-1 shows the IRAs on each ranger district

In addition to the general absence of constructed roads, IRAs contain other important environmental values that warrant protection. These values include nine values or features

identified in the Roadless Area Conservation Rule that characterize IRAs, as well as seven attributes that characterize wilderness potential. Given the large number of IRAs on the Dixie National Forest and the inability to predict where potential oil and gas activity may occur, detailed information on the characteristics and attributes of each individual IRA is not presented in this EIS. Rather, the characteristics and attributes are described in general in this section and any unique characteristics known to be present within a specific IRA are discussed within the individual ranger district sections. Further, since IRAs cover such a large percentage of the analysis area, it is assumed that they contain a full range of the physical and biological characteristics found on each ranger district.

Table 3.3-1 Inventoried Roadless Areas on the Dixie National Forest, by Ranger District

Ranger District	IRA Name	Acres
Pine Valley	Atchinson	17,663
	Bull Valley	10,907
	Cave Canyon	5,661
	Cedar Bench	8,917
	Cottonwood	6,752
	Cove Mountain	16,634
	Dixie	109
	Gum Hill	3,181
	Headwaters/Pine Park Bench/Pine Park	10,949
	Kane Mountain	8,016
	Lost Peak	4,144
	Mogotsu	16,771
	Moody Wash	31,853
	North Hills	24,485
	Pine Valley Mountains	57,683
	Rock Canyon	16,463
	Stoddard Mountain	13,155
	Total	253,342
Cedar City	Bear Valley Peak	7,419
	Bunker Creek	7,286
	Hancock	9,806
	Lava Beds	14,940
	Mineral Canyon	8,392
	Total	47,842
Powell	Casto Bluff	87,416
	Deer Creek	39,784
	Fishhook	12,921
	Horse Valley	13,603
	Red Canyon North	9,964
	Red Canyon South	3,730
	Total	167,418

Ranger District	IRA Name	Acres
Escalante	Boulder Mtn/Boulder Top/Deer Lake	14,888
	Box-Death Hollow	3,171
	Hog Ranch	17,114
	Jake Hollow	15,135
	Long Neck Mesa/Steep Creek/Oak Creek – Steep Creek/Oak Creek	11,139
	McGath Lake – Auger Hole	8,328
	New Home Bench	10,505
	Shakespeare Point	750
	South Rim	1,367
	Table Cliffs – Henderson Canyon	19,561
	Total	101,958
Forest Total		570,559

3.3.2.1 Roadless Characteristics

High quality or undisturbed soil, water, and air: These three resources are the foundation upon which other resource values and outputs depend. Healthy watersheds provide clean water for domestic, agricultural, and industrial uses; maintain fish and wildlife populations; and provide recreational opportunities.

Sources of public drinking water: National Forest System lands contain watersheds that are important sources of public drinking water. Maintaining these areas in a relatively undisturbed condition is crucial to maintain the flow and affordability of clean water to a growing population.

Diversity of plant and animal communities: IRAs are more likely than roaded areas to support greater ecosystem health, including the diversity of native and desired nonnative plant and animal communities. These areas serve as a buffer against the spread of nonnative invasive species.

Habitat for threatened, endangered, proposed, candidate, and sensitive species and for those species dependent on large, undisturbed areas of land: IRAs function as biological strongholds and refuges for many species including 25% and 13% of federally listed animal and plant species, respectively. In addition, 65% of all Forest Service sensitive species are directly or indirectly supported by IRAs (36 CFR 294).

Primitive, Semi-Primitive Non-Motorized, and Semi-Primitive Motorized classes of dispersed recreation: IRAs often provide outstanding dispersed recreation opportunities in areas with wilderness-like attributes. These areas reduce recreation pressure on designated Wilderness, and unlike Wilderness, the use of mountain bikes and other mechanized means of travel is permitted.

Reference landscapes: Reference landscapes of relatively undisturbed areas serve as a barometer to measure the effect of development on other parts of the landscape.

Natural appearing landscapes with high scenic quality: High quality scenery, especially scenery with natural-appearing landscapes, is a primary reason that people choose to recreate. In

addition, quality scenery contributes directly to real estate values in nearby communities and residential areas.

Traditional cultural properties and sacred sites: Traditional cultural properties are places, sites, structures, art, or objects that have played an important role in the cultural history of a group. Sacred sites are places that have special religious significance to a group. Many of these sites may be eligible for protection under the National Historic Preservation Act; however, many of these areas have not been inventoried.

Other locally identified unique characteristics: IRAs may offer other locally identified unique characteristics and values such as, uncommon geological formations, unique wetland complexes, or social, cultural, or historical characteristics.

3.3.2.2 Wilderness Attributes

Natural Integrity: Natural integrity is the extent to which long-term ecological processes are intact and operating. It describes the extent to which human influences have altered natural processes.

Apparent Naturalness: Apparent naturalness means that the environment looks natural to most people using the area.

Solitude and Primitive Recreation: Solitude is defined as isolation from the sights, sounds, and presence of others as well as human development. Opportunities for primitive recreation is a measure of the experiences available to be isolated from the evidence of man, to feel a part of nature, to have a vastness of scale, and a high degree of challenge and risk while using outdoor skills. Physical factors that can create primitive recreation opportunities include topography; vegetative screening; distance form human impacts such as roads, motorized vehicles, and logging operation; and difficulty of travel.

Challenging Experience: A challenging experience is one that requires self-reliance through application of outdoor skills.

Special Features/Special Places/Special Values: These consist of unique geological, biological, ecological, cultural, or scenic features.

Wilderness Manageability and Boundaries: To be evaluated for wilderness, an area generally must comprise a minimum of 5,000 acres. The boundaries of these areas should be manageable without conflicts to existing developments and uses. The shape of an area and changes to the shape can influence how it can be managed.

3.3.3 Unroaded-Undeveloped Areas

Unroaded-Undeveloped Areas are all those classified as such within the Dixie National Forest GIS database and indentified on the 2005 Draft Inventory map of Unroaded/Undeveloped Areas. The inventory of Unroaded-Undeveloped Areas was conducted jointly with the Fishlake National Forest while planning for Forest Plan Revisions, it was based on direction in the Intermountain Region Planning Desk Guide: A Protocol for Identifying and Evaluating Areas for Potential Wilderness" (cited in USFS 2009a). Unroaded-Undeveloped Areas identified according to this protocol only exclude classified Forest-system roads as of 2004, and thus still contained numerous "constructed" (unclassified) roads and trails, as well as timbered areas, powerlines, and other infrastructure. After the inventory of Unroaded-Undeveloped Areas, the Fishlake and

Dixie National Forests began an evaluation of the suitability of each Unroaded-Undeveloped Area for wilderness recommendation. The purpose of this evaluation was to determine which areas met the definition of wilderness found in the 1964 Wilderness Act, and as such "meet the criteria for wilderness suitability and possibly recommendation to Congress for wilderness study or designation." (Forest Service Handbook 1909.12: Chapter 70).

About sixty (59%) percent of the total Unroaded-Undeveloped Area on the Dixie National Forest overlaps with IRAs. Table 3.3-2 lists the Unroaded-Undeveloped Areas in each Ranger District, their size, and the extent of overlap with IRAs.

Table 3.3-2 Unroaded-Undeveloped Areas on the Dixie National Forest, by Ranger District

Ranger District	Name	Total Acres	Acres within IRAs
Pine Valley	Atchinson	24,306	17,617
	Bull Valley	13,372	10,882
	Cave Canyon	8,136	5,660
	Cedar Bench	10,002	8,900
	Cottonwood[1]	8,845	6,752
	Cove Mountain	15,678	15,017
	Kane Mountain	9,632	7,955
	Lost Peak	6,053	4,143
	Moody Wash / Mogotsu	58,978	48,043
	North Hills	24,864	24,483
	Pine Park	31,550	16,367
	Pine Valley Mountain[1]	154,495	57,376
	Stoddard Mountain	14,196	12,981
	TOTAL	380,108	246,578 (65%)
Cedar City	Ashdown Gorge[1]	12,148	0
	Bear Valley Peak	11,379	6,136
	Bunker Creek	12,333	4,448
	Hancock	10,140	9,439
	Lava Beds #1	7,058	6,434
	Lava Beds #2	8,643	7,146
	Little Creek Peak	19,345	0
	Mineral Canyon	13,409	7,238
	Wagon Box	5,671	0
	TOTAL	100,125	40,840 (41%)
Powell	Big Hollow	7,791	0
	Blind Springs	9,917	0
	Casto Bluff	86,408	84,966
	Deep Creek	41,984	39,499
	Fishhook	11,437	11,326
	Horse Valley	14,588	12,760
	Lower Hoodle	10,254	9,398
	Red Canyon North	15,131	9,363
	Red Canyon South	5,597	2,642
	TOTAL	203,106	160,555 (79%)
Escalante	Antimony	20,604	0
	Barker	16,337	9,094
	Birch Creek	6,105	3
	Boulder Top	37,364	22,105
	Box-Death Hollow[1]	32,922	2,886

	Canaan Mountain	7,683	0
	Dry Lake	9,268	0
	Heaps Canyon	6,622	0
	Henderson Canyon	23,113	18,613
	Hog Ranch	5,924	3,761
	Jake Hollow	11,812	8,891
	Long Neck	12,711	10,903
	Pacer Lake	16,328	0
	Pretty Tree Bench	12,021	5,702
	Shakespeare Point	1,109	1,108
	TOTAL	219,923	83,067 (38%)
Forest Total		**903,262**	**531,040 (59%)**

[1] Partially within a Wilderness Area (see Table 1.5-1).

There is no policy, law, or directive guiding the management of Unroaded-Undeveloped Areas that lie outside of IRAs or wilderness areas. Currently, the only guidance for these areas is general forest or management area direction. It is the intent of the Dixie National Forest to manage these Unroaded-Undeveloped Areas for multiple resource benefits while maintaining their undeveloped character to the extent possible.

3.3.4 Suitable Wild and Scenic Rivers

The Wild and Scenic Rivers Act of 1968 established a National Wild and Scenic Rivers System to preserve free-flowing rivers that possess outstandingly remarkable scenic, recreational, geologic, fish and wildlife, historic, cultural, or other similar values. Section 5(d) of the Act requires the Forest Service to evaluate rivers within its jurisdiction for their potential for inclusion in the National Wild and Scenic Rivers System. The Forest Service does not have the authority to designate Wild and Scenic Rivers. Rather, the Forest Service can only evaluate potential river segments and determine suitability, the US Congress then has the ability to designate suitable segments. The Forest Service evaluation of potential Wild and Scenic Rivers consists of a 3-step process.

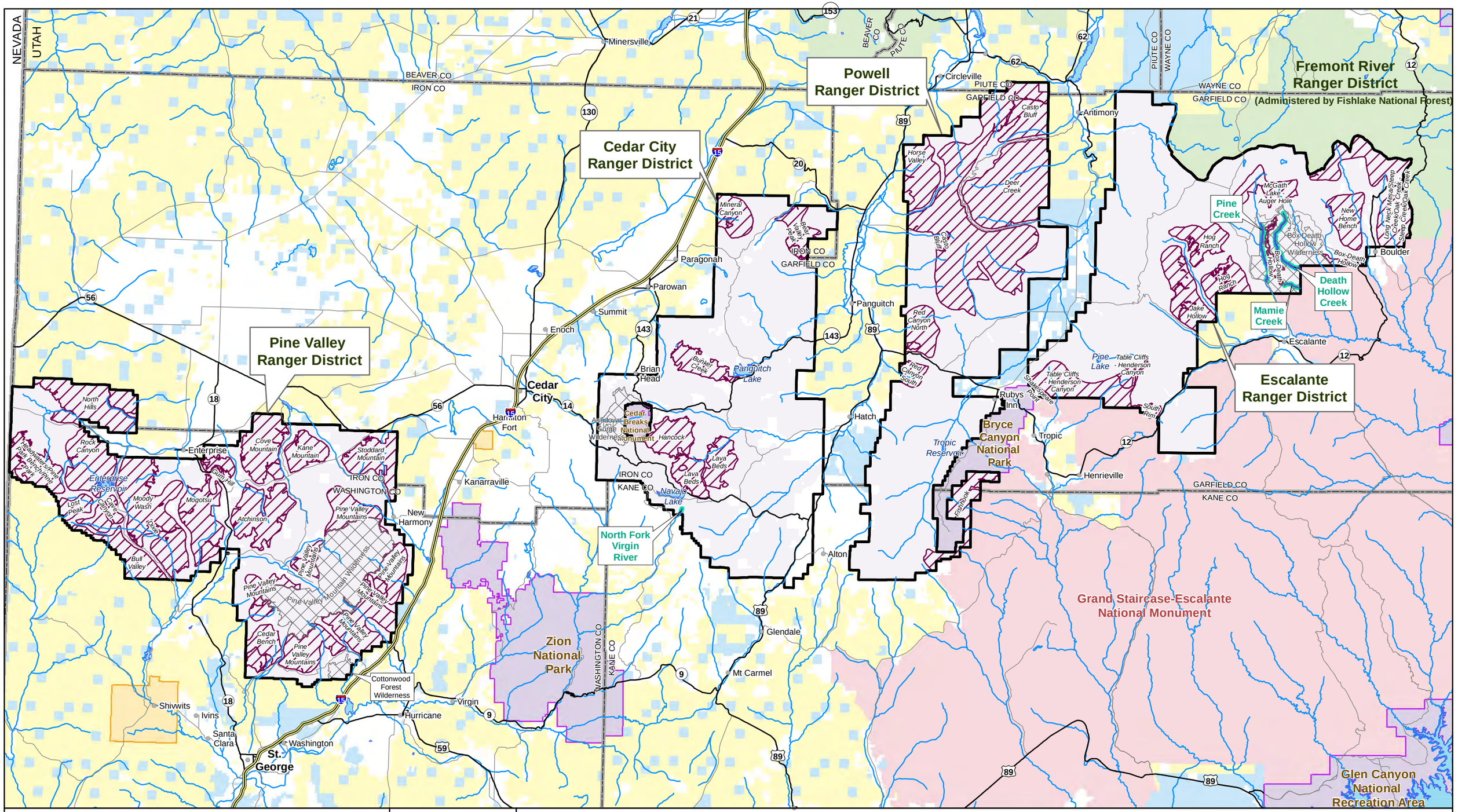
(1) Determination of eligibility (inventory)

(2) Potential classification as wild, scenic, or recreational (inventory)

(3) Determination of suitability (decision)

Following completion of this three-step process, suitable segments are recommended to the US Congress, which makes final decisions on designation of rivers as part of the National System. To be eligible for Wild and Scenic River status, a river or segment of a river must be free flowing and possess at least one or more river-related outstandingly remarkable values. Eligible segments are tentatively classified as wild, scenic, or recreational depending upon the degree of development and access along the river. Rivers or river segments tentatively classified as wild are generally inaccessible, except by trail, with unpolluted water and watersheds or shorelines that are essentially primitive. A scenic tentative classification indicates that watersheds or shorelines are generally still primitive and undeveloped; however, the river may be accessible in some places by roads. Rivers that are readily accessible by road or railroad and have development along their shorelines are classified as recreational.

The Forest Service evaluated all rivers and streams on the Dixie National Forest to determine which river segments meet eligibility criteria for inclusion in the National Wild and Scenic Rivers System. Segments of six different streams on the Dixie National Forest were determined to be



Oil & Gas Leasing EIS on Lands Administered by the Dixie National Forest

FIGURE 3.3-1
Inventoried Roadless Areas & Suitable Wild & Scenic Rivers

Horizontal Datum = NAD 83 Coordinate System = Zone 12N	1:590,000	1 in = 9 miles

Legend

- Cities
- Freeways
- Highways
- Minor Roads*
- Major Streams & Rivers
- Water Bodies
- County Boundaries
- State Boundaries

National Forest System Lands
- Dixie National Forest
- Wilderness Areas
- Fishlake National Forest

Other Land Administration
- Bureau of Land Management
- GSENM**
- National Park Service
- Private
- State of Utah
- Tribal

- Wild & Scenic Rivers
- Wild & Scenic River Corridors (0.5-mi wide)
- Inventoried Roadless Areas

0 4 8 12 16 Miles

N

Original data was compiled from multiple source data and may not meet the U.S. National Mapping Accuracy Standard of the Office of Management and Budget. For specific dates and/or additional digital information, contact the Forest Supervisor, Dixie National Forest, Cedar City, Utah. This map has no warranties to its contents or accuracy.

*Not all roads are shown. Only some roads are depicted for orientation purposes.
**Grand Staircase-Escalanted National Monument. Managed by the Bureau of Land Management.

eligible for inclusion. Four of these river segments were then found suitable for inclusion into the National Wild and Scenic Rivers System (Table 3.3-3). A summary of the characteristics of each suitable stream segment is presented below. The location of the streams is shown in Figure 3.3-1.

Table 3.3-3 Suitable Wild and Scenic Rivers on the Dixie National Forest

River	Classification	Segment Length (miles)	Acres within Buffer (at least ½-mile wide)
Cedar City RD			
North Fork of the Virgin River	Scenic	0.7	279
Escalante RD			
Death Hollow Creek	Wild	9.6	2,801
Mamie Creek	Wild	2.0	697
Pine Creek	Wild	7.8	2,234

Management guidelines in Section 10(a) of the Wild and Scenic Rivers Act dictates that designated Wild and Scenic Rivers should be administered in a manner that will protect and enhance the values that caused them to be designated. Specific direction for oil and gas development in Section 9 of the Act prohibits mining claims and mineral leases within ¼ mile of a designated Wild and Scenic River (¼ mile measured from each bank, for a total width of at least ½ mile around each stream). However, these management guidelines only apply to designated Wild and Scenic Rivers, or to legislatively mandated study rivers (defined in Section 5(a) of the Wild and Scenic Rivers Act). These guidelines do not apply directly to river segments determined to be eligible or suitable by the Forest Service under Section 5(d) of the Act. Protection for those river segments identified as suitableis provided through a forest plan amendment at II-48a (ROD for Wild and Scenic River Suitablity Study, Nov 2008) and Forest Service Handbook 1909.12 at chapter 80, section 82.

The guidelines state that protection of Forest Service identified rivers is derived from existing authorities such as the Clean Water Act, the Endangered Species Act, the Archeological Resources Protection Act, etc. Furthermore, the guidelines state that projects and activities on National Forest System Lands within the river corridor (within ¼ mile) of an eligible or suitable river must be consistent with the following guidelines:

- The free-flowing character of the identified river is not modified
- Outstandingly remarkable values of the identified river area are protected
- Classification is maintained as inventoried unless a suitability study (a decision) is completed that recommends management at a less restrictive classification (such as from wild to scenic or scenic to recreational)

Regarding oil and gas development, Section 82.51 of USFS (2006a) states, “Leases, licenses, and permits under mineral leasing laws would be subject to conditions necessary to protect the values in the event it (a suitable Wild and Scenic River) is subsequently included in the National System.” In accordance with this direction and to protect the suitability of these streams, a ¼-mile buffer measured out from either streambank is applied to suitable streams in this EIS. The area encompassed by the buffer around suitable streams is specified in Table 3.3-2.

3.3.5 Pine Valley Ranger District

3.3.5.1 Inventoried Roadless Areas and Unroaded-Undeveloped Areas

There are 17 IRAs on the Pine Valley Ranger District covering a total of 253,342 acres. The IRAs are identified in Table 3.3-1 and are Atchison (17,663 acres), Bull Valley (10,907 acres), Cave Canyon (5,661 acres), Cedar Bench (8,917 acres), Cottonwood (6,752 acres), Cove Mountain (16,634 acres), Dixie (109), Gum Hill (3,181), Headwaters/Pine Park Bench/Pine Park (10,949 acres), Kane Mountain (8,016 acres), Lost Peak (4,144), Mogotsu (16,771 acres), Moody Wash (31,853 acres), North Hills (24,485 acres), Pine Valley Mountains (57,683 acres), Rock Canyon (16,463 acres), and Stoddard Mountain (13,155 acres).

There are 13 Unroaded-Undeveloped Areas in the Pine Valley Ranger District, covering 380,108 acres. Sixty-five percent of these areas fall within IRAs. None of these areas are less than 5,000 acres in size.

The Pine Valley Ranger District contains the largest amount of biological crusts and gypsiferous soils and these resources would be expected to occur on IRAs. Eight municipal watersheds covering 14,669 acres are at least partially located on the Pine Valley Mountains IRA. The watersheds are Central, Enterprise, Leeds, New Harmony, Pine Valley, Pintura, Sawyer Spring, and St. George. In addition, based on Dixie National Forest GIS data, IRAs include 18,040 acres of known or suitable habitat for threatened and endangered species including California condor (*Gymnogyps californianus*) and Mexican spotted owl (*Strix occidentalis*). The IRAs also include 24,557 acres of suitable habitat for sensitive species including bald eagle (*Haliaeetus leucocephalus*), flammulated owl (*Otus flammeolus*), peregrine falcon (*Falco peregrinus*), northern goshawk (*Accipiter gentilis*), pygmy rabbit (*Brachylagus idahoensis*), sensitive fishes, and sensitive bats.

3.3.5.2 Suitable Wild and Scenic Rivers

There are no streams on the Pine Valley Ranger District that are suitable for inclusion in the National Wild and Scenic River System.

3.3.6 Cedar City Ranger District

3.3.6.1 Inventoried Roadless Areas and Unroaded-Undeveloped Areas

There are five IRAs on the Cedar City Ranger District covering a total of 47,842 acres. The IRAs are identified in Table 3.3-1 and are Bear Valley Peak (7,419 acres), Bunker Creek (7,286 acres), Hancock (9,806 acres), Lava Beds (14,940 acres), and Mineral Canyon (8,392 acres). The Bunker Creek IRA includes 1,163 acres of the Parowan municipal watershed. Based on Dixie National Forest GIS data, IRAs on the Cedar City Ranger District include 2,689 acres of known or suitable habitat for threatened, endangered, or candidate species including California condor, Mexican spotted owl, Utah prairie dog (*Cynomys parvidens*), and greater sage-grouse (*Centrocercus urophasianus*). IRAs on the Ranger District also include 24,381 acres of suitable habitat for sensitive species including flammulated owl, peregrine falcon, northern goshawk, pygmy rabbit, sensitive fishes, and sensitive bats.

There are nine Unroaded-Undeveloped Areas on the Cedar City Ranger District, covering 100,125 acres and none of these areas are less than 5,000 acres in size. Forty-one percent of these areas fall within IRAs. Three Unroaded-Undeveloped Areas: Ashdown Gorge (12,148

acres), Little Creek Peak (19,345 acres), and Wagon Box (5,671 acres) are completely outside IRAs.

3.3.6.2 Suitable Wild and Scenic Rivers

NORTH FORK OF THE VIRGIN RIVER

Approximately 0.7 miles of the North Fork of the Virgin River is classified as Scenic, beginning at the headwaters and extending downstream to the Dixie National Forest boundary. The North Fork of the Virgin River begins at Cascade Falls, a perennial spring that is fed by Navajo Lake through underground lava tubes and a limestone solution channel. Cascade Falls is located in the Pink Cliffs on the south edge of the Markagunt Plateau. From here, the river flows as a boulder dominated, cascading to step-pool stream system through the Grey Cliffs before cutting down through the Kolob Terrace into Zion National Park (USFS 2007d).

There are no water developments on the North Fork of the Virgin River; however, the segment is classified as Scenic due to signs of human activity and a four-wheel-drive road that provides access to private property that is within a half mile of the river corridor. Outstandingly remarkable values for this reach are scenic, geological, and recreational. The river begins at Cascade Falls and flows through the pink cliffs of the Virgin River rim and other high elevation landscapes of Jurassic and Cretaceous sediment deposits, with extensive viewsheds and examples of stream erosion. The stream corridor also supports a diverse riparian plant community, and near Cascade Falls the watershed supports a population of bristlecone pine (*Pinus longaeva*) trees. The North Fork of the Virgin River provides a unique recreational opportunity for hiking, sightseeing, and studying the ecology of southern Utah. The Cascade Falls National Recreation Trail (#32055) is one of the most popular and heavily used trails on the Dixie National Forest; however, it has been closed for several years due to erosion damage. The trail terminates at a viewpoint looking directly into the limestone cavern from which water exits and forms Cascade Falls. The Virgin River Rim Trail (#32011) also provides visitors a view of the river segment (USFS 2007d).

3.3.7 Powell Ranger District

3.3.7.1 Inventoried Roadless Areas and Unroaded-Undeveloped Areas

There are six IRAs on the Powell Ranger District covering a total of 167,418 acres. The IRAs are identified in Table 3.3-1 and are Casto Bluff (87,416 acres), Deer Creek (39,784), Fishhook (12,921 acres), Horse Valley (13,603 acres), Red Canyon North (9,964 acres), and Red Canyon South (3,730 acres). The Deer Creek IRA overlaps 5,303 acres of the Antimony municipal watershed. Based on Dixie National Forest GIS data, IRAs on the ranger district include 43,745 acres of known or suitable habitat for threatened and endangered species including California condor, Mexican spotted owl, greater sage-grouse, and Utah prairie dog. IRAs also include 80,023 acres of suitable habitat for sensitive species including flammulated owl, peregrine falcon, northern goshawk, pygmy rabbit, boreal toad (*Anaxyrus boreas*), sensitive fishes, and sensitive bats.

There are nine Unroaded-Undeveloped Areas in the Powell Ranger District, totaling 203,106 acres and none of these areas are less than 5,000 acres in size. Seventy-nine percent of these areas fall within IRAs. Two Unroaded-Undeveloped Areas: Big Hollow (7,791 acres) and Blind Springs (9,917 acres) are completely outside IRAs.

3.3.7.2 Suitable Wild and Scenic Rivers

There are no streams on the Powell Ranger District that are suitable for inclusion in the National Wild and Scenic River System.

3.3.8 Escalante Ranger District

3.3.8.1 Inventoried Roadless Areas and Unroaded-Undeveloped Areas

There are 10 IRAs on the Escalante Ranger District covering a total of 101,958 acres. The IRAs are listed in Table 3.3-1 and are Boulder Mountain/Boulder Top/Deer Lake (14,888 acres), Box-Death Hollow (3,171 acres), Hog Ranch (17,114 acres), Jake Hollow (15,135 acres), Long Neck Mesa/Steep Creek/Oak Creek – Steep Creek/Oak Creek (11,139 acres), McGath Lake–Auger Hole (8,328 acres), New Home Bench (10,505 acres), Shakespeare Point (750 acres), South Rim (1,367 acres), and Table Cliffs – Henderson Canyon (19,561 acres). The Hog Ranch and McGath Lake – Auger Hole IRAs overlap with 1,006 acres of the Escalante municipal watershed and the New Home Bench IRA overlaps with 426 acres of the Boulder Town municipal watershed. The Side Hollow Ponderosa Pine Provenance Study Area covers 4.5 acres within the New Home Bench IRA. The Study Area contains ponderosa pine (*Pinus ponderosa*) from various origins that are being used for genetic studies (USFS 2006b). Based on Dixie National Forest GIS data, IRAs on the ranger district include 85,203 acres of known or suitable habitat for threatened and endangered species including California condor, Mexican spotted owl, and Utah prairie dog. IRAs also include 106,119 acres of suitable habitat for sensitive species including flammulated owl, peregrine falcon, northern goshawk, pygmy rabbit, sensitive fishes, and sensitive bats.

There are 15 Unroaded-Undeveloped Areas on the Escalante Ranger District, totaling 219,923 acres. Only Shakespeare Point is less than 5,000 acres in size. Thirty-eight percent of these areas are within IRAs. Six Unroaded-Undeveloped Areas: Antimony (20,604 acres), Birch Creek (6,105 acres), Canaan Mountain (7,683 acres), Dry Lake (9,268 acres), Heaps Canyon (6,622 acres), and Pacer Lake (16,328 acres) are completely outside IRAs.

3.3.8.2 Suitable Wild and Scenic Rivers

There are three stream segments on the Escalante Ranger District, Death Hollow Creek, Mamie Creek, and Pine Creek, which are suitable for inclusion in the Wild and Scenic River System. All three segments are classified as Wild. These segments are entirely within the Box-Death Hollow Wilderness Area. As a result, these streams would not be impacted by oil and gas leasing and will not be described in detail below.

3.4 Recreation Resources

3.4.1 Introduction

Recreation resources on the Dixie National Forest are extensive and a major attraction for at least half a million visitors each year (USFS 2004a, USFS 2006c, USFS 2010b). The Dixie National Forest contains over 1,300 miles of trails, which includes 143 miles within wilderness areas, the Great Western Trail, two National Recreation Trails, and 11 scenic byways and backways that are frequented by regional, national, and international visitors.

The Forest Service manages recreation settings in order to provide opportunities for recreational experiences. Those experiences are also influenced by many other factors

including the recreationists' own views, perceptions, and expectations. Experience has demonstrated that the public expects a wide range of recreation opportunities and settings on the Dixie National Forest from wilderness to fully developed campgrounds.

The objective in managing recreational settings on the Dixie National Forest is to provide opportunity for people to have recreational experiences. The key to providing most recreational experience opportunities is the setting and how it is managed. Land managers can facilitate or hamper many desired experiences by the way they manage such setting indicators as access, remoteness, social encounters, visitor management, facilities and site management, visitor impacts, and naturalness.

3.4.2 Visitation

The Dixie National Forest is primarily frequented by visitors from areas within one-hour driving time of the Forest, as well as those from major population centers in Utah, southern Nevada, and California (USFS 2010b). Three National Parks and two National Monuments are adjacent to the Dixie National Forest and the scenic beauty of these areas is characteristic of the region. These National Parks and Monuments draw millions of national and international visitors to the region and may provide a spillover effect on Forest visitation numbers and demographics. In 2009, approximately five percent of Forest visitors were from other countries (USFS 2010b).

A national forest site visit is the entry of one person upon a national forest site or area to participate in recreation activities for an unspecified period of time. A national forest visit is composed of one or more national forest site visits. For a multiple-day visit to count as one national forest visit, time spent on the forest must be continuous. For example, one national forest visit could include hiking on one day, spending the night in a Forest Service campground, and then going fishing on the second day. However, if the individual spent the night in a hotel in the local community, the two days of activity (hiking one day and fishing the next) would count as two national forest visits (USFS 2004b).

In fiscal year 2003, recreation use on the Dixie National Forest was approximately 773,789 national forest visits with an 80 percent confidence interval of +/- 13.3 percent (USFS 2004a). In addition, there was an average of 1.15 site visits per national forest visit (900,873 total site visits, including 13,952 Wilderness visits). Revised visitation numbers from 2006, report 646,000 forest visits and 728,000 site visits (80 percent confidence interval of 7.1 percent, USFS 2007f). Visitation numbers from 2009 report 924,300 forest visits and 1,077,700 site visits (90 percent confidence interval of 14 percent). This shows a general decrease in visitation on the Dixie National Forest in recent years followed by a sharp increase in 2009.

Typical visitors to the Dixie National Forest are white, male, and fall into the 40 to 49 year age class. A large percentage of visitors also fall into the under 16 age class suggesting that many young families visit and recreate on the Forest (USFS 2004a; USFS 2010b).

Visitors to the Dixie National Forest engage in a variety of recreational activities, which are listed in Table 3.4-1 along with the percentages that participate in these activities. Most visitors consider hiking/walking, relaxing, and viewing natural features and wildlife as primary reasons to choose the Dixie National Forest for recreation.

Table 3.4-1 Recreation Activities on the Dixie National Forest and Visitor Participation

Activity	Percent of Visitors Participating in Activity[1]
Relaxing	66.1
Viewing Natural Features	54.4
Hiking/Walking	40.6
Viewing Wildlife	35.7
Driving for Pleasure	32.2
Fishing	26.2
Downhill Skiing	18.0
Motorized Trail Activity	16.7
Picnicking	13.9
Nature Center Activities	11.3
Primitive Camping	10.2
Nature Study	8.1
Developed Camping	8.0
Hunting	7.2
Visiting Historic Sites	5.4
Off-Highway Vehicle (OHV) Use	4.7
Gathering Forest Products	4.4
Bicycling	3.8
Resort Use	1.3
Motorized Water Activities	1.3
Other Non-Motorized Activities	1.2
Non-Motorized Water Activities	1.1
Horseback Riding	1.0
Backpacking	0.5
Snowmobiling	0.2
Cross-Country Skiing	0.1
Other Motorized Activity	0.0

[1] Percentages exceed 100 percent due to visitor participation in more than one activity.
Source: USFS 2010b

3.4.3 Recreation Opportunity Spectrum

Recreation provides tangible benefits for individuals, families, communities, and society as a whole. National Forest System lands support a vast array of recreational activities, ranging from hiking in remote areas to skiing on groomed trails to camping in developed sites. In response, the Forest Service has developed the Recreation Opportunity Spectrum (ROS) classification system to characterize and help manage for recreation opportunities. The ROS provides a framework for stratifying, defining, and managing classes of outdoor recreation settings, activities, and experience opportunities. ROS is a continuum or spectrum that has been divided into six classes ranging from least developed to most developed settings (see 3.4.3.2 for a description of each class): Primitive, Semi-primitive Non-motorized, Semi-Primitive Motorized, Roaded Natural, Rural, and Urban.

3.4.3.1 ROS Setting Indicators

The setting indicators considered in defining the various ROS classes are introduced in Table 3.4-2 and discussed below.

Table 3.4-2 ROS Class Setting Indicators

Setting Factors	Physical	Social	Managerial
ROS Class Setting Indicators	Access	Social encounters	Facilities & Site development
	Remoteness	Visitor impacts	Visitor management
	Naturalness		

ACCESS

Access includes type and mode of travel. Highly developed access generally reduces the opportunities for solitude, risk, and challenge. However, it can enhance opportunities for socializing and feelings of safety and comfort. Accessibility for persons with disabilities can be organized along the ROS framework. Access in Rural or Urban settings should be easy per the Americans with Disabilities Act Guidelines (ADAAG) of 1990. Increasing difficulty should be designed into travelways as one moves toward the primitive end of the spectrum to elicit greater feelings of challenge and achievement (Table 3.4-3).

Table 3.4-3 Compatibility of Setting Access Compared to ROS Class

ROS Class	Description of Setting Relative to ROS Class Indicator				
	Cross-country (off-trail) travel and travel on non-motorized trails	Non-motorized trails	Motorized trails & primitive roads	Controlled service level roads	Full access
Primitive					
Semi-Primitive Non Motorized					
Semi-Primitive Motorized					
Roaded Natural					
Rural					
Urban					

Table Key: Fully Compatible | Normal | Inconsistent | Unacceptable

Source: ROS Primer and Field Guide (USFS 1990a)

REMOTENESS

Remoteness refers to the extent to which individuals perceive themselves removed from the sights and sounds of human activity. Remoteness is important for some ROS settings such as primitive experience in Wilderness and conversely lack of remoteness is important in rural or urban setting experience (Table 3.4-4).

Table 3.4-4 Compatibility of Setting Remoteness Compared to ROS Class

ROS Class	Description of Setting Relative to ROS Class Indicator				
	Out of sight and sound of human activity, more than 1-1/2 hour walk	Distant sight and/or sound of human activity, more than 1/2 hour walk from any motorized travel	Distant sight and/or sound of human activity, more than 1/2 hour walk from any better-than-primitive roads	Remoteness of little or no relevance	
Primitive					
Semi-Primitive Non Motorized					
Semi-Primitive Motorized					
Roaded Natural					
Rural					
Urban					

Table Key: **Fully Compatible** | **Normal** | **Inconsistent** | **Unacceptable**

Source: ROS Primer and Field Guide (USFS 1990a)

NATURALNESS

Naturalness refers to the degree of human-caused change in the landscape setting. This affects psychological outcomes associated with enjoying nature. This indicator is assessed by using the compatible scenic integrity objective for each setting (Table 3.4-5).

SOCIAL ENCOUNTERS

This factor refers to the number and type of other recreationists or other Forest-users that are met along travelways, or camped or encountered within sight or sound of others (Table 3.4-6). This setting indicator measures the extent to which an area provides experiences such as solitude or the opportunity for social interaction. Increasing the number of visitors to an area or developing an area for oil and gas leasing changes the kind of recreation experience offered, attracting additional users, and causing others to leave.

Table 3.4-5 Compatibility of Setting Naturalness Compared to ROS Class

ROS Class	Description of Setting Relative to ROS Class Indicator				
	Very high scenic integrity[1]	High scenic integrity[1]	Moderate scenic integrity[1]	Low scenic integrity[1]	Very low scenic integrity[1]
Primitive					
Semi-Primitive Non Motorized					
Semi-Primitive Motorized					
Roaded Natural					
Rural					
Urban					N/A

Table Key: **Fully Compatible** | **Normal** | **Inconsistent** | **Unacceptable**

[1] These descriptions are tied to the scenic integrity objectives in the USFS Scenery Management System (USFS 1995).

Source: ROS Primer and Field Guide (USFS 1990a)

Table 3.4-6 Compatibility of Setting Social Encounters Compared to ROS Class

ROS Class	Description of Setting Relative to ROS Class Indicator				
	6 parties or less met per day, less than 3 parties seen at campsites	6-15 parties met per day, 6 or less parties seen at campsites	Moderate to high contact on roads. Moderate to low contact on trails and developed sites	Moderate to high contact at developed sites, roads, and trails	Large numbers of users on-site and nearby areas. High number of social encounters
Primitive					
Semi-Primitive Non Motorized					
Semi-Primitive Motorized					
Roaded Natural					
Rural					
Urban					

Table Key: **Fully Compatible** | **Normal** | **Inconsistent** | **Unacceptable**

Source: ROS Primer and Field Guide (USFS 1990a)

VISITOR IMPACTS

This factor refers to visitor use of the environment and the impacts associated with different recreation uses (Table 3.4-7). Land managers are primarily concerned with determining how much environmental change should be allowed and which actions are appropriate for control. For example, impacts on wildlife habitat, soil, air, water, and sound quality also affect visitor experience. Visitor impacts can alter wildlife habitat or displace wildlife species. Maintaining resource quality standards, and by association, recreation settings in the face of future oil and gas developments is important across all ROS classes.

FACILITIES AND SITE DEVELOPMENT

This indicator refers to the level of site development (Table 3.4-8). A lack of facilities and site modifications can enhance feelings of self-reliance and independence and can provide experiences with a high degree of naturalness. Highly developed facilities can add feelings of comfort and convenience and increase opportunities for socializing.

It is unlikely that any oil and gas activities would affect the level and type of recreation site development, thus this setting indicator will not be used to measure potential effects.

Table 3.4-7 Compatibility of Visitor Impacts Compared to ROS Class

ROS Class	Description of Setting Relative to ROS Class Indicator				
	Unnoticeable impacts. No site hardening	Subordinate impacts. No site hardening	Subordinate impacts. Limited site hardening	Subtle site hardening	Site hardening may be dominant but in harmony
Primitive					
Semi-Primitive Non Motorized					
Semi-Primitive					

Motorized					
Roaded Natural					
Rural					
Urban					

Table Key: **Fully Compatible** | **Normal** | **Inconsistent** | **Unacceptable**

Source: ROS Primer and Field Guide (USFS 1990a)

Table 3.4-8 Compatibility of Setting Facilities and Development Compared to ROS Class

ROS Class	Description of Setting Relative to ROS Class Indicator				
	No facilities for user comfort. Rustic & rudimentary facilities for site-protection only. Native materials only.	Rustic & rudimentary facilities primarily for site-protection only. No evidence of synthetic materials. Native materials only.	Rustic facilities providing some comfort for the user as well as site protection. Native materials but with more refinement in design. Synthetic materials should not be evident.	Some facilities designed primarily for user comfort & convenience. Some synthetic but harmonious materials are may be incorporated. Design may be more complex and refined.	Facilities mostly designed for user comfort & convenience. Synthetic materials are commonly used. Facility design may be highly complex and refined but in harmony or complimentary to the site.
Primitive					
Semi-Primitive Non Motorized					
Semi-Primitive Motorized					
Roaded Natural					
Rural					
Urban					

Table Key: **Fully Compatible** | **Normal** | **Inconsistent** | **Unacceptable**

Source: ROS Primer and Field Guide (USFS 1990a)

VISITOR MANAGEMENT

This includes the degree to which visitors are regulated and controlled as well as the level of information and services provided for visitor enjoyment (Table 3.4-9). In some ROS settings, controls are expected and appropriate. For example, people sometimes seek developed campgrounds and other similar settings for security and safety. Elsewhere, on-site controls such as locked gates and fenced well pads may detract from desired recreation experiences.

The type and level of information and where it is provided to the visitor may facilitate or hinder desired recreation experience. On-site interpretive and directional signing may adversely affect the visitor where experiences such as self-discovery, challenge, and risk are important. In other situations, on-site information may be essential to achieve desired experiences and satisfaction.

Generally, on-site information is more appropriate at the developed end of the spectrum, rural and urban, while off-site sources are preferable at the primitive and semi-primitive end.

Table 3.4-9 Compatibility of Setting Visitor Management Compared to ROS Class

ROS Class	Description of Setting Relative to ROS Class Indicator				
	Low regimentation & no on-site controls or information facilities	Subtle on-site regimentation & controls, Very limited information facilities	On-site regimentation & controls are noticeable but harmonize with the natural environment, Simple informational facilities	Regimentation & controls are obvious & numerous but harmonize, More complex information facilities	Regimentation & controls are obvious & numerous, Sophisticated information exhibits
Primitive					
Semi-Primitive Non Motorized					
Semi-Primitive Motorized					
Roaded Natural					
Rural					
Urban					

Table Key: Fully Compatible | Normal | Inconsistent | Unacceptable

Source: ROS Primer and Field Guide (USFS 1990a)

3.4.3.2 Forest ROS Inventory

For this analysis, the ROS classifications of Rural and Urban are not discussed. There are no areas inventoried as Rural or Urban ROS Settings on the Dixie National Forest. This leaves four remaining ROS classes that occur across the Forest. Inventoried ROS acres are described below.

PRIMITIVE

Primitive areas are characterized by a natural, unmodified environment with similar characteristics as are found in designated Wilderness. Approximately 80 percent of Primitive ROS areas on the Dixie National Forest are within designated Wilderness. In Primitive areas, users will rarely encounter other people or evidence of human activity, and the areas offer a high degree of challenge and risk. There may be trails, but few structures. Of the lands classified under the ROS on the Dixie National Forest, 103,924 acres (six percent) are classified as Primitive (Table 3.4-10). Figure 3.4-1 shows the location of these areas across the Forest.

SEMI-PRIMITIVE NON-MOTORIZED

Semi-Primitive Non-Motorized areas are characterized by a natural or natural-appearing environment. Although concentration of use is low, some evidence of human activity can be observed. A high probability of experiencing isolation from other user groups exists, and opportunities for challenge and risk are available. The setting may have subtle modifications, but they remain unobtrusive to users moving through the area. Areas that are classified as Semi-Primitive Non-Motorized are dispersed throughout the Dixie National Forest and generally

occur where no roads exist. As a result, most IRAs are classified as Semi-Primitive Non-Motorized. However, there are areas on the Dixie National Forest that are outside of IRAs and are classified as Semi-Primitive Non-Motorized. Further, although IRAs are protected from road building by the 2001 Roadless Area Conservation Rule, areas classified as Semi-Primitive Non-Motorized are part of the ROS classification system used for land management and are not protected from development by federal law. Of the lands classified under the ROS on the Dixie National Forest, 700,990 acres (43 percent) are classified as Semi-Primitive Non-Motorized (Table 3.4-10). Figure 3.4-1 shows the location of these areas across the Forest.

SEMI-PRIMITIVE MOTORIZED

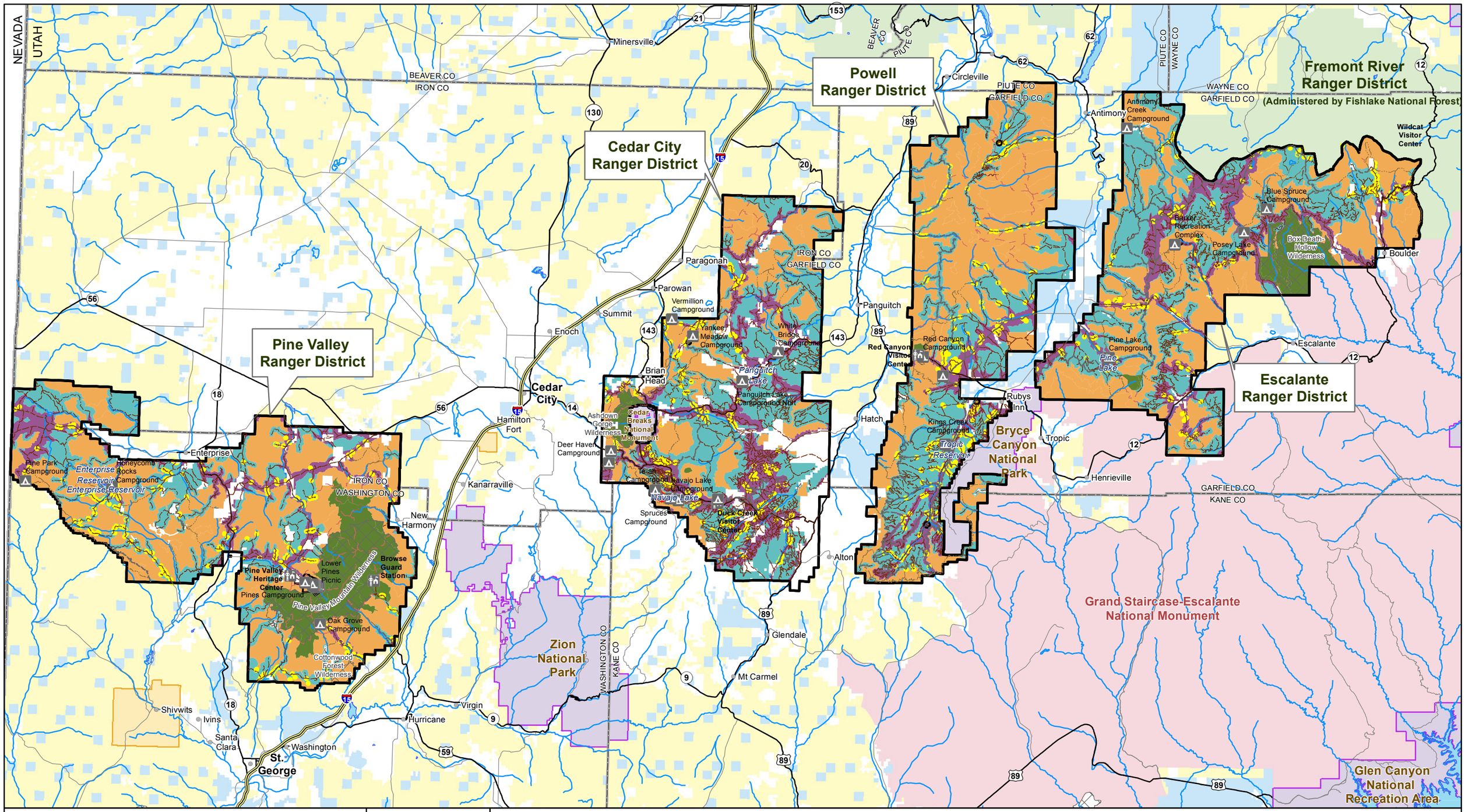
Semi-Primitive Motorized areas are characterized by a predominately natural or natural-appearing environment. Although concentration of use is low, evidence of human activity can be observed throughout the area. A moderate probability of experiencing isolation from other user groups exists, and opportunities for challenge and risk are available. The setting may have subtle modifications, but they remain visually unobtrusive to users traveling the trails and primitive roads in the area. Motorized travel is allowed. Semi-Primitive Motorized areas usually occur at a distance greater than 0.5 mile from highly modified, constructed roads. Of the lands classified under the ROS on the Dixie National Forest, approximately 560,052 acres (34 percent) are classified as Semi-Primitive Motorized (Table 3.4-10). Figure 3.4-1 shows the location of these areas across the Forest.

ROADED NATURAL

Roaded Natural areas are characterized by a predominately natural-appearing environment with moderate evidence of human activity. An equal probability of experiencing isolation from or affiliation with other user groups exists. There are opportunities for a high degree of interaction with the natural environment, but opportunities for challenge and risk are minimal. Resource modification and utilization are evident, but harmonize with the natural environment. From sensitive travel routes and use areas, these alterations should remain visually subordinate. Roads within these areas consist of paved and gravel through highways, local roads, and primitive Forest Service roads that form a large network throughout the Dixie National Forest. Most of the secondary paved highways take travelers through the Forest to other destinations while many of the gravel roads and primitive Forest Service roads lead to developed recreation sites or dispersed recreation areas and private residences. Of the lands classified under the ROS on Dixie National Forest, approximately 264,434 acres (16 percent) are classified as Roaded Natural (Table 3.4-10). Figure 3.4-1 shows the location of these areas across the Forest.

3.4.4 Developed Recreation

Developed recreation includes a variety of activities that are generally centered on developed facilities such as campgrounds and visitor centers (Figure 3.4-1). These facilities provide a safe, efficient, and comfortable experience for visitors of differing abilities. Much of the developed recreation on the Dixie National Forest is located near the five scenic byways and six scenic backways that cross the Forest. Mapped, developed recreation areas occur on all four ranger districts (Table 3.4-10) and include developed sites, administrative sites, and recreation residences. These areas are described below.



Oil & Gas Leasing EIS on Lands Administered by the Dixie National Forest

FIGURE 3.4-1
Developed Recreation Resources

Horizontal Datum = NAD 83 Coordinate System = Zone 12N	1:590,000	1 in = 9 miles

Legend

- Cities
- Freeways
- Highways
- Minor Roads*
- Major Streams & Rivers
- Water Bodies
- County Boundaries
- State Boundaries

Forest Trails

- Unspecified
- Motorized
- Non-Motorized
- Non-Mechanized

Forest Sites

- Campgrounds
- Visitor Centers

National Forest System Lands

- Dixie National Forest
- Wilderness Areas
- Fishlake National Forest

Other Land Administration

- Bureau of Land Management
- GSENM**
- National Park Service
- Private
- State of Utah
- Tribal

- Dispersed Campsites
- Recreation Residences (1/4-mi buffer)

Recreation Opportunity Spectrum

- Roaded Natural
- Semi-Primitive Motorized
- Semi-Primitive Non-Motorized
- Primitive

- Administrative Sites
- Recreation Sites

Miles: 0 3 6 9 12

Original data was compiled from multiple source data and may not meet the U.S. National Mapping Accuracy Standard of the Office of Management and Budget. For specific dates and/or additional digital information, contact the Forest Supervisor, Dixie National Forest, Cedar City, Utah. This map has no warranties to its contents or accuracy.

*Not all roads are shown. Only some roads are depicted for orientation purposes.
**Grand Staircase-Escalanted National Monument. Managed by the Bureau of Land Management.

Table 3.4-10 Acres of Mapped Developed Recreation on the Dixie National Forest

Type of Site	Pine Valley	Cedar City	Powell	Escalante	TOTAL
Developed sites (includes recreation sites)	2,169	1,393	610	752	4,924
Administrative sites	232	0	489	127	848
Recreation residences	241	579	0	0	819

3.4.4.1 Campsites and Other Developed Sites

There are approximately 65 developed recreation sites and administrative sites on the Dixie National Forest. There are 28 larger sites that cover approximately 4,924 acres. Of these, 16 are campgrounds (including two equestrian campgrounds) with three separate historic guard stations operated as rental cabins, and the Red Canyon and Duck Creek Visitor Centers. The majority of these areas average between 100 and 200 acres in size, with the exception of the Pine Valley Recreation Complex, which covers approximately 1,964 acres. Administrative sites alone cover 848 acres. The location of these areas is shown in Figure 3.4-1 and the acres by ranger district are presented in Table 3.4-10.

3.4.4.2 Recreation Residences

Recreation residences on the Dixie National Forest include 42 privately owned cabins authorized under special use permits. The recreation residences are concentrated in two areas on the Dixie National Forest. Thirty-three recreation residences are located on the western edge of Navajo Lake on the Cedar City Ranger District. Nine recreation residences are located on the Pine Valley Ranger District near the Pine Valley Recreation Area. Recreation residences with a ¼-mile buffer cover approximately 579 and 241 acres on the Cedar City and Pine Valley Ranger Districts, respectively (Table 3.4-10). Figure 3.4-1 shows the location of these areas.

3.4.5 Dispersed Recreation

Generally speaking, the Dixie National Forest's recreation opportunities are more unstructured or dispersed in nature. These dispersed recreation activities are a very important component of the Forest's recreation opportunity niche. Dispersed recreation requires few, if any, improvements and typically occurs in conjunction with roads or trails. Dispersed activities are often day-use oriented and involve many types of activities such as fishing, hunting, mountain biking, nature study, off-highway vehicle (OHV) use, hiking, cross country skiing, horseback riding, picnicking, and viewing natural features and wildlife, either on foot or from a vehicle. Many visitors that enjoy these day-use activities also choose to camp overnight within the Dixie National Forest.

3.4.5.1 Camping

Dispersed camping is popular on the Dixie National Forest. There are over 1,000 inventoried dispersed campsites on the Forest. Dispersed campsites generally have small improvements such as existing fire rings, but do not have other improvements, hardened surfaces, or modern facilities. The majority of these areas are located adjacent to existing roads as shown in Figure 3.4-1. Six areas with heavy impacts from dispersed camping (i.e., East Fork of the Sevier River, Yankee Meadows, Mammoth Springs, Mammoth Creek, Enterprise Reservoir, and Leeds Creek) are closed to open-access camping and limit visitors to designated dispersed camping sites. This management approach focuses and redistributes widespread impacts to only a few areas.

3.4.5.2 Hiking and Equestrian Use

Trail uses on the Dixie National Forest range from hiking alpine mountains and slot canyons to horseback riding along the Great Western Trail. There are over 187 non-motorized and non-mechanized trails that cross the Forest. Off-highway vehicles (OHVs) including snowmobiles are prohibited from non-motorized trails, however human-powered mechanized equipment (i.e., bicycles) are permitted to use these trails. All non-mechanized trails are located within designated wilderness areas and are off limits to both motorized and mechanized equipment.

The Dixie National Forest monitors 20-30 non-motorized trails and motorized trails for use each year. The monitoring occurs on all four ranger districts.

3.4.5.3 Mountain Biking

There are numerous opportunities for mountain biking on the Dixie National Forest, but only on roads and specified trails. Some popular routes include Dave's Hollow Trail, Casto Canyon Trail, East Fork of the Sevier Scenic Backway, and the Great Western Trail. In 2006, 2007, and 2008, trail monitoring studies (Section 3.4.5.2) indicated that most of the high use trails tended to be either scenic and/or mechanized (USFS 2006c, USFS 2008b, USFS 2009b).

3.4.5.4 OHV Use

Increased OHV use on the Dixie National Forest has been linked not only to the growing popularity of OHVs, but also to the population growth of southwestern Utah, Salt Lake City, Utah, and Las Vegas, Nevada over the past decade. Concurrent growth of subdivisions located within and adjacent to the Dixie National Forest has also occurred, accounting for hundreds of building permits issued annually for private use and residential and vacation homes. Increased OHV use and related impacts have been observed surrounding these growing communities. The Record of Decision for the Dixie National Forest Motorized Travel Plan established a designated system of approximately 2,700 miles of motorized roads and trails open to the public and eliminated cross-country travel.

In at least 2006 and 2007 there was an increase in the total use numbers for motorized trails (USFS 2006c and 2008b); use leveled off in 2008, which may reflect the economic downturn (USFS 2009b). In general, trail use is expected to increase with increases in population growth and recreating public (USFS 2009b).

3.4.5.5 Hunting and Fishing

Hunting is a major recreation activity for residents and nonresidents on the Dixie National Forest. Rifle hunting for mule deer (*Odocoileus hemionus*) is the most common; however, permits for elk (*Cervus elaphus*) and pronghorn (*Antilocapra americana*) are allowed. Limited Entry hunting permits are typically expensive and may be limited for each user over a lifetime. Harvest success rates for Limited Entry elk hunts are high for most hunt types (excluding archery; UDWR 2006a). Limited Entry permit areas for elk occur on the Cedar City, Powell, and Escalante Ranger Districts, and include the following Utah Division of Wildlife Resources (UDWR) hunt units: Panguitch Lake (Cedar City), Paunsaugunt (Powell), Mount Dutton (Powell), Plateau/Boulder (Escalante), and Kaiparowits (Escalante).

There are many reservoirs, lakes, and streams on the Dixie National Forest used by anglers. Several fisheries are stocked with rainbow trout (*Oncorhynchus mykiss*) in the summer months.

Other game fish include brook trout (*Salvelinus fontinalis*), cutthroat (including native Bonneville cutthroat (*Oncorhynchus clarki utah*) and Colorado River cutthroat (*Oncorhynchus clarki pleuriticus*)), and brown trout (*Salmo trutta*).

There are approximately 40 commercial outfitters and guides that operate in Dixie National Forest. The majority of these outfitters and guides provide equipment and tours for hunting, fishing, mountain biking, horseback riding, and OHVs.

3.4.5.6 Winter Activities

Winter sports, such as downhill skiing, cross country skiing, and snowmobiling are available in many of the areas on the Dixie National Forest, including Brian Head Ski Area. The Utah Department of Parks and Recreation maintains an extensive system of groomed snowmobile trails on Cedar Mountain (Cedar City Ranger District) under an MOU with the Forest Service (Intermountain Region). Approximately 1,000 acres on Cedar Mountain have been designated the Deer Valley Nonmotorized Winter Recreation Area. Trails for cross country skiing and snow shoeing are groomed by volunteers.

3.4.6 Pine Valley Ranger District

The Pine Valley Ranger District is known for its distinctive vegetation, ranging from Pinyon/Juniper to Engelmann Spruce forests. The Pine Valley Mountain Wilderness is located in this district and is the second largest wilderness area in the state. It is also known for its most prominent feature, the Pine Valley Laccolith. This unique geologic feature is the largest of its kind in the United States. Approximately 14 percent (67,286 acres) of the ranger district is classified as Primitive (most within Pine Valley Mountain and Cottonwood Forest Wilderness Areas), 48 percent (225,173 acres) of the ranger district is classified as Semi-Primitive Non-Motorized, 25 percent (115,425 acres) as Semi-Primitive Motorized, and 12 percent (54,764 acres) as Roaded Natural.

3.4.6.1 Developed Recreation

Developed recreational sites on the district include the Pine Valley Recreation Area, and the Honeycomb Rocks and Oak Grove campgrounds. Several additional campgrounds, a fishing area, and trailheads are located within the Pine Valley Recreation Complex. Administrative sites include the Pine Valley Administrative Site and Browse Guard Station. All of these developed and administrative sites cover approximately 2,400 acres. Enterprise Reservoir, located near the Honeycomb Rocks Campground, provides fishing and boating opportunities. Recreation residences on the ranger district are located near the Pine Valley Recreation Area.

3.4.6.2 Dispersed Recreation

Access for various dispersed activities on the ranger district is provided by over 200 miles of trails including Gardner Peak, Oak Grove, and Water Canyon. Areas most commonly used for dispersed recreation on the Pine Valley Ranger District largely occur in the Pine Valley Recreation Area and near the trailheads at Pinto Creek, Comanche Spring, and Bench Spring (USFS 1994a). There are also 241 acres occupied by recreation residences within and in the vicinity of the Pine Valley Recreation Area. Inventoried dispersed camping sites near these areas and across the ranger district cover approximately 24 acres. Upper and Lower Enterprise Reservoirs, Leeds and South Ash Creeks, and the Santa Clara River are all available for fishing. The reservoirs allow powerboats and contain rainbow trout and bass. The low elk population in this area offers difficult hunting within the Pine Valley General Any Bull Elk Unit (UDWR 2006a).

3.4.7 Cedar City Ranger District

The Cedar City Ranger District is known for its high alpine mountain meadows bordered by large aspen stands and its abundant wildlife. The geology of the ranger district is a unique blend of red rock cliffs, cinder cones, and large lava fields. The Ashdown Gorge Wilderness is adjacent to Cedar Breaks National Monument and is characterized by extremely steep-walled canyons cut through the west rim of the Markagunt Plateau. Approximately 2 percent (7,260 acres) of the ranger district is classified as Primitive (most within Ashdown Gorge Wilderness), 28 percent (96,937 acres) as Semi-Primitive Non-Motorized, 43 percent (153,143 acres) as Semi-Primitive Motorized, and 27 percent (95,148 acres) as Roaded Natural.

3.4.7.1 Developed Recreation

Developed recreation sites on the Cedar City Ranger District include the Cedar Canyon, Deer Haven, Duck Creek, Navajo Lake, Spruces, Te-ah, White Bridge, and Yankee Meadows campgrounds as well as the Panguitch Lake recreation area. These areas cover a combined total of 1,393 acres (Table 3.4-10). There are also 579 acres on the west end of Navajo Lake that are occupied by recreation residences. In addition, there are five points of interest, including the Brian Head Observation Point near Brian Head Ski Area, Zion Overlook and Navajo Lake viewing area along Scenic Highway 14, Cascade Falls National Recreation Trail with access from Forest Service Road No. 054, and Strawberry Point with access from Forest Service Road No. 058 (USFS 1994).

3.4.7.2 Dispersed Recreation

Aspen Mirror, Bristlecone Pine, Cascade Falls, and Navajo Lake are a few of the 51 trails (approximately 155 miles) that cross the Cedar City Ranger District and provide access for many dispersed recreation activities. There are approximately 112 miles of non-motorized trails that can be used by mountain bikes. The Markagunt Motorized Trail System on Cedar Mountain contains hundreds of miles of designated roads and trails with special signing. Commonly used dispersed recreation areas occur in the areas of Bear Valley, Bear Flat, Yankee Meadow Reservoir, the Pass (near Copper Knoll), Mammoth Springs, Deer Valley, and to the south of Scenic Byway 14 between Dry Valley and Strawberry Creek (USFS 1994). Inventoried dispersed camping sites across the ranger district cover approximately 45 acres.

The Cedar City Ranger District has seven lakes and reservoirs that serve as magnets for dispersed recreation activities on the Forest. Aspen-Mirror Lake, Navajo Lake, and Panguitch Lake are popular with anglers and are stocked with rainbow trout during the summer. More than eight creeks and other tributaries are available for fishing as well. The Panguitch Lake Limited Entry Elk Hunting Unit is also located on this district.

3.4.8 Powell Ranger District

The Powell Ranger District encompasses nearly 400,000 acres of high plateau country, with distinctive vegetation and geological features. The Red Canyon “Little Bryce” area of the ranger district offers many unique hiking experiences with spectacular views. Less than one percent (529 acres) of the ranger district is classified as Primitive, 52 percent (197,547 acres) as Semi-Primitive Non-Motorized, 36 percent (140,321 acres) as Semi-Primitive Motorized, and 12 percent (45,242 acres) as Roaded Natural.

3.4.8.1 Developed Recreation

Developed recreation sites on the Powell Ranger District include the King Creek and Red Canyon campgrounds as well as the Jones Corral and Podunk Guard Stations, which are operated as rental cabins. There is also an equestrian campground. These areas cover a total of 1,099 acres (Table 3.4-10). The Red Canyon Area includes a scenic byway, roadless area, campground, visitor center, and an extensive trail system to assist visitors in viewing the outstanding rock formations (USFS 1994).

3.4.8.2 Dispersed Recreation

Commonly used dispersed recreation areas in the Powell District are located near Jones Corral, and along the East Fork of the Sevier Backway, mainly at Tropic Reservoir, Blubber Creek, Kanab Creek, and near the Podunk Forest Service Guard Station (USFS 1994). Inventoried dispersed camping sites across the district cover approximately 34 acres. Popular hiking areas on the district include Arches, Bird's Eye, Losee Canyon, Cassidy, and Photo trails, among others. There are approximately 129 miles of non-motorized trails on the district that can be used for mountain biking. Motorized trails on the ranger district include the Paunsaugunt, Casto Canyon, and Fremont Trails.

The ranger district lies within two adjacent Limited Entry Elk Hunt Units: the Paunsaugunt (in the south) and Mt. Dutton (in the north). Tropic Reservoir, East Fork of the Sevier, and Podunk Creek are stable fisheries and yield rainbow, brook, and brown trout for anglers.

3.4.9 Escalante Ranger District

The Escalante Ranger District is known for its hundreds of high mountain lakes and large stands of aspen trees. The majority of the district is located on high timbered plateaus with rolling hills and open meadow. The Box-Death Hollow Wilderness is located in this district and is characterized by vertical gray-orange walls of Navajo sandstone above two canyon tributaries of the Escalante River in Pine Creek and Death Hollow. Approximately 7 percent (28,849 acres) of the ranger district is classified as Primitive (most within Box-Death Hollow Wilderness), 42 percent (181,332 acres) as Semi-Primitive Non-Motorized, 35 percent (151,162 acres) as Semi-Primitive Motorized, and 16 percent (69,280 acres) as Roaded Natural.

3.4.9.1 Developed Recreation

Developed recreation sites on the Escalante Ranger District include the Blue Spruce, Pine Lake, and Posy Lake campgrounds. The Barker Recreation Area is located on the district and includes individual and group campsites, a day use area, fishing lakes, and many trails. The Cowpuncher Guard Station (operated as a rental cabin) is located on the district and is well situated for stream fishing, hiking, mountain biking, and big game hunting. These areas cover a total of 879 acres (Table 3.4-10). The Escalante District has two major points of interest including the Powell Point and Roger Peak viewing areas (USFS 1994).

3.4.9.2 Dispersed Recreation

Commonly used dispersed recreation areas on the Escalante Ranger District occur in the vicinity of Barker Reservoir, Lower Barker Reservoir, Joe Lay Reservoir, around McGath Lake, along the East Fork of Boulder Creek, and around the location of Chriss Lake, Green Lake, and Deer Lake (USFS 1994). Inventoried dispersed camping sites across the district include approximately 20 acres. The Posy Lake Lookout Trail, Great Western Trail, and the Barker Complex Trail System also provide access for many dispersed activities. There are

approximately 108 miles of non-motorized trails that can be used by mountain bikes. Motorized trails on the ranger district include the Pine Lake and Poison Creek Trails. There are many lakes, reservoirs, and creeks available for fishing, including Barker's Reservoir, Pine Lake, and Posey Lake, to name a few.

3.5 Fish and Wildlife

3.5.1 Introduction

The diverse mosaic of vegetation on the Dixie National Forest provides habitat for approximately 350 wildlife species. The most abundant vegetation types – pinyon-juniper, aspen/conifer, ponderosa pine, and sage steppe – along with cliffs, canyons, streams, and lakes, provide year-round habitat for rabbits, rodents, carnivores, ungulates, amphibians, bats, reptiles, and birds that occur on the Dixie National Forest. A comprehensive list of wildlife species that occur or have the potential to occur on the Dixie National Forest can be found in USFS (1993).

Wildlife species on the Dixie National Forest include mammals, reptiles, birds, and aquatic species. In order to compare the alternatives outlined in Chapter 2, which are based on leasing options, only fish and wildlife with associated oil and gas leasing options (Table 2.5-1) are discussed specifically. These species include migratory birds (including raptors) and aquatic species. Other species are discussed in more general terms, with terrestrial species discussed in Section 3.5.2 and 3.5.3 and aquatic species discussed in Section 3.5.4.

Special status species (Threatened, Endangered, Candidate, or Forest Service-Sensitive) are covered in detail in Section 3.6. In addition, Section 3.6 discusses Management Indicator Species (MIS).

3.5.2 Wildlife

Terrestrial wildlife discussed in this section includes mammals, reptiles, and birds. General mammals and reptiles are only discussed briefly in this section as all mammals and reptiles assigned special leasing options or protected by specific laws are discussed in Section 3.6, Special Status Species. Most birds are protected by the Migratory Bird Treaty Act and are discussed in more detail in the next section (3.5.3).

Mammals are hairy, warm-blooded vertebrates that give birth to live young, and can be found in a variety of habitats on the Dixie. Mammals on the Dixie National Forest include small animals such as shrews, bats, lagomorphs (rabbits and hares), chipmunks, and mice; larger mammal predators such as coyote (*Canis latrans*), bobcat (*Lynx rufus*), weasel (*Mustela spp.*), badger (*Taxidea taxus*), and cougar (*Felis concolor*); big game (discussed in Section 3.6); and black bears (*Ursus americanus*). Reptiles are cold-blooded, egg-laying vertebrates that are generally small and located in warm habitats. Reptiles are present on the Dixie National Forest in relatively low abundance.

3.5.3 Migratory Birds

Migratory birds are protected under the Migratory Bird Treaty Act, which prohibits "take" of migratory birds (including disturbance of nests) and emphasizes conservation of migratory bird populations and promoting the long-term sustainability of their habitats. To "take" is defined as to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect. Direction from the USFWS regarding migratory birds on USFS lands states that activities occurring within

migratory bird habitats should "minimize direct take of individual migratory birds when feasible" (USFS 2007g). The Dixie National Forest is considered compliant with the Migratory Bird Treaty Act if this direction is followed and habitats as well as populations of migratory birds are sustained over the long term.

A wide variety of migratory birds are found on the Dixie National Forest either seasonally, as transients, or as permanent residents. High value waterfowl habitat is relatively scarce on the Dixie and exists at Enterprise Reservoir (Pine Valley Ranger District); Panguitch and Navajo Lakes (Cedar City Ranger District); and several small lakes near the boundary of the Escalante Ranger District. Of the 124 species of migratory birds that occur on the Dixie National Forest, about 60 percent breed in wetland, riparian, or other wet habitats (including playa lakes and coastal areas). The most abundant breeding habitats for migratory birds on the Dixie National Forest include ponderosa pine or woodland (including oak), followed by aspen (including mixed conifer), pinyon-juniper, subalpine conifer (i.e., spruce fir), cliffs or rocks, bogs or open woods, shrub steppe, high desert scrub, mountain shrub, grassland or meadow, agriculture, and alpine or tundra habitat. Most migratory birds on the Dixie National Forest are ground nesters (Table 3.5-1); several nest in trees or shrubs (information taken from Parrish et al. 2002).

Eighteen species of migratory birds that are known or suspected to occur on the Dixie National Forest (see USFS 2007h) are considered to be birds of conservation concern; these species are included on either the Birds of Conservation Concern (USFWS 2002b) or Partners in Flight priority species lists (Parrish et al. 2002). Species on these lists were identified by USFWS as meriting special attention to comply with the Migratory Bird Treaty Act (USFS 2007g) and are listed in Table 3.5-1.

Table 3.5-1 Selected Priority Migratory Birds that Occur on the Dixie National Forest

Species	Breeding habitat	Status on Dixie National Forest	Occurrence on Dixie National Forest
American avocet *Recurvirostra americana*	On the ground near desert wetlands or shallow ponds; nests north of Dixie National Forest	Summer	Common
American white pelican *Pelecanus erythrorhynchos*	On the ground; Great Salt Lake only	Summer	Uncommon; on water bodies
Black-rosy finch *Leucosticte atrata*	On the ground or on a cliff; alpine habitat	Winter	Uncommon
Black-throated gray warbler *Dendroica nigrenscens*	In trees; pinyon-juniper	Summer	Common
Brewer's sparrow *Spizella breweri*	In a shrub; shrub steppe obligate	Summer	Common
Broad-tailed hummingbird *Selasphorus platycercus*	In a deciduous tree or conifer	Summer	Common
Burrowing owl *Athene cunicularia*	Underground burrows in open habitat	Summer	Uncommon; may occur in Pine Valley Ranger District
Flammulated owl[1] *Otus flammeolus*	In snag; mature ponderosa pine and Douglas-fir	Summer	Uncommon
Grace's warbler *Dendroica graciae*	In trees; pine or other coniferous	Summer	Common

Species	Breeding habitat	Status on Dixie National Forest	Occurrence on Dixie National Forest
	forest habitat		
Gray vireo *Vireo vicinior*	In fork of juniper tree or shrub; pinyon-juniper habitat in southwestern Utah	Year-round	Common
Lewis's woodpecker *Melanerpes lewis*	In a cavity within deciduous tree or snag; breeds mainly in northern Utah	Year-round	Uncommon
Long-billed curlew *Numenius americana*	On the ground; rangeland and pastures; also grassy shorelines and arid grasslands	Summer	Uncommon; one breeding record in Cedar City Ranger District (Bosworth 2003)
Marbled godwit *Limosa fedoa*	Loose colonies; on the ground in dry areas of prairie wetlands	Transient	Common
Sage sparrow *Amphispiza belli*	In a shrub or on the ground; shrub steppe obligate	Summer	Common
Three-toed woodpecker[1] *Picoides tridactylus dorsalis*	In a snag	Year-round	Uncommon
Virginia's warbler *Vermivora vinginiae*	On the ground in chaparral and montane habitats	Summer	Common
Williamson's sapsucker *Sphyrapicus thyroideus*	In a cavity within deciduous tree or conifer	Summer	Uncommon; most likely in Cedar City and Powell Ranger Districts (high elevation plateaus)
Wilson's phalarope *Phalaropus tricolor*	On the ground within 100 meters of water; Great Salt Lake	Summer	Common

[1] TES species discussed in Section 3.6.

Raptors on the Dixie National Forest are also protected under the Migratory Bird Treaty Act. Active raptor nests have special leasing stipulations (Table 2.5-1), and are protected individually, unlike (non-raptor) migratory birds that are protected at the habitat level (see USFS 2007g). The Bald and Golden Eagle Protection Act of 1940, as amended, provides for the protection of the bald eagle (*Haliaeetus leucocephalus*) and the golden eagle (*Aquila chrysaetos*), by prohibiting, except under certain specified conditions, the taking, possession, and commerce of individual birds. Although the Bald and Golden Eagle Protection Act was modeled from the Migratory Bird Treaty Act, its civil and criminal penalties are more severe.

Suitable habitat for raptors includes appropriate areas for nesting, rearing, roosting, and foraging. Raptors generally nest in forested and riparian areas, in large trees, on cliffs, or in open areas on the ground or beneath shrubs. Roosting may occur in trees, cliffs, on power poles, fences, or other man-made structures. Foraging generally occurs in open areas such as agricultural fields, grasslands, or shrub habitats. There are 17 raptor species that can be found on the Dixie National Forest, including three TES species (California condor, goshawk, and peregrine falcon, see Section 3.6); species are listed in Table 3.5-2.

Table 3.5-2 Raptors on the Dixie National Forest

Species[1]	Suitable habitat	Nest type; location	Occurrence on Dixie National Forest
American kestrel *Falco sparverius*	Open habitats; prairies, deserts, wooded stream, farmlands	Cavity; in snag or on cliff	Common; year-round resident
Bald eagle[2,3] *Haliaeetus leucocephalus*	Forested stands near water (winter roosting)	Platform; on cliff or in large tree	Uncommon winter and summer resident; most likely to occur at Panguitch Lake, Pinto Creek, Enterprise Reservoir, or Duck Creek. Pairs have been observed nesting on the Forest.
California condor[3] *Gymnogyps californianus*	Chaparral-covered mountains; roosting in large snags, cliffs	Platform; in cave, pothole, sheltered rock outcrop	Rare; reported sightings in Cedar City Ranger District
Cooper's hawk *Accipiter cooperii*	Woodland areas and riparian zones	Platform; in conifer or deciduous tree	Common; year-round resident
Ferruginous hawk *Buteo regalis*	Open habitats; pinyon-juniper, shrub steppe, or grassland	Platform; in conifer or other tree, on cliff, ground outcrop, or utility structure	Uncommon summer resident; most likely to occur in Pine Valley Ranger District
Golden eagle[2] *Aquila chrysaetos*	Open habitats, especially mountainous regions	Platform; usually on cliff or rocky outcrop. Often on top of existing nests and materials from previous structures (Hawkwatch 2007).	Common; year-round resident; occurs on all four ranger districts.
Merlin *Falco columbarius*	Any open country, grassland or desert scrub	Platform; on cliff or in deciduous tree	Uncommon winter resident
Northern goshawk[3] *Accipiter gentilis*	Montane coniferous and deciduous woodland interspersed with small openings.	Platform; in conifer or deciduous tree	Uncommon year-round resident
Northern harrier *Circus cyaneus*	Open habitats; marshes, fields, and grasslands	Platform; on ground or in shrub; within thick vegetation	Common; year-round resident
Osprey *Pandion haliaetus*	In Utah, mountain lakes and along Green River	Platform; on cliff or in deciduous trees	Uncommon summer resident; at lease six nest sites on the Cedar City Ranger District.
Peregrine falcon[3] *Falco peregrinus*	Open habitats	Scrape; on cliff or in tree	Rare; eight nest sites are known in Cedar City and Powell Ranger Districts
Prairie falcon *Falco mexicanus*	Open habitats; plains and prairies	Scrape or crevice; on cliff	Common; year-round resident
Red-tailed hawk *Buteo jamaicensis*	Open habitats with scattered trees or	Platform; on cliff or in deciduous tree	Common; year-round resident

Species[1]	Suitable habitat	Nest type; location	Occurrence on Dixie National Forest
	other perches		
Rough-legged hawk *Buteo lagopus*	In winter, open habitats such as grasslands, marshes, or sagebrush	Usually in trees, on cliffs, or other man-made structures	Common; winter resident
Sharp-shinned hawk *Accipiter striatus*	Forest and woodland areas	Platform; in conifer or deciduous tree	Common; year-round resident
Swainson's hawk *Buteo swainsoni*	Open habitats; shrub and grassland	Platform; on cliff or in deciduous tree	Uncommon summer resident
Turkey vulture *Cathartes aura*	Most common in open habitats, also in forest	No nest; eggs laid on cliff crevices or snags	Uncommon summer resident

[1] All raptor species are protected under the Migratory Bird Treaty Act.

[2] Protected by Bald and Golden Eagle Protection Act in addition to the Migratory Bird Treaty Act.

[3] Discussed in Section 3.6

3.5.4 Aquatic Species and Habitat

3.5.4.1 Fisheries

Aquatic habitats on the Dixie National Forest include approximately 400 miles of streams and over 3,100 acres of lakes and reservoirs, which support a variety of native and non-native fish (USFS 1995b). Many lakes and reservoirs are also stocked with game fish (including MIS trout; see Section 3.6) by the UDWR. Blue Ribbon Fisheries on the Dixie National Forest include Panguitch Lake, McGath Lake, Paragonah (aka Red Creek) Reservoir, and Panguitch Creek. All Blue Ribbon Fisheries meet certain standards for water quality and quantity, public accessibility, and sustainability (i.e., natural reproduction capacity; UDWR 2006b). Although the larger lakes are developed for recreational fishing, there are also numerous small lakes supporting good fisheries. Native and non-native fish species that are likely to occur in the waters of the Dixie National Forest are listed in Table 3.5-3.

Table 3.5-3 Common Native Fishes and Non-native Game Fishes that occur on the Dixie National Forest

Common Name[1]	Origin	Occurrence on Dixie National Forest[2]			
		PV	CC	PL	ES
NATIVE FISHES					
Utah chub *Gila atraria*	Bonneville Basin		X	X	X
Speckled dace *Rhinichthys osculus yarrowi*	Bonneville Basin	X	X	X	X
Mottled Sculpin *Cottus bairdi*	Bonneville Basin		X	X	X
Redside shiner *Richardsonius balteatus*	Bonneville Basin		X	X	
Mountain sucker *Catostomus platyrhynchus*	Bonneville Basin		X	X	X
Desert sucker *Catostomus clarki*	Virgin River drainage	X			
NON-NATIVE (GAME) FISHES (not including MIS species)					
Tiger trout *Salmo trutta X S. fontinalis*	stocked (hybrid)		Panguitch Lake, Paragonah Reservoir		Several lakes across the district

Splake *Salmo namaycush X S. fontinalis*	stocked (hybrid)		Navajo Lake		
Smallmouth bass *Micropterus dolomieu*	stocked	Lower Enterprise Reservoir			
Arctic grayling					Several lakes across the Boulder Top

[1] Does not include Special Status Species or MIS
[2] Ranger Districts: PV = Pine Valley, CC = Cedar City, PL = Powell, ES = Escalate

Tiger trout and splake are both sterile, hybrid sport fish that do not reproduce and as such their population numbers are controllable (by UDWR).

The state has defined six stream classes and four quality ratings that may be applied to streams on the Dixie National Forest and denote their relative importance as fisheries. Class I waters are the highest class and most important fisheries in Utah. Most streams on the Dixie National Forest are Class III fisheries streams; no Class I streams or lakes have been designated (USFS 1995b). Class III waters are smaller lakes used primarily by nearby residents; Class I waters, by contrast, are large bodies of water that satisfy heavy fishing pressure and where fish productivity is high. The Dixie National Forest considers all stream sections, reservoirs, lakes, and ponds identified as Class III as "high value," which denotes "intensive use area" for one or more species of historic or existing high-interest wildlife (i.e., wildlife of economic, aesthetic, scientific, or educational significance; USFS 1995b: Appendix A).

Endangered, threatened, sensitive, and MIS fish species, their ecology, distribution, and habitat are discussed in Section 3.6. These species include Bonneville cutthroat trout (MIS and sensitive; *Oncorhynchus clarki utah*), Colorado cutthroat trout (MIS and sensitive; *Oncorhynchus clarki pleuriticus*), brown trout (MIS; *Salmo trutta*), brook trout (MIS; *Salvelinus fontinalis*), rainbow trout (MIS; *Oncorhynchus mykiss*), other cutthroat species (MIS), Virgin spinedace (MIS; *Lepidomeda mollispinus*), Southern leatherside (MIS and sensitive; *Lepidomeda alecia*), Virgin River chub (endangered; *Gila seminuda*), and woundfin (threatened; *Plagopterus argentissimus*). The quantity and quality of surface water, stream morphology, riparian vegetation, and wetland and floodplain function is discussed in Section 3.7.

3.5.4.2 Mollusks and Amphibians

Most mollusks on the Dixie National Forest are associated with springs or other wet habitats and are only known from a few locations. Out of 38 mollusks listed in CWCS (UDWR 2005a) for example, 17 are known only from springs and nine are known only from stream banks, lakes or ponds, marshes, or seeps. Eight species are known from only one location/population in Utah; eight species are known from only two or three populations. On the Dixie National Forest, the Brian Head mountainsnail (*Oreohelix parawanensis*) occurs on Brian Head Peak (Oliver and Bosworth 1999).

Herpetofauna is relatively limited on the Dixie National Forest. Amphibians are likely to occur in any relatively high quality aquatic or riparian habitat (Section 3.7). Most amphibians would be found in slow water near streams, lakes, and stream and lake margins, including riparian areas and floodplains. They would also be expected in and around wetlands. Eleven amphibians are known or suspected to occur within wetland or riparian habitats on the Dixie National Forest (USFS 1993).

3.5.4.3 Aquatic habitat

Aquatic habitats on the Dixie National Forest are critical ecosystem components because water sources in the region are relatively rare. The overall health of aquatic habitats is a direct result of the condition of the entire watershed (i.e., uplands, riparian corridor and the stream channel), particularly the upland plant community. The condition and health of vegetation throughout a watershed is the major factor determining the quantity and quality of the associated flow regime, which is naturally regulated by healthy and diverse bank vegetation. Vegetation in good condition provides greater ground cover, which reduces runoff and increases infiltration rates, and diverse plant communities contain microsites that extend the runoff period through variable snowmelt. Collectively, these factors produce more stable base flows that are essential for high quality fish and riparian habitats (WFGD 2004). The condition of riparian vegetation on the Dixie National Forest is discussed further in Section 3.7.

MACROINVERTEBRATES

Aquatic macroinvertebrates are invertebrates that live in water and that are large enough to be seen with the naked eye. They are useful indicators of aquatic habitat conditions due to their strict habitat requirements. Most macroinvertebrate species are adapted to fast-water stream environments, as evidenced by flattened bodies, streamlined shape, suckers, friction pads and hooks, secretions, and upstream migrations. Species include mayflies (Ephemeroptera), stoneflies (Plecoptera), caddisflies (Trichoptera), and true flies (Diptera); as well as crustaceans, mollusks, and freshwater earthworms (Rodriguez 2004).

Aquatic macroinvertebrate communities are naturally dynamic, due to seasonal variations, life cycles, and natural stream disturbances. According to Macroinvertebrate analyses from 2002 (Vinson 2003), 2003 (Vinson 2005), 2004 (Vinson 2006), and 2007 (Wisseman 2008), a comparable number of streams on the Dixie National Forest had good or excellent biotic condition indexes as had poor or fair indexes. Biotic condition indexes use the indicator-taxa concept, based on species' differing tolerances to pollution, so that in theory, more intolerant species indicate a higher biotic condition. Since 2010, it was determined that the biotic condition index is easily affected by conditions not related to management and thus not an indicator of effects of management activity (i.e., macroinvertebrates are no longer a MIS; USFS 2010a).

Aquatic habitat conditions in some areas of the Dixie National Forest have been severely affected by flood or fire in the past several years. Aquatic habitat condition data from 2005 indicated that fire-affected streams on the Dixie National Forest (i.e., Antimony, Cottonwood, Deep, Deer, Mill, and Water Canyon creeks) were lacking invertebrate diversity by several metrics, including low total taxa richness, few Ephemeroptera/Plecoptera/Trichoptera taxa (mayflies/stoneflies/caddisflies), virtually no longer lived taxa, low predator richness and abundance, and high dominance of relatively few taxa. Most of these stream sites were found to be dominated by black flies and mayflies, two taxa that tend to colonize streams after disturbances (Wisseman 2006) and monopolize resources. Surveys of Deep, Deer, and Cottonwood creeks in 2005 found that none of the streams met the standards for fish and riparian habitat conditions in USFS (1986) (USFS 2005). Additional streams were surveyed in 2006 (i.e., Forest, Pine, Harmon, and Leap creeks) and similar conditions were found (Wisseman 2007), with the exception of Forest Creek and Pine Creek, which both had moderately higher diversity scores and showed relatively high biological integrity. As of 2007, several streams had recovered to a point where habitat conditions were supporting a limited population of fish. Bonneville cutthroat trout have been introduced to several fire-affected

streams, and as of the last data collection, most reintroduced populations have shown overwinter survival and evidence of reproduction (see Section 3.6).

3.5.5 Pine Valley Ranger District

Migratory birds are probably most abundant in the Pine Valley Ranger District. Extensive pinyon-juniper and mountain shrub communities, as well as scattered desert scrub and chaparral, provide habitat for migratory birds that build nests on the ground and in trees. Across the Dixie National Forest, these habitats are substantially more abundant on the Pine Valley Ranger District, which is at a lower elevation than the rest of the Forest. Ferruginous hawk and other raptors also occur in these habitats.

The Pine Valley Ranger District includes streams that drain north into the Bonneville Basin as well as those that drain south into the Virgin River and Colorado River basin. Water quality sampling indicates that phosphorous levels in the upper Santa Clara River are above state limits (USFS 2004c). Biotic indices from 2002 indicate that aquatic habitat in this river is poor (Vinson 2003). Overall there are few sample sites within the Pine Valley Ranger District used to collect macroinvertebrate data that could be used to indicate the health of the aquatic habitat.

Aquatic habitat in fire-affected streams in the Pine Valley Ranger District is poor. Three fire-affected streams within the Pine Valley Ranger District were analyzed for aquatic habitat condition and were found to be of poor quality; invertebrate diversities in Mill Creek and Leap Creek were “very low” and diversity in Harmon Creek was “low” (Wisseman 2006 and 2007).

3.5.6 Cedar City Ranger District

Forest communities (e.g., aspen and ponderosa pine) on high elevation plateaus and waterbodies within the Cedar City Ranger District provide good habitat for migratory birds, and cliffs across the ranger district provide raptor habitat. Similar migratory bird habitats can be found on the Powell and Escalante Ranger Districts.

According to UDWR (2006b), Blue Ribbon Fisheries on the Cedar City Ranger District include Panguitch Lake (1,234 surface acres), Paragonah (aka Red Creek) Reservoir (70 surface acres), and Panguitch Creek (11 miles total, from an irrigation diversion near Panguitch to the Butler Creek confluence; 9.5 miles on the Dixie National Forest). Asay Creek is a Blue Ribbon Fishery located just downstream from the Dixie National Forest, which joins the main stem of the Sevier River just west of the Forest boundary.

The majority of the Cedar City Ranger District is within the Sevier River basin and the extreme southern portion of the district drains into the Virgin River basin. The loss of riparian vegetation in Threemile Creek has led to a decrease in shade levels and a concomitant increase in stream temperatures above state limits; however, this creek currently supports self-sustaining fish populations. Biotic Condition Index data from 2003 indicates that Threemile Creek is in good condition (Vinson 2003). Data from 2002 indicate that Butler Creek, Castle Creek, and Lower Center Creek are in excellent condition; Upper Center Creek, Mammoth Creek, and Mammoth Spring were in poor condition in 2002 (Vinson 2003). Data from 2003 indicate Bowery Creek is in excellent condition (Vinson 2005), and 2004 data (Vinson 2006) indicate that Bunker Creek and parts of Deer Creek unaffected by fire are also in excellent condition. Duck Creek was in poor condition in 2004 (Vinson 2006). Fine sediment in Little Creek is greater than 25 percent, which decreases spawning and overwintering habitat of native fishes (USFS 2004c).

3.5.7 Powell Ranger District

Sagebrush habitat on the Powell Ranger District provides habitat for many migratory birds that build nests on the ground or in shrubs. Migratory bird habitat in the Powell Ranger District is similar to that found in the Cedar City and Escalante Ranger Districts. Raptors such as ferruginous hawks are likely to nest in these areas, and other raptors likely use sagebrush habitat for foraging as well as cliffs for nesting.

The East Fork Sevier River (11.5 miles from the Otter Creek Reservoir Diversion to the confluence with Deer Creek; UDWR 2006b) is a Blue Ribbon Fishery stream located east of the Powell Ranger District, but is downstream from several streams on the Forest.

The Powell Ranger District includes streams that drain primarily into the Sevier River and the East Fork Sevier River. In 2004, Kanab Creek was in excellent condition according to Biotic Condition Index data (Vinson 2006).

Regarding fire-affected streams, fish habitat inventories were conducted in 2004 on Cottonwood Creek, Deep Creek, and Deer Creek (USFS 2004c) and surveys showed that the streams and associated riparian areas were beginning to recover from the heavy impacts of the Sanford Fire. Bonneville cutthroat trout have been introduced to Deep Creek (Section 3.6). Recovering riparian vegetation has been impacted by trespass cattle (USFS 2004c). Pine Creek had "moderately high" invertebrate diversity (no streams on the Dixie National Forest were "high" or "very high"; Wisseman 2006 and 2007).

3.5.8 Escalante Ranger District

Waterbodies on the Escalante Ranger District provide important water sources for migratory birds. Several forested and shrub-dominated vegetation types as well as cliffs, similar to the Cedar City and Powell Ranger Districts, provide roosting, nesting, and foraging habitat for migratory bird species, including raptors.

McGath Lake (43 surface acres) is a Blue Ribbon Fishery located on the Escalante Ranger District (UDWR 2006b).

The majority of streams on the Escalante Ranger District drain into the Escalante River drainage. Other parts of the District drain into the East Fork Sevier River (Bonneville Basin), including Antimony Creek, Center Creek, and Ranch Creek. Many of the more western streams draining into the Escalante River drainage have higher sediment concentrations due to less vegetated watersheds overlying shale and siltstone (USFS 1995c). The loss of riparian vegetation in Bear Creek has led to a decrease in shade levels and a concomitant increase in stream temperatures above state limits; however, this creek currently supports self-sustaining fish populations. In 2002, two reaches sampled in Bear Creek were in poor biotic condition and one was in good condition (Vinson 2003). Ranch Creek was in excellent biotic condition in 2002 (Vinson 2003). West Fork Boulder Creek was in poor biotic condition in 2003 (Vinson 2005). Antimony Creek, in the northwestern end of the ranger district had "moderately high" invertebrate diversity (no streams analyzed by Wisseman on the Dixie National Forest were "high" or "very high"; Wisseman 2006 and 2007). Antimony Creek was in excellent condition in 2002 (Vinson 2003). In Twitchell Creek in Garfield County, one reach was poor, one was fair, and one was in excellent condition according to biotic condition indices (Vinson 2003).

3.6 Special Status Species

3.6.1 Introduction

Threatened, Endangered, Candidate (TEC), and Forest Service Sensitive species and MIS on the Dixie National Forest ("special status species") are described in this section. Species information includes descriptions of suitable habitats, life history information where relevant, and habitat or occurrence data relevant to the Dixie National Forest. Sources include Bosworth (2003), Parrish et al. (2002), Rodriguez (2008), Utah Native Plant Society Rare Plant Guide (UNPS 2007), and the draft leasing EIS for the Dixie National Forest prepared in 1993-1994 (USFS 1995a, 1995b, and 1995d). TEC species are discussed in Section 3.6.2; Sensitive species are discussed in Section 3.6.3; MIS are discussed in Section 3.6.4. Bonneville cutthroat trout, Colorado cutthroat trout, southern leatherside, and northern goshawk are Sensitive species and MIS.

3.6.2 Threatened, Endangered, and Candidate (TEC) Species

TEC species are identified by the US Fish and Wildlife Service (USFWS). Seven TEC species are known to occur or have suitable habitat present on the Dixie National Forest (Table 3.6-1). For most TEC species, the Dixie National Forest provides at least some suitable habitat and ongoing surveys are conducted by Dixie National Forest biologists.

Table 3.6-1 TEC Species Known or Suspected to Occur on the Dixie National Forest, by Ranger District

Species		Status	Pine Valley	Cedar City	Powell	Escalante
Virgin River chub *Gila seminude*	fish	Endangered	present off-Forest[1]	no habitat	no habitat	no habitat
Woundfin *Plagopterus argentissimus*	fish	Endangered	present off-Forest[1]	no habitat	no habitat	no habitat
California condor *Gymnogyps californianus*	bird	Endangered	may occur, fully protected by ESA	Exp pop area[2]	Exp pop area[2]	Exp pop area[2]
Utah prairie dog *Cynomys parvidens*	mammal	Threatened	no habitat	habitat	habitat	habitat
Mexican spotted owl *Strix occidentalis*	bird	Threatened	habitat	habitat	habitat	habitat
Greater sage-grouse *Centrocercus urophasianus*	bird	Candidate	habitat	present	present	present
Western yellow-billed cuckoo *Coccyzus americanus*	bird	Candidate	marginal habitat[3]	marginal habitat[3]	marginal habitat[3]	marginal habitat[3]

[1] Species does not occur on Forest Service-administered lands but has been documented downstream in the Virgin River.
[2] Exp pop area = Experimental/nonessential population area for a reintroduced species
[3] The exact locations of potentially suitable (marginal) habitat on the Dixie National Forest are not known.

3.6.2.1 Endangered species

According to the USFWS, endangered species are animals or plants in danger of extinction within the foreseeable future throughout all or a significant portion of their range (USFWS 2007a). Virgin River chub, woundfin, and California condors are endangered species that may occur or that may be affected by activities on the Dixie National Forest. Suitable habitats for endangered species on the Dixie National Forest are listed in Table 3.6-2.

Table 3.6-2 Acres of Mapped Habitat for Endangered Species on the Dixie National Forest

	Pine Valley	Cedar City	Powell	Escalante	TOTAL[1]
California condor rim habitat	65,884[2]	40,461	102,930	232,022	441,298

[1] May not add up exactly due to rounding
[2] Condors in the Pine Valley Ranger District are fully protected by ESA; condors outside of the Pine Valley Ranger District are part of the Experimental/Nonessential population.

VIRGIN RIVER CHUB AND WOUNDFIN

The Virgin River chub and woundfin are rare minnows that are now restricted to the Virgin River mainstem from Pah Tempe Springs (Utah) downstream to the Mesquite diversion (near the Arizona-Nevada border) and downstream to Lake Mead, respectively (USFWS 2000). The Virgin River chub is endemic to the Virgin River system of southeastern Utah, southern Nevada, and northwestern Arizona; the woundfin is endemic to the Colorado River system. Designated critical habitat for both species extends on the mainstem Virgin River from the confluence of La Verkin Creek to Halfway Wash, Nevada. The La Verkin Creek confluence is approximately 14 stream miles southeast of the Pine Valley Ranger District.

During a "normal" year with adequate flows, both Virgin River chub and woundfin inhabit the mainstem of Ash Creek from the confluence with La Verkin Creek up to the Toquerville and Ash Springs diversions (southeast of the Dixie National Forest). The diversions are large head cuts that cut down into the shallow alluvial aquifer to withdraw water, and as a result, provide some surface flow to the creek, but often go subsurface during periods of low flow. During periods of high flow, both Virgin River chub and woundfin may also move upstream of these diversions, with presence noted in the mainstem of Ash Creek as far north as Ash Creek Reservoir (A.H. Rohm, Wildlife Biologist, UDWR, Personal Communication). Thus, both species can be found in waters that flow directly from the Pine Valley Ranger District; however, no known populations of Virgin River chub or woundfin occur within the Forest boundary (Rodriguez 2008).

CALIFORNIA CONDOR

The California condor is one of the largest flying birds in the world, with a wingspan of nearly 10 feet and weighing approximately 22 pounds. Condors require large areas of remote country for nesting, foraging, and roosting. Nesting occurs primarily in chaparral-covered mountains in caves, potholes, and sheltered rock outcrops. Foraging occurs in grasslands. Condors feed on carrion, mainly of larger animals (i.e., bison, deer, pronghorn, or beached marine animals). Roosting occurs on large, old growth trees or snags, or on isolated rocky outcrops and cliffs (Mesta 1996). In 1987, when the last wild birds were captured, condors were limited to the coastal foothills and mountains of southern California. In 1997, condors were released in the wild in northern Arizona near the Grand Canyon (Vermillion Cliffs) as part of a captive breeding and reintroduction program. In Utah, the designated nonessential experimental population area for these reintroduced birds is bounded on the west by I-15, on the north by I-70, and on the east by Highway 191; thus, the area overlaps the Cedar City, Powell, and Escalante Ranger

Districts of the Dixie National Forest. Condors within the Pine Valley Ranger District would not be part of this experimental population and would be considered Endangered. Condors from the Vermillion Cliffs release point have subsequently been observed in various locations in southern Utah, including in and around Zion National Park adjacent to the Pine Valley Ranger District. These birds appear to eventually return to the Vermilion Cliffs in Arizona where they were released.

Suitable habitat for condors occurs on the Dixie National Forest as part of the experimental population area; however, California condors are not known to nest on the Dixie National Forest and would only be expected on a transient basis. Condors have been observed searching for nests along the I-15 corridor, between the Pine Valley and Cedar City Ranger Districts. Condors have also been observed in at least three locations on the Cedar City Ranger District north of Highway 14 (Long Valley, Aspen Mirror Lake, and Panguitch Lake) in the recent past. On the Dixie National Forest, over 450,000 acres of "rim" habitat that is suitable for California condor have been mapped (Table 3.6-2). Only condors in the Pine Valley Ranger District are protected by ESA.

3.6.2.2 Threatened species

According to the USFWS, threatened species are those that are likely to become endangered within the foreseeable future throughout all or a significant portion of their range (USFWS 2007a). Threatened species either present or with suitable habitat on the Dixie National Forest include Utah prairie dogs and Mexican spotted owls. Suitable habitats for threatened species on the Dixie National Forest are listed in Table 3.6-3; locations of suitable habitat are shown in Figure 3.6-1.

Table 3.6-3 Acres of Mapped Habitat for Threatened Species on the Dixie National Forest

	Pine Valley	Cedar City	Powell	Escalante	TOTAL[1]
Utah prairie dog colonies	0	6,412	30,883	12,333	49,628
Potential (unverified) Mexican spotted owl habitat	22,437	9,193	7,227	8,676	47,532
Designated Critical Mexican spotted owl habitat[2]	0	0	0	18,048	18,048
Mexican spotted owl PACs	0	0	0	732	732

[1] May not add up exactly due to rounding.
[2] Most areas of Designated Critical habitat are not included in "potential Mexican spotted owl habitat."

UTAH PRAIRIE DOG

Utah prairie dogs are highly sociable, herbivorous rodents that live in underground burrow colonies called "towns." Towns are organized into discrete family units. Utah prairie dogs require deep, well-drained soils in which to dig burrows, vegetation low or sparse enough to see over or through, and suitable forage. Utah prairie dogs prefer alfalfa and grasses as forage, but also eat insects, particularly cicadas. In general, drought or the lack of sufficient moist vegetation is thought to be one of the most important factors influencing the distribution of Utah prairie dogs (Rodriguez 2008). Utah prairie dogs presently occur in three areas in southwestern

and south central Utah: the Awapa Plateau (Escalante Ranger District), the Paunsaugunt region along the east fork of the Sevier River (Powell Ranger District), and the West Desert region east of Iron County (not on the Forest; USFWS 1991).

The Utah prairie dog was listed as an endangered species on June 4, 1973 (38 FR 14678). At the time of listing the species was threatened by habitat destruction and modification, over exploitation, disease, and predation (USFWS 2010). In 1972 the UDWR started a transplant program to move animals from private to public lands (USFWS 1991). From 1972 to 2000, over 19,561 Utah prairie dogs were removed from private lands and relocated to lands managed by the BLM, USFS, NPS, and State of Utah (Bonzo and Day 2003). Utah prairie dog populations increased significantly in portions of their range and on May 29, 1984 (49 FR 22330) the species was reclassified as threatened with a special rule to allow regulated take of the species (USFWS 2010). In 2002, a total of 382 prairie dogs were translocated from 21 different colonies in the West Desert Recovery Unit, to three different locations (two in the West Desert; one on the Paunsaugunt). Post-release counts at two West Desert sites accounted for 1) between 11 and 16 Utah prairie dogs (on different days; out of 186 released) at one site, and 2) between 9 and 34 Utah prairie dogs (on different days; out of 196 total) at the other. From these results it appears that survivorship of the translocated Utah prairie dogs for this particular effort was low. Since 2002, a more successful translocation effort has been observed at a relocation site on the Dixie National Forest (Berry Springs, within the Paunsaugunt Recovery Unit), where many provisions of a Recommended Translocation Procedures document (2006 – see USFWS 2009) have been implemented. Spring counts at this location increased from 8 adult Utah prairie dogs in 2007 to approximately 100 adult Utah prairie dogs in 2010 (UDWR 2011; USFWS 2009).

The Utah Division of Wildlife Resources (UDWR) initiated biannual census counts in 1975 and annual counts in 1978. According to the 2002 annual report, Utah prairie dogs in the Awapa Plateau and Paunsaugunt Recovery Units showed a recent declining trend (Bonzo and Day 2003: Appendix I; counts from 1998-2002 in Awapa Unit = 353, 201, 424, 244, 218; counts from 1998-2002 in Paunsaugunt Unit = 1,100, 1,173, 934, 735, 863). Recent monitoring (trends as of 2007) of Utah prairie dog colonies in the Awapa and Paunsaugunt Recovery Units shows that populations are at least stable, if not increasing (Rodriguez 2008). There are 50,000 acres of colony areas (with 0.5-mile buffer) that have been mapped on the Dixie National Forest (Table 3.6-3). Considering that only colonies on public lands count toward recovery of the species, colonies on the Powell Ranger District may contain the majority of Utah prairie dogs within the Paunsaugunt Recovery Unit (USFWS 1991).

MEXICAN SPOTTED OWL

The Mexican spotted owl is a large owl that typically roosts and nests in shady, mature forests, but in southern Utah prefers the cracks of deep slot canyons (USFWS 1995). In Utah, breeding spotted owls typically utilize deep, steep-walled canyons that contain mature coniferous or deciduous trees within the canyon bottom. Nest sites in Utah have only been documented on cliff ledges. During winter, owls tend to move out of the canyons and onto mesa-tops, benches, and warmer slopes (Rodriguez 2008).

"Potential habitat" for spotted owls occurs on all four ranger districts of the Dixie National Forest and covers about 47,000 acres (Table 3.6-3; Figure 3.6-1). Potential habitat was mapped using breeding and roosting habitat from the 1997 and 2000 Willey-Spotskey Mexican Spotted Owl Habitat Models, which is to be used for "initial evaluation of potential habitat within project areas" and must be verified by "field evaluations to determine the actual extent of owl habitat in the project area and the subsequent need for owl surveys (USFWS 2002a)." The presence of

Oil & Gas Leasing EIS on Lands Administered by the Dixie National Forest

FIGURE 3.6-1

Threatened & Endangered Species Habitat

Horizontal Datum = NAD 83 Coordinate System = Zone 12N	1:590,000	1 in = 9 miles

Legend

- Cities
- Freeways
- Highways
- Minor Roads*
- Major Streams & Rivers
- Water Bodies
- County Boundaries
- State Boundaries

National Forest System Lands

- Dixie National Forest
- Wilderness Areas
- Fishlake National Forest

Other Land Administration

- Bureau of Land Management
- GSENM**
- National Park Service
- Private
- State of Utah
- Tribal

Mexican Spotted Owl

- Protected Activity Centers
- Potential Habitat
- Critical Habitat

Miles: 0 4 8 12 16

N

Original data was compiled from multiple source data and may not meet the U.S. National Mapping Accuracy Standard of the Office of Management and Budget. For specific dates and/or additional digital information, contact the Forest Supervisor, Dixie National Forest, Cedar City, Utah. This map has no warranties to its contents or accuracy.

*Not all roads are shown. Only some roads are depicted for orientation purposes.
**Grand Staircase-Escalanted National Monument. Managed by the Bureau of Land Management.

suitable Mexican spotted owl breeding/roosting habitat within potential habitat is officially unverified until field surveys document the suitability of breeding/roosting habitat. Surveys may be warranted if habitat is determined to be suitable and if activities within 0.5 miles are proposed. Of the acres identified as potentially suitable breeding/roosting habitat (see Table 3.6-3), about 25,000 have been field-verified.

The Dixie National Forest is located within the northern edge of Critical Habitat unit CP-12 (Colorado Plateau-12) for Mexican spotted owls, one of five Critical Habitat units in Utah that cover more than two million total acres. About 18,000 acres of CP-12 overlap the southern edges of the Escalante Ranger District (Table 3.6-3; Figure 3.6-1). A 732-acre Protected Activity Center (PAC) for Mexican spotted owls occurs within this Critical Habitat area, near Pasture Canyon. Two spotted owls were detected on the Cedar City Ranger District during winter in non-canyon areas. Both locations were the results of a telemetry study monitoring dispersal, and in both cases the owls did not stay on the Dixie National Forest. Spotted owls have also been detected on the Escalante Ranger District in steep-walled canyon complexes and in the established PAC; however, no nests have been located (Rodriguez 2008). As of 2008, no nesting owls have been located anywhere on the Dixie National Forest.

3.6.2.3 Candidate species

Candidate species do not receive federal protection under the Endangered Species Act, but are treated as Listed for the purpose of this analysis. Candidate species have been studied and the USFWS has concluded that they should be proposed for addition to the federal endangered and threatened species list (USFWS 2007a). The only candidate species known or suspected to occur on the Dixie National Forest are the western yellow-billed cuckoo and greater sage-grouse.Suitable habitats for candidate species on the Dixie National Forest are listed in Table 3.6-4; locations of suitable habitat are shown in Figure 3.6-1.

Table 3.6-4 Acres of Mapped Habitat for Candidate Species on the Dixie National Forest

	Pine Valley	Cedar City	Powell	Escalante	TOTAL[1]
Sage grouse brood rearing habitat	0	3,415	0[2]	9,562	12,977
Sage grouse leks	0	16,739	23,268	2,809	42,816

[1] May not add up exactly due to rounding.
[2]All brood-rearing habitat is contained within the buffered “leks” area on the Powell Ranger District.

GREATER SAGE-GROUSE

The USFWS found on 5 March 2010 that listing greater sage-grouse (range-wide) was warranted, but that listing was precluded by higher-priority listing actions. The greater sage-grouse was assigned a Candidate Listing Priority Number of 8, where 1 is the highest priority; FR 75(55):13910-14014, published March 23, 2010). Thus, greater sage-grouse is a candidate species for listing as of March 5, 2010.

Sage-grouse are large, chicken-like birds that are brownish grey with conspicuous black and white markings (Parrish et al. 2002). Sage-grouse are dependent on sagebrush habitats, specifically big sagebrush (*Artemisia tridentata*) for brood rearing, nesting cover, and year-round diet. Suitable sagebrush habitat is limited by elevation and topography (USFS 1995b:25). Sage-grouse habitat on the Dixie National Forest contains varied topography and vegetation communities are heterogeneous. Sage-grouse populations on the Dixie have not contracted in

size at the same scale as populations in Wyoming (WAFWA 2008). According to Connelly et al. (2004), forested and alpine habitats in mountainous areas were likely unoccupied historically by sage-grouse, including the Markagunt, Paunsaugunt, and Aquarius Plateaus. However, current populations in Utah appear to be more isolated than they were in pre-settlement times (Schroeder et al. 2004). Loss, fragmentation, and degradation of sage-grouse habitat occurred gradually across Utah, beginning with the establishment of settlements along sagebrush foothills and in valleys, followed by ploughing of arable areas and livestock grazing, and exacerbated by fire and invasions of exotic species (particularly cheatgrass; Beck et al. 2003).

Breeding in greater sage-grouse occurs on "leks" or openings surrounded by sagebrush in broad valleys, ridges, benches, and plateaus or mesas. Lek sites generally have good visibility (for predator detection), acoustical qualities (so mating sounds will carry), and an abundance of sagebrush within about 300 to 660 feet (for escape cover). Hens build nests at the base of a live sagebrush plant and remain in sagebrush vegetation with chicks until conditions are too dry, at which point hens with broods move towards wet meadow or riparian areas. Preferred nest habitats are those with live sagebrush along the periphery for escape cover.

Flocks of sage-grouse form in early fall, containing unsuccessful and successful hens and chicks from several broods. During fall and early winter, movements of sage-grouse flocks can be extensive. Sagebrush habitats are still important to sage-grouse in winter (20% canopy cover preferred; Parrish et al. 2002). In Utah, Homer et al. (1993) found that wintering grouse preferred shrub habitats with medium to tall (40-60 cm) shrubs and moderate shrub canopy cover (20-30 percent; Homer et al. 1993). Sage-grouse avoided winter habitats characterized by medium (40-49 cm) shrub height with sparse (<14 percent) sagebrush canopy cover. As described in Connelly et al. (2004), the spatial distribution of sage-grouse in winter often is related to snow depth. At the onset of winter, sage-grouse typically move to lower elevations with greater exposure of sagebrush above snow and taller sagebrush; in migratory populations, this movement may extend up to 160 km. Winter migration areas for sage-grouse populations on the Dixie are not known, but winter use by sage-grouse is expected.

Mapped brood-rearing habitat for sage-grouse occurs on the Cedar City and Escalante Ranger Districts. Brood-rearing areas occur primarily adjacent to the Dixie National Forest, overlapping the northeast corner of the Cedar City Ranger District and the north edge of the Escalante Ranger Districts (Table 3.6-4; Figure 3.6-1). Actual lek sites on the Dixie National Forest (mapped with a one- or two-mile buffer, depending on the alternative) total 42,816 acres (Table 3.6-4). The current status of these leks is not known (USFS 1995b:25). A large amount of suitable, unmapped brood-rearing habitat occurs within the lek buffer.

Based on GIS data of all roads on the Dixie National Forest, including unauthorized roads and trails, road/trail densities in the vicinity of leks on the Dixie National Forest are relatively high (greater than three miles per square mile within the subwatershed) in a few areas, including near leks northeast of Panguitch Lake and White Bridge Campground, and leks north of Highway 12 on the east side of the Powell Ranger District. Complete information on road density can be found in the Dixie National Forest Motorized Travel Plan EIS (USFS 2009c).

WESTERN YELLOW-BILLED CUCKOO

The western yellow-billed cuckoo is a distinctive neotropical migrant that nests in dense, deciduous, streamside forests. Most nesting in the West occurs within relatively large patches (25+ acres) of riparian forest containing cottonwoods or willows. Yellow-billed cuckoos require a humid, shady environment for nesting to protect eggs and fledglings from the otherwise

unsuitably dry and hot desert conditions. Nesting typically begins in mid-June and lasts less than three months, which is the shortest incubation and nestling period of any bird. Yellow-billed cuckoos eat a wide variety of insects, including caterpillars that are toxic to most other animals. Approximately 115 acres of potentially suitable habitat for western yellow-billed cuckoo has been identified on the Dixie National Forest and regular surveys are conducted; however, this area has not been mapped. Western yellow-billed cuckoos are unlikely to occur on the Dixie National Forest because cottonwood riparian areas with dense understories are at a much higher elevation on the Dixie National Forest than the species is known to prefer (Rodriguez 2008).

3.6.3 Sensitive Species

The Regional Forester identifies Sensitive species as those for which population viability ("persistence") is a concern, as evidenced by significant current and predicted downward trends in population numbers, density, and/or habitat capability that would reduce a species' existing distribution. Sensitive species must receive special management emphasis to ensure their viability and to preclude trends toward endangerment that could result in the need for federal listing (FSM 2672.1). Sensitive species that are known or suspected to occur on the Dixie National Forest are listed in Table 3.6-5. An "X" indicates confirmed presence; "habitat" indicates presence not confirmed but suitable habitat occurs.

Table 3.6-5 Sensitive Species That Occur on the Dixie National Forest, by Ranger District. "X" indicates presence

	Pine Valley	Cedar City	Powell	Escalante
FISHES and AMPHIBIANS				
Colorado River cutthroat trout *Oncorhynchus clarki pleuriticus*				X
Bonneville cutthroat trout *Oncorhynchus clarki utah*	X	X	X	X
Southern leatherside (chub) *Lepidomeda aliciae*		X	X	X
Boreal toad *Anaxyrus boreas*		habitat[3]	X	habitat[2]
MAMMALS				
Pygmy rabbit *Brachylagus idahoensis*	habitat	habitat	X	habitat
Townsend's big-eared bat *Corynorhinus townsendii*	X	X	habitat	habitat
Spotted bat *Euderma maculatum*	habitat	X	habitat	habitat
Desert bighorn sheep *Ovis Canadensis nelsoni*	habitat	X	X	X
BIRDS				
Northern goshawk *Accipiter gentilis*	X	X	X	X
Peregrine falcon *Falco peregrinus*	habitat	X	X	X
Bald eagle *Haliaeetus leucocephalus*	winter/ migrant	winter/ migrant; nesting	winter/ migrant	winter/ migrant
Flammulated owl *Otus flammeolus*	X	X	X	X
Three-toed woodpecker	X	X	X	X

	Pine Valley	Cedar City	Powell	Escalante
Picoides tridactylus				
PLANTS				
Dana's milkvetch *Astragalus henrimontanensis*				X
Navajo Lake milkvetch *Astragalus limnocharis limnocharis*		X		
Table Cliff milkvetch *Astragalus limnocharis tabulaeus*				X
Guard milkvetch *Astragalus zionis vigulus*	X			
Peculiar moonwort *Botrychium paradoxum*				X
Aquarius paintbrush *Castilleja aquariensis*				X
Tushar paintbrush *Castilleja parvula parvula*		X[1]		
Reveal paintbrush *Castileja parvula revealii*		X	X	X
Yellow-white catseye *Cryptantha ochroleuca*			X	X
Cedar Breaks biscuitroot *Cymopterus minimus*		X	X	X
Creeping draba *Draba sobolifera*		X[1]		
Widtsoe wild buckwheat *Eriogonum aretioides*			X	X
Pine Valley goldenbush *Ericameria crispa*	X			
Jones golden-aster *Heterotheca jonesii*				X
Zion jamesia *Jamesia americana zionis*		X[1]		
Neese's pepperplant *Lepidium montanum neeseae*				X
Paria breadroot *Pediomelum pariense*			X[1]	
Red Canyon beardtongue *Penstemon bracteatus*			X	
Little (aquarius) penstemon *Penstemon parvus*				X
Pinyon penstemon *Penstemon pinorum*	X			
Arizona willow *Salix arizonica*		X	X	
Podunk goundsel *Packera malmstenii*		X	X	X
Peterson catchfly *Silene petersonii*		X	X	X
Rock tansy *Sphaeromeria capitata*			X	

[1]Presence not confirmed.
[2] Habitat not mapped.
[3] Amphibian habitat exists but no historical records of boreal toads.

Mapped habitat areas for Sensitive species, including bald eagle, pygmy rabbit, sensitive bats, peregrine falcon, flammulated owl, goshawk, and sage grouse are shown in Figure 3.6-2.

3.6.3.1 Fishes

Fisheries habitat on the Dixie National Forest for the purpose of this analysis includes habitat that is occupied, or habitat that is suitable (and unoccupied). Suitable, unoccupied habitats are all areas currently identified by Conservation Teams, UDWR, and/or the Forest as having the potential for reintroductions within the next ten years.

Sensitive aquatic species on the Forest include: 1) Colorado River cutthroat trout, 2) Bonneville cutthroat trout, 3) Southern leatherside chub, and 4) boreal toad. All species are cooperatively managed between the Forest Service and other Agencies under Conservation Agreement and Strategy (CAS) documents, shown in the following table. Virgin spinedace, an MIS, is also included.

Table 3.6-6 Conservation agreements in place for sensitive or MIS aquatic species on the Dixie National Forest

Species	Conservation Agreements	Signatories
Colorado River cutthroat trout	Range wide: CRCT Coordination Team 2006	Colorado Department of Natural Resources, Wyoming Game and Fish Committee, UDWR, USFWS, BLM, USFS, Ute Indian Tribe, NPS
Bonneville cutthroat trout	Range wide: UDWR 2000a	Idaho department of Fish and Game, Nevada Department of Wildlife, UDWR, Wyoming Department of Fish and Game, Confederate Tribes of the Goshute Reservation, USFWS, BLM, NPS, USFS, Utah Reclamation Mitigation and Conservation Commission
	Utah: UDWR 1997	UDWR, USFWS, BLM, USFS, Confederated Tribes of the Goshute Reservation, Bureau of Reclamation, Utah Reclamation Mitigation and Conservation Commission
Southern leatherside	Utah: UDWR 2010	UDWR, USFWS, BLM, Bureau of Reclamation, USFS, Utah Reclamation Mitigation and Conservation Commission, Utah Central Water Conservancy, Trout Unlimited
Virgin spinedace (MIS)	Utah: UDWR 2002	UDWR, USFWS, BLM, NPS, Nevada Department of Conservation and Natural Resources, Washington County Water Conservancy District, Arizona Fish and Game
	Utah: UDWR 2008b	UDWR, USFS, NPS, BLM (Arizona and Utah), Nevada Department of Wildlife, Arizona Fish and Game, Washington County Water Conservancy District
Boreal toad	Utah: UDWR 2005b	UDWR, USFS, USFWS, BLM, Bureau of Reclamation, and the Utah Reclamation

		Mitigation and Conservation Commission

Table 3.6-7 Acres of Fisheries and Boreal Toad Habitat on the Dixie National Forest.

	Pine Valley	Cedar City	Powell	Escalante	TOTAL[1]
Fisheries habitat	4,896	4,105	7,892	6,572	23,465
Boreal toad habitat (mapped)	0	0	50,166	0	50,166

[1] May not add up exactly due to rounding

COLORADO RIVER CUTTHROAT TROUT (MIS AND SENSITIVE)

Colorado River cutthroat trout (CRCT) is one of three subspecies of cutthroat native to Utah. The species is restricted to the upper Colorado River drainage. CRCT occur in headwater streams and mountain lakes of the Uinta, La Sal, and Abajo Mountains, the Tavaputs Plateau, and the Escalante and Fremont River drainages (Bosworth 2003); pure strains occur predominantly in isolated headwater streams at high elevation (Behnke 1992, UNHP 2007). Two-thirds of all occupied habitats occur on National Forest lands (Hirsch et al. 2006).

CRCT were petitioned for listing under the Endangered Species Act in December 1999; the US Fish and Wildlife Service (USFWS) determined that listing was not warranted in April 2004 and in June of 2007. A status review was completed by the CRCT Conservation Team in 2005 (Hirsch et al. 2006). A Conservation Agreement and Strategy were signed in 2006. According to these documents, the current distribution of CRCT primarily in isolated headwater streams and lakes has been limited by the widespread introductions of non-native salmonids. The Conservation Assessment states that most conservation populations of CRCT are isolated but there are ongoing restoration efforts to create metapopulations.

CRCT were thought to have been extirpated from streams as far south as the Escalante River drainage until a remnant population was found in the East fork of Boulder Creek on the Escalante Ranger District in the 1980s. Subsequent surveys in the 1990s identified five populations of CRCT occupying approximately 8.2 miles of Escalante River tributary streams on the Dixie National Forest (Hepworth et al. 2001). Currently, CRCT occupy an estimated 27 miles of stream habitat and approximately 19 acres of lentic habitat (lakes/reservoirs) on the Escalante Ranger District (Hadley et al. 2008).

Within the 23,000 acres of suitable fisheries habitat on the Dixie National Forest, 4,849 acres on the Escalante Ranger District is mapped as occupied habitat for Colorado cutthroat trout and 183 acres on the Escalante Ranger District is mapped as potential (unoccupied) habitat.

BONNEVILLE CUTTHROAT TROUT (MIS AND SENSITIVE)

Bonneville cutthroat trout (BCT) is one of three subspecies of cutthroat trout native to Utah. It occurs in streams and lakes of the Bonneville Basin and a limited portion of the Virgin River Drainage (Hepworth et al. 1997; Bosworth 2003). BCT historically occupied most water bodies with suitable habitat within the Bonneville Basin, including portions of Utah, Nevada, Idaho, and Wyoming (USFWS 2001). In general, habitat is variable, ranging from high elevation streams with coniferous and deciduous riparian trees to low elevation streams in sage-steppe grasslands containing herbaceous riparian zones (Rodriguez 2008 and UNHP 2007). Regardless of habitat, BCT require a functional stream riparian zone that provides structure, cover, shade, and bank stability (UNHP 2007). This subspecies does relatively well in marginal habitats and has also been found in warmer, turbid water where non-native trout cannot survive (Behnke 1992).

Most populations are found in the headwater streams and high-elevation river reaches of drainages entering the Bonneville Basin at its east and southeast edge; small populations occur in perennial streams in the Deep Creek Mountains and in a few headwater streams of the Virgin River drainage in the Pine Valley Mountains (Hepworth et al. 1997; Bosworth 2003; Hepworth et al. 2003; Hadley et al. 2011). The USFS owns the vast majority (over 90 percent) of the land containing BCT in the Southern Geographic Unit (Sevier River Basin) on the Dixie and Fishlake National Forests (USFWS 2001).

BCT were petitioned for listing under the Endangered Species Act in February 1998. A range-wide Conservation Agreement and Strategy for BCT was published in 2000. A status review for BCT was completed in 2001 (USFWS 2001) and the petition for listing was found not warranted in October 2001.

On the Dixie National Forest, BCT remnant populations were found in Reservoir Canyon and Water Canyon within the Santa Clara River drainage in the 1970s. The Santa Clara drainage lies within the Virgin River Basin, which is outside what was thought to be the range of BCT; however, records from early pioneers indicate that cutthroat trout were common in the Santa Clara. That along with geological evidence supports the hypothesis that Grassy Creek may have been captured from the Bonneville Basin into the Virgin River Basin approximately 2,000 years ago making these two populations true remnants (Hepworth et al. 1997, Hadley et al. 2011). By 1995 two additional remnant populations had been found on the Dixie National Forest in Deep Creek and Ranch Creek, both of which drain into the East Fork Sevier River.

In addition to these four remnant populations, 14 tributaries on the Dixie National Forest have been renovated with pesticides or had BCT reintroduced to them. In the 2002 flooding, ash flows and debris flows following the Sanford fire extirpated the remnant population in Deep Creek, as well as another reintroduced population in Left Fork Sanford Creek. That same year, flooding, ash flows, and debris flows following the Sequoia Fire severely degraded BCT habitat in streams along the east side of the Pine Valley Mountains. Since then BCT have been reintroduced to Deep Creek, Mill Creek, Leap Creek, Harmon Creek, and South Ash Creek. The Deep Creek population has received several transfers from Ten Mile Creek on the Fishlake National Forest, where BCT salvaged from Deep Creek after the Sanford fire was reintroduced. Sampling in 2009 indicated that both the distribution and abundance of BCT is improving and that some reproduction and recruitment has occurred (Hadley et al. 2010).

Fire impacts have affected the current distribution of BCT on the Dixie National Forest. In addition, many of the streams containing BCT on the Forest have areas of marginal habitat, which cause fluctuations in the amount of occupied habitat between sampling efforts based on variations in climate conditions. Currently, conservation populations of BCT occupy 37.6 miles (60.9 km) of stream on the Forest, with their maximum distribution in these streams since the 1970s being 56.7 miles (90.2 km; Hadley et al. 2010, Hadley et al. 2011).

Within the 23,000 acres of suitable fisheries habitat on the Dixie National Forest, mapped suitable occupied habitat for Bonneville cutthroat trout includes 8,032 acres on all four ranger districts. Half the mapped, occupied Bonneville cutthroat trout habitat occurs on the Pine Valley Ranger District (4,110 acres). The 23,000 acres also includes potential (unoccupied) habitat for Bonneville cutthroat trout, which occurs on the Cedar City (1,987 acres) and Powell (6,205 acres) Ranger Districts.

SOUTHERN LEATHERSIDE (MIS AND SENSITIVE)

The southern leatherside is a small desert fish endemic to streams in the southern and eastern Bonneville Basin. Southern leatherside was formerly known as leatherside chub, which was split into two unique species, the northern and southern leatherside. Some information below pertains to leatherside chub and some is specific to the southern leatherside (the following taken from the Conservation Agreement for Southern Leatherside in Utah: UDWR 2010).

Southern leatherside require flowing water and do not persist in lakes or reservoirs. Occupied streams have a high variability of stream flow, annual precipitation, gradient, elevation, conductivity, and pH. Microhabitat variables associated with leatherside chub include low water velocities (2.5-45 cm/sec), intermediate water depths (25-65 cm), and low percent composition of sand-silt or gravel substrates. Adult and juveniles utilize the main channel of streams more often than off-channel habitats, although the presence of brown trout may shift habitat use. Southern leatherside occur in streams with a broad range of temperatures and have habitat requirements of healthy riparian vegetationand intact streambanks (UDWR 2010).

On the Dixie National Forest, Southern leatherside have been documented in two 4th-level HUCs (Hydrologic Unit Codes): the Upper Sevier and East Fork Sevier, since 1994. Within these HUCs, southern leatherside are known to occur in the mainstem of the Sevier River and the East Fork Sevier River downstream from Tropic Reservoir. Southern leatherside historically occupied almost the entire East Fork Sevier River; however their current distribution on the Powell Ranger District is limited to 5.0 miles of the East Fork Sevier River immediately downstream from Tropic Reservoir.

Tributaries known to contain southern leatherside on the Dixie Natinoal Forest include: Threemile Creek, Bear Creek, Panguitch Creek, Butler Creek, and Clay Creek (UDWR 2010). Recent survey efforts by UDWR and Dixie National Forest personnel indicate that southern leatherside is no longer present in Asay Creek, East Fork Sevier River upstream from Tropic Reservoir, or Mammoth Creek (Morvilius and Fridell 2004a, Bennion 2009a, Bennion 2009b, Golden and Mecham 2010a). Additionally, UDWR and Dixie National Forest surveys indicate that southern leatherside may have been extirpated from Clay Creek by a large flood event in 2008 (Morvilius and Fridell 2004b, UDWR 2009, Golden and Mecham 2010b). Prior to the extirpation of this population, the Dixie National Forest had 23.2 miles of stream occupied by southern leatherside; however, without this population occupied stream mileage is reduced to 20 miles. There are approximately 41.1 miles of potential historical habitat for southern leatherside on the Dixie National Forest.

Within the 23,000 acres of suitable fisheries habitat on the Dixie National Forest, suitable occupied habitat for southern leatherside includes 1,115 mapped acres on the Cedar City Ranger District (Bear Creek, Panguitch Creek, and Threemile Creek) and 433 mapped acres on the Escalante Ranger District (Clay Creek).

BOREAL TOAD

The boreal toad subspecies of the western toad (*Anaxyrus boreas*) is found from coastal Alaska south through British Columbia, western Alberta, Washington, Oregon, and northern California, and east through Idaho, western Montana, Wyoming, Nevada, the mountains of Utah and Colorado, and extreme northern New Mexico (USFWS 2005). The boreal toad within Utah and the Dixie National Forest is not part of the Southern Rocky Mountain Distinct Population Segment that was Candidate for Listing until 2005. There is some evidence, however, that the

Paunsaugunt Plateau population of boreal toad in southern Utah is genetically distinct (Goebel 2005; Hogrefe 2001; Keniath and McGee 2005; Goebel et al. 2009; Switzer et al. 2009).

A Conservation Plan for boreal toad in the State of Utah was published in November 2005 (UDWR 2005b). Cooperating agencies include UDWR, USFS, USFWS, BLM, Bureau of Reclamation, and the Utah Reclamation Mitigation and Conservation Commission.

Western toads are found in a variety of habitats such as desert springs and streams, meadows and woodlands, and in and around ponds, lakes, reservoirs, and slow-moving rivers and streams. Breeding areas are typically shallow water areas at the edges of ponds, or lakes, stream or river edges with slow-moving water, or other flooded or ponded areas (Keinath and McGee 2005). After breeding, western toads move to more terrestrial habitats and eventually to hibernacula that may be a substantial distance from the breeding site (up to 2.5 km, but usually much less; Keinath and McGee 2005). Western toads dig a burrow in loose soil or use burrows of small mammals (Groves et al. 1997) and remain in hibernation until the following spring.

Occupied wetlands in Utah are surrounded by a variety of upland vegetation communities, including sagebrush and grassland, pinyon-juniper, mountain shrubs, and coniferous forest. Extensive observations of upland and winter habitat use in Utah have not been completed. However, toads have been observed using small mammal burrows in drier upland areas. Breeding habitats in Utah include low velocity, low gradient streams, off channel marshes, beaver ponds, small lakes, reservoirs, stock ponds, wet meadows, seeps, and associated woodlands. Hibernacula in Utah have not been described. As of 2005, only one hibernaculum was discovered in the Paunsaugunt Plateau (UDWR 2005b).

UDWR inventories of boreal toads in southern Utah from 1994 to 1998 reported toads on the Dixie National Forest from seven beaver dam complexes built on the East Fork Sevier River, Left Fork Kanab Creek, and Tropic Reservoir (UDWR 2000b). In recent years, however, breeding activity in this area appears to be limited to only a few beaver ponds on the East Fork Sevier River upstream from the Mill Creek confluence and along the Left Fork of Upper Kanab Creek (Mike Golden, Fish Biologist, Dixie National Forest, Personal Commuication 22 March 2010). Boreal toads are also found in and around the Boulder Mountain area (UDWR 2000b), which is north of the Escalante Ranger District (see Goates et al. 2007).

Suitable mapped habitat for boreal toad includes three areas within two Level 6 (HUC 12) subwatersheds on the Powell Ranger District (50,000 total acres; Table 3.7-7). Suitable habitat also occurs on the Cedar City and Escalante Ranger Districts but is not mapped on either District and there are no historical records on the Cedar City Ranger District.

3.6.3.2 Mammals

Mapped acres of sensitive mammal habitat on the Dixie National Forest are summarized in Table 3.6-8.

Table 3.6-8 Acres of Mapped Sensitive Mammal Habitat on the Dixie National Forest

	Pine Valley	Cedar City	Powell	Escalante	TOTAL[1]
Pygmy rabbit habitat	16,302	10,822	25,097	8,532	60,752
Sensitive bat habitat	635	290	684	852	2,461

[1] May not add up exactly due to rounding

PYGMY RABBIT

Pygmy rabbits are small, secretive rabbits that dig their own burrows. Pygmy rabbits are limited to habitat characterized by deep, friable soils and tall (often greater than six feet), dense sagebrush, which provides both food (95% of the diet) and cover. Burrows are usually located on slopes at the base of sagebrush plants. There is one known location of pygmy rabbit on the Dixie National Forest, located on the west edge of Mount Dutton on the Powell Ranger District. Over 60,000 acres of suitable habitat occurs across all four ranger districts (Table 3.6-8; Figure 3.6-2) and pygmy rabbits could be present in many other areas. Historic (pre-1983) records exist in several areas of the Dixie National Forest (Bosworth 2003).

TOWNSEND'S BIG-EARED BAT

Townsend's big-eared bat is one of the most common bat species in Utah, roosting in a variety of desert and forest communities at elevations between sea level and 10,000 feet elevation. Roosts occur in caves, rocky outcrops, old buildings, and mine shafts (Rodriguez 2008). In winter, both sexes hibernate in mines or caves, either alone or in small groups. In a survey of 820 potential roosting sites in northern Utah, abandoned mines and caves with small to midsize openings located at low to mid-elevations, in areas dominated by sagebrush, grassland, juniper woodlands, or mountain brush communities were most likely to be occupied by big-eared bats (Sherwin et al. 2000). Several individuals were located and monitored on the Dixie National Forest from 1997 to 2001. Mammoth Cave and Bower's Cave (Cedar City Ranger District) are known to be hibernacula sites for the species from October to February. Mammoth Cave and Bower's Cave are administratively closed to the public during winter and spring (October 1 – April 1) to protect hibernating bats (Section 3.8). Almost 2,500 acres of potential habitat for sensitive bats occur on all four ranger districts of the Dixie National Forest (Table 3.6-8; Figure 3.6-2). The largest concentrations of habitat occur in the Pine Valley Mountains (Pine Valley Ranger District), Cedar Breaks and Vermillion Castle areas (Cedar City Ranger District), Sunset Cliffs and Sevier Plateau (Powell Ranger District), and the Box Death Hollow Wilderness (Escalante Ranger District).

SPOTTED BAT

Spotted bats occur in a wide variety of habitats, including ponderosa pine (*Pinus ponderosa*) forests, pinyon/juniper woodlands, canyon bottoms, open pastures, and hayfields. Limited observations indicate that spotted bats roost in relatively remote and undisturbed areas, typically in rock crevices located high on steep rock faces in limestone or sandstone cliffs (Rodriguez 2008). Spotted bats forage primarily over dry, open coniferous forest (Groves et al. 1997). Migration patterns are poorly understood, but populations from lower elevation habitats apparently do not migrate. Surveys conducted on six sites on the Dixie National Forest in 1994 resulted in documented occurrence on the Cedar City Ranger District (Rodriguez 2008). Potential habitat for sensitive bats occurs on all four ranger districts of the Dixie National Forest (Table 3.6-8; Figure 3.6-2).

BIGHORN SHEEP

Desert bighorn sheep were added to the Region IV Sensitive Species List on July 29, 2009 (USFS 2011a). Desert bighorn sheep are native to southern Utah and mainly inhabit the southeastern part of the state (UNHP 2007). Significant populations occur across the Colorado Plateau and throughout the Colorado River (UDWR 2000c). Some native herds of desert bighorn sheep were nearly extirpated following pioneer settlement (UDWR 2008c), and desert bighorns were reintroduced to Utah in 1973 (in Zion National Park). The most recent population estimate (2008) for desert bighorns in Utah is 3,100 sheep (UDWR 2008c). Desert bighorn

sheep prefer open, rocky habitat types with adjacent steep areas for escape and safety, such as rugged canyons, gulches, talus cliffs, steep slopes, mountaintops, and river benches. Several unconfirmed sightings of desert bighorn sheep have been made on the Dixie National Forest in the past several years. These individuals have likely dispersed from populations in Canyonlands, Grand Staircase Escalante National Monument, BLM-administered lands in the Virgin River Gorge, or Zion National Park. Suitable habitat exists on the Dixie National Forest. However, the Forest has not mapped suitable habitat for bighorn sheep due to lack of data for this species.

3.6.3.3 Birds

Mapped acres of sensitive bird habitat on the Dixie National Forest are summarized in Table 3.6-9.

Table 3.6-9 Acres of Mapped Sensitive Bird Habitat on the Dixie National Forest

	Pine Valley	Cedar City	Powell	Escalante	TOTAL[1]
Goshawk nest areas	1,470	26,303	17,728	17,831	63,331
Goshawk PFAs	2,195	35,637	24,975	21,530	84,337
Peregrine falcon nest areas	0	9,754	8,101	0[2]	17,855
Peregrine falcon rim habitat	65,884	40,461	102,930	232,022	441,298
Bald eagle winter concentration areas	3,612	4,173	1,744	1,736	11,265
Flammulated owl habitat	37,497	162,624	75,707	144,712	420,541

[1] May not add up exactly due to rounding

[2]One eyrie has recently been found on the Escalante Ranger District. Baseline acres reflect the original nest area as the impacts determination would not change with this addition.

NORTHERN GOSHAWK (MIS AND SENSITIVE)

Northern goshawks inhabit montane coniferous and deciduous woodland in the West, nesting in stands of intermediate to high canopy-closure with a thin understory, interspersed with small openings, fields, or wetlands. Important internal components of forests where goshawks nest in Utah include snags, multiple canopies, and down woody debris. In southern Utah, goshawks are most often associated with mature to old growth stands of Engelmann spruce (*Picea engelmannii*) and subalpine fir (*Abies lasiocarpa*), followed by aspen (*Populus tremuloides*; Graham et al. 1999). Goshawks generally nest in large trees adjacent to open flight corridors; they appear to prefer north to east aspects as well as flat to moderately sloped land for nest sites because stands are typically denser (Shuster 1980 and Weber 2006). Nesting activity on the Dixie National Forest generally ranges from 20 to 30 nests annually (Rodriguez 2008). Buffered (radius = 0.5 mile) nest areas total over 63,000 acres on all four ranger districts, and Post Fledgling Areas (PFAs) total 84,337 acres (Table 3.6-9; PFAs shown in Figure 3.6-2). Active goshawk territories and goshawk production appear to be linked to precipitation data on the Dixie National Forest; the increase in goshawk activity in 2004, for example, coincides with the end of a prolonged five-year drought (USFS 2004d). In 2005, 39 territories were considered occupied and 36 were active (USFS 2005a). In 2006, 50 territories were occupied and 42 were active (USFS 2006c). In 2007 58 territories were occupied and 46 were active (USFS 2008b).

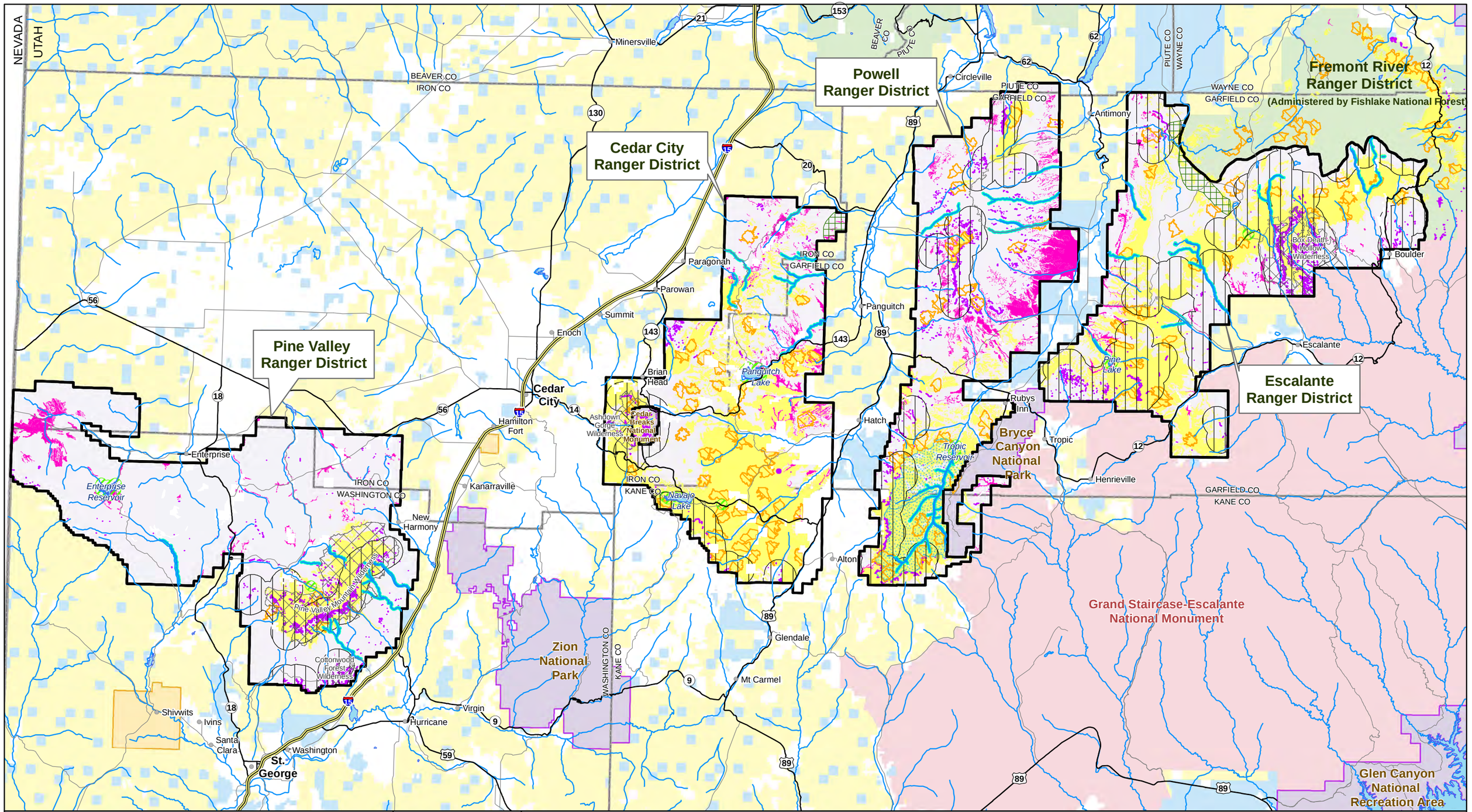
In 2008 41 territories were occupied and 28 were active (USFS 2009b). In 2009 47 territories were occupied and 26 were active (USFS 2010c). The most recent monitoring report lists 162 existing goshawk territories (USFS 2011b).

PEREGRINE FALCON

Peregrine falcons occupy a wide variety of open habitats. They forage wherever prey concentrate, usually along marshes, streams, and lakes within a 10-mile radius of the nest (Rodriguez 2008). Marshes, croplands, meadows, river bottoms, and lakes that support good populations of small- to medium-sized terrestrial birds, shorebirds, and waterfowl are important hunting sites. Cliffs are preferred nesting sites, although nests also occur on river banks, tundra mounds, stick nests of other species, tree cavities, and man-made structures (USFS 2003a:E-76). No Forest-wide surveys have been conducted on the Dixie National Forest. However, 14 nest sites are known on the Forest, and numerous sightings have occurred within the Forest boundary. Peregrine nest areas (with 0.5-mile buffer) total aboutt 18,000 acres on the Cedar City and Powell Ranger Districts (Table 3.6-9). In addition, one eyrie has recently been located on the Escalante Ranger District (Table 6.4-5; see footnote). Over 440,000 acres of mapped "rim" habitat for both peregrine falcon and California condor (Endangered; see Section 3.6.2.1) occurs across all four ranger districts (Table 3.6-9; Figure 3.6-2).

BALD EAGLE

Bald eagles occur in Utah generally on a migratory or wintering basis. Bald eagles are opportunistic predators, especially in winter, when they will feed on any available fish, waterfowl, small mammal, or carrion. Bald eagles tend to concentrate wherever food is available, roosting in large groups in forested stands that provide protection from harsh weather. They may also winter in upland habitats, feeding on small mammals and deer carrion. Marginal roosting habitat is available on the Dixie National Forest wherever large trees occur along bodies of water. Bald eagles typically occur on the Dixie National Forest during late winter (winter residents) or during fall and spring months (thought to be northern migrants). There is one known bald eagle nesting territory on the Dixie National Forest, located on the Cedar City Ranger District near Panguitch Lake. It is expected that more bald eagles will nest on the Dixie National Forest in the future. A nesting bald eagle has also been recorded near the town of Teasdale (off the Forest), on private land (Rodriguez 2008). Generally, when water bodies freeze in late fall or early winter, eagles on the Dixie National Forest move down in elevation to forage off the Dixie National Forest (Rodriguez 2008). Potential bald eagle wintering sites on the Dixie National Forest include Enterprise Reservoir and Pine Valley Reservoir (Pine Valley Ranger District); Duck Lake, Navajo Lake, and Panguitch Lake (Cedar City Ranger District; Panguitch Lake is also a nesting site); Tropic Reservoir (Powell Ranger District); and Pine Lake and Posey Lake (Escalante Ranger District). A total of 11,265 acres of winter concentration areas are mapped across the Dixie National Forest (Table 3.6-9; Figure 3.6-2). Intensive monitoring of four geographic areas within the Dixie National Forest has occurred since 1996, including Panguitch Lake, Pinto Creek, Enterprise Reservoir, and Duck Creek. The greatest number of bald eagle sightings generally occurs at Panguitch Lake; trends on the Dixie National Forest are stable (Rodriguez 2008).



Oil & Gas Leasing EIS on Lands Administered by the Dixie National Forest

FIGURE 3.6-2
Sensitive Wildlife Species Habitat

Horizontal Datum = NAD 83 Coordinate System = Zone 12N	1:590,000	1 in = 9 miles

Legend

- Cities
- Freeways
- Highways
- Minor Roads*
- Major Streams & Rivers
- Water Bodies
- County Boundaries
- State Boundaries

National Forest System Lands

- Dixie National Forest
- Wilderness Areas
- Fishlake National Forest

Other Land Administration

- Bureau of Land Management
- GSENM**
- National Park Service
- Private
- State of Utah
- Tribal

Special Status Wildlife Habitat

- Bald Eagle Winter Concentration Areas
- Condor/Peregrine Falcon Rim Habitat
- Flammulated Owl Habitat
- Greater Sage Grouse Brood-Rearing Habitat
- Pygmy Rabbit Habitat
- Sensitive Bats, Potentially Suitable Habitat
- Boreal Toad Habitat

Fisheries Habitat***

- 500-foot buffer

Northern Goshawk

- Protected Fledgling Area

Miles: 0 4 8 12 16

Original data was compiled from multiple source data and may not meet the U.S. National Mapping Accuracy Standard of the Office of Management and Budget. For specific dates and/or additional digital information, contact the Forest Supervisor, Dixie National Forest, Cedar City, Utah. This map has no warranties to its contents or accuracy.

*Not all roads are shown. Only some roads are depicted for orientation purposes.
**Grand Staircase-Escalanted National Monument. Managed by the Bureau of Land Management.
***Streams and lakes occupied and suitable for Bonneville Cutthroat Trout, Colorado River Cutthroat Trout, Leatherside Chub, and Virgin River Spinedace.

FLAMMULATED OWL

Flammulated owls inhabit montane forest, specifically mature and old growth ponderosa pine and Douglas-fir habitats with open stand structure. This species typically nests in large cavities made by woodpeckers and feeds on nocturnal arthropods (USFS 2003a:F-73). Flammulated owls have a low reproductive rate, with a large variation in adult survival. Timber harvesting can have negative impacts on flammulated owls if large old trees, open stand structure, and somedense vegetation for roosting are not retained (McCallum 1994). Flammulated owl surveys have been conducted on the Dixie National Forest, which detected flammulated owls within all four ranger districts. The areas where detections were most concentrated occurred within the Paunsaugunt Plateau (Powell Ranger District) and the Aquarius Plateau (Escalante Ranger District). Suitable nesting habitat exists throughout the high-elevation forested areas of the Dixie National Forest (USFS 1995b) and covers 420,541 acres (Table 3.6-9; Figure 3.6-2).

THREE-TOED WOODPECKER

Northern three-toed woodpeckers are primarily associated with dense subalpine fir and Engelmann spruce forests at high elevations. Mature to old-growth stands are preferred due to an abundance of insect prey in large snags and downed woody debris. Three-toed woodpeckers excavate their own nest cavities in snags or occasionally in live trees. Nests are found in cavities located 5 to 12 feet above the ground in dead spruce, tamarack pine (*Larix* spp.), cedar (*Thuja* spp.), and aspen trees (Rodriguez 2008). Up to 75 percent of their diet consists of wood-boring beetles and caterpillars that attack dead or dying conifers (USFS 2003a:F-80). Populations have been shown to increase in some areas three to five years after forest fires, presumably in response to spruce beetle outbreaks (Koplin 1969). Formal surveys for three-toed woodpecker have been conducted on the Dixie National Forest and woodpecker habitat is present in all ranger districts. Three-toed woodpecker surveys have not yet been conducted on suitable habitat in the Pine Valley Ranger District; however, woodpeckers are expected to occur there. A total of 131 detections on Cedar City, Powell, and Escalante have been documented since 1996 and the numbers of individuals are increasing presumably due to the increase of spruce bark beetle infestations. In the Cedar City Ranger District, seven three-toed woodpeckers were detected at six calling points in both 1999 and 2000 near Brian Head Ski Area in association with a field ecology course (Rhett Boswell, UDWR, Personal Communication; via Nate Yorgason, Wildlife Biologist, Dixie National Forest). Three-toed woodpeckers have also been detected consistently on the Breeding Bird Survey Route #85020 (Navajo Lake). An average of five woodpeckers was detected each year along this route from 2000 to 2004. Since then, detections have dropped off considerably due to the spruce beetle epidemic having run its course. In the Escalante Ranger District, two nests were found along Barney Top northwest of the Table Cliff Plateau and individuals have been detected east of Antimony Creek.

3.6.3.4 Plants

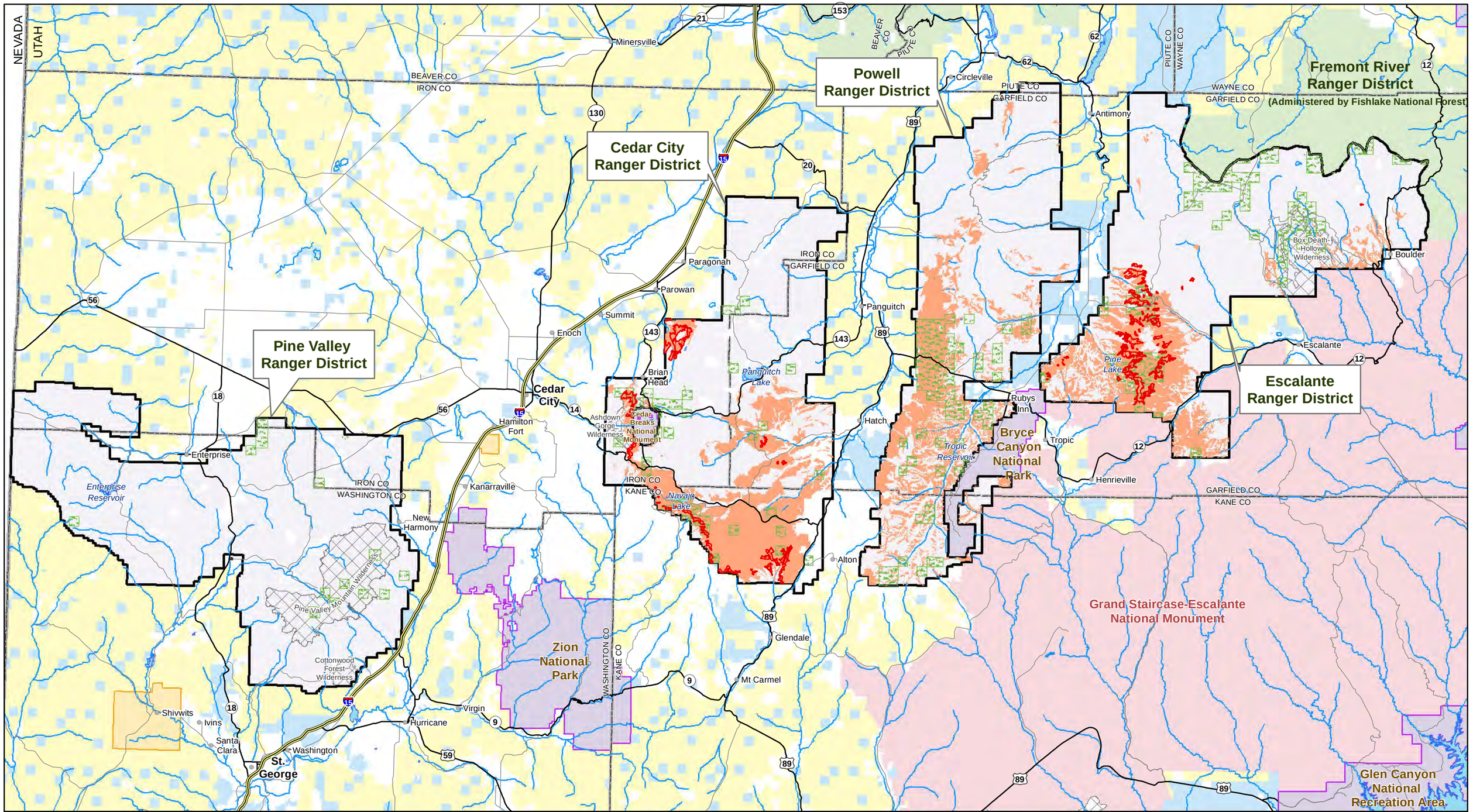
There are over 125,000 acres of sensitive plant habitat (including occurrences) mapped on the Dixie National Forest, spread across all four ranger districts (Table 3.6-10). This GIS coverage includes habitat for Threatened and Endangered species also, although no listed plants occur on lands administered by the Dixie National Forest.

Table 3.6-10 Acres of Mapped Sensitive Plant Habitat on the Dixie National Forest

	Pine Valley	Cedar City	Powell	Escalante	TOTAL[1]
Sensitive (and TES) plant habitat	9,908	19,718	43,718	51,664	125,009

[1] May not add up exactly due to rounding

There are 24 sensitive plants that are known or suspected to occur on the Dixie National Forest (Table 3.6-11). Half of these species occur on Claron (Wasatch) Limestone or within rock garden and bristlecone pine communities (Figure 3.6-3), which are underlain by the Claron Limestone Formation. Claron Limestone is widespread on the southern Cedar City, central Powell, and southern Escalante Ranger Districts (Figure 3.6-3) and is associated with the following sensitive plants: Navajo Lake milkvetch, Table Cliff milkvetch, Reveal paintbrush, yellow-white catseye, Cedar Breaks biscuitroot, Widtsoe wild buckwheat, Neese's pepperplant, Paria breadroot, Red Canyon beardtongue, Podunk goundsel, Peterson catchfly, and rock tansy (Table 3.6-11).



Oil & Gas Leasing EIS on Lands Administered by the Dixie National Forest

FIGURE 3.6-3
Threatened, Endangered & Sensitive Plant Species Habitat

Horizontal Datum = NAD 83 Coordinate System = Zone 12N	1:590,000	1 in = 9 miles

Legend

- Cities
- Freeways
- Highways
- Minor Roads*
- Major Streams & Rivers
- Water Bodies
- County Boundaries
- State Boundaries

National Forest System Lands

- Dixie National Forest
- Wilderness Areas
- Fishlake National Forest

Other Land Administration

- Bureau of Land Management
- GSENM**
- National Park Service
- Private
- State of Utah
- Tribal

Threatened, Endangered & Sensitive Plant Species Habitat

- Bristlecone Pine & Rock Gardens
- Claron Sandstone Formation
- Threatened, Endangered & Sensitive Plants

0 4 8 12 16 Miles

N

Original data was compiled from multiple source data and may not meet the U.S. National Mapping Accuracy Standard of the Office of Management and Budget. For specific dates and/or additional digital information, contact the Forest Supervisor, Dixie National Forest, Cedar City, Utah. This map has no warranties to its contents or accuracy.

*Not all roads are shown. Only some roads are depicted for orientation purposes.
**Grand Staircase-Escalanted National Monument. Managed by the Bureau of Land Management.

Table 3.6-11 Sensitive Plant Species on the Dixie National Forest

Species[1]	Description[1]	Habitat[1]	Dixie National Forest Occurrence[1]
Dana's milkvetch	perennial herb; yellow-white flowers with purple tips open April-May	washouts, gravelly loam soil; 7,000-9,200 feet	Escalante Ranger District: Henry Mountains and Aquarius Plateau
Navajo Lake milkvetch	perennial herb; yellow-white or pinkish purple flowers open June-Aug	steep slopes with clay soils, loose rock; assoc with bristlecone pine on pink Wasatch Limestone and along terrace below high water mark at Navajo Lake; 8,800-10,500 feet	Cedar City Ranger District
Table Cliff milkvetch	perennial herb; pink-purple flowers open June-Aug	steep, unstable limestone slopes on pink Wasatch Limestone; 9,200-10,170 feet	Escalante Ranger District: Table Cliff Plateau
Guard milkvetch	perennial herb; pink-purple or pale flowers open April-July	assoc with pinyon-juniper, mountain mahogany, and oak-Garrya; 5,000-8,200 feet	Pine Valley Ranger District: Pine Valley Mountains
Peculiar moonwort	succulent; spike-like; cluster of sporangia have frosted, glaucous coloration	wet meadow, along intermittent draws, grassy fields on south-facing slopes; at about 10,800 feet	Escalante Ranger District: near Cyclone Lake on the Aquarius Plateau and near Jacobs Valley
Aquarius paintbrush	perennial herb; yellow inflorescence; "flowers" open June-Aug	silver sage meadows or cobbled rocky areas; 9,150-10,500 feet	Escalante Ranger District: top of Boulder Mountain and Aquarius Plateau
Tushar paintbrush	perennial herb; purple-fringed, green bracts; rarely purple; "flowers" open June to Aug	alpine meadows and talus slopes above timberline; tertiary igneous rockbeds sandy gravel; 10,000-12,000 feet	Cedar City Ranger District (suspected)
Reveal paintbrush	perennial herb; magenta to rose bracts; "flowers" open mid-June to mid-July	assoc with bristlecone and ponderosa pine; heavy clay soils from pink Wasatch Limestone; west to southwest-facing slopes; 7,800-8,500 feet	Cedar City and Powell Ranger Districts
Yellow-white catseye	perennial herb; pale yellow flowers open May-late June	dry, open sites on southern, warm slopes; pink Wasatch Limestone; 6,500-9,000 feet	Powell and Escalante Ranger Districts
Cedar Breaks	perennial; flowers pink	assoc with bristlecone,	Cedar City Ranger

Species[1]	Description[1]	Habitat[1]	Dixie National Forest Occurrence[1]
biscuitroot	or pale purple with white margins open July-Aug	ponderosa pine, and spruce fir; Wasatch Limestone; 8,000-10,400 feet	District
Creeping draba	perennial mustard; yellow flowers open July-Aug	igneous gravels and talus in alpine tundra or spruce-fir; 10,000-12,000 feet	Cedar City Ranger District (suspected)
Widtsoe wild buckwheat	perennial herb; yellow flowers open late May - June	dry, open ridgetops; pink Wasatch Limestone; 7,500-9,000 feet	Powell and Escalante Ranger Districts
Pine Valley goldenbush	woody shrub; yellow disk flowers open Aug	moderately open areas assoc with ponderosa pine, manzanita, fir, and aspen; 5,970-9,200 feet	Pine Valley Ranger District
Jones golden-aster	perennial herb; yellow ray flowers open May-Sep	on sandstone or in sand on south and west-facing slopes; 4,000-9,400 feet	Escalante Ranger District: Hell's Backbone Road and within Death Hollow Wilderness Area
Zion jamesia	woody shrub; white flowers open June-early Aug	assoc with pinyon-juniper, oak, and ponderosa pine; cliffsides, hanging gardens; 4,200-6,000 feet	Cedar City Ranger District: Kolob Terrace
Neese's pepperplant	perennial herb; white flowers open May-early June	dry, sandy sites, mostly open with little cover; pink and white Wasatch Limestone and Navajo Sandstone; 7,300-9,000 feet	Escalante Ranger District
Paria breadroot	perennial herb; cream to yellow-white flowers with purple open June-July	ponderosa pine or pinyon-juniper; calcerous or sandy soils on Wasatch Limestone, Navajo Sandstone, and Quaternary alluvium; 5,500-8,000 feet	Powell Ranger District (suspected)
Red Canyon beardtongue	perennial herb; blue to violet flowers open May-early June	pine needle duff on clay loam soils of calcerous, gravelly slopes and rock slides along pink Wasatch Limestone; 6,900-8,300 feet	Powell Ranger District: Bryce Canyon and Red Canyon
Little (aquarius) penstemon	perennial herb; blue flowers open June-Aug	assoc with sagebrush-grass, pinyon-juniper, and spruce; tertiary volcanic gravels in sandy, gravelly loam; 8,200-11,500 feet	Escalante Ranger District: Aquarius Plateau between Cyclone and Big Lake
Pinyon penstemon	perennial herb; blue-violet flowers open May-	pinyon-juniper; gravelly soils and volcanic	Pine Valley Ranger District: Pine Valley

Species[1]	Description[1]	Habitat[1]	Dixie National Forest Occurrence[1]
	early June	rubble of foothills; 5,620-6,700 feet	Mountains
Arizona willow	small perennial shrub; young stems are bright red; catkins have brown to black pubescent scales	wet meadows, streamsides, and cienegas on volcanic soils; above 8,500 feet	Cedar City and Powell Ranger Districts: Sidney Valley, Rainbow Meadows, and East Fork Sevier River
Podunk goundsel	perennial herb; yellow discoid flowers open June-Aug	assoc with bristlecone pine, spruce, fir, other conifers; talus slopes of Claron Limestone; 8,000-10,000 feet	Cedar City, Powell, and Escalante Ranger Districts: Markagunt and Paunsaugunt Plateaus and Canaan Mountain
Peterson catchfly	perennial herb; bright pink flowers open late July-Aug	assoc with ponderosa pine, aspen, and spruce-fir; open calcerous limestone and igneous gravels; 7,000-11,200 feet	Cedar City, Powell, and Escalante Ranger Districts
Rock tansy	perennial herb; yellow flowers open in July	occurs with bristlecone pine on exposed slopes of Cedar Breaks Limestone; 5,000-7,800 feet	Powell Ranger District Garfield County only

[1] Information taken from Rodriguez 2008, UNPS 2007, Welsh et al. 1987, and USFS 1995d

3.6.4 Management Indicator Species

Management Indicator Species (MIS) are species associated with certain vegetation types that are used in the planning process to monitor certain habitats on the Dixie National Forest. MIS are selected based on five criteria: 1) the species must have a strong, but not exclusive affinity for one vegetation type; 2) the vegetation type is key habitat to the life cycle of the species; 3) the species must be sensitive to habitat alteration; 4) the species must be highly visible and in adequate numbers as to make monitoring easy; and, 5) the species must be somewhat representative of all species that utilize the vegetation type. Some MIS species are designated due the high level of interest given them by the public, including Bonneville cutthroat trout, other trout, and big game.

MIS on the Dixie National Forest include trout and other fish species (Bonneville and Colorado River cutthroat, other cutthroat, rainbow, brook, and brown trout, southern leatherside, and Virgin spinedace), mule deer, Rocky Mountain elk, northern goshawk, wild turkey, and northern flicker. MIS species are presented with associated habitats in Table 3.6-12 and described in more detail below.

Table 3.6-12 MIS Species and Associated Habitats on the Dixie National Forest

MIS	Associated habitat
Bonneville cutthroat trout	Headwater streams
Colorado River cutthroat trout	
Cutthroat trout (other spp.) *Onychorhynchus clarki*	Streams, rivers, lakes, and reservoirs
Rainbow trout Oncorhynchus mykiss	

Brook trout *Salvelinus fontinalis*	
Brown trout *Salmo trutta*	
Virgin spinedace	Streams
Southern leatherside	
Rocky Mountain Elk *Cervus canadensis*	Grass-forb, sapling to mature aspen, sapling to old growth conifer
Mule deer *Odocoileus hemionus*	Grass-forb, sagebrush, mountain brush, pinyon-juniper, sapling to mature aspen, sapling to mature conifer
Northern goshawk	Riparian trees, mature aspen, mature to old growth conifer
Northern flicker *Colaptes auratus*	Mature aspen, mature conifer
Wild turkey *Meleagris gallopavo*	Mountain brush, pole to mature aspen, mature to old growth conifer

Sources: USFS 1986; USFS 2010a

3.6.4.1 Aquatic MIS

In June 2010 the Dixie National Forest amended their LRMP to eliminate aquatic macroinvertebrate biotic condition index (BCI) as a designated MIS, eliminate the use of the BCI as a designated monitoring method, include additional fish species as aquatic MIS, and eliminate obsolete references to directives. Changes to the LRMP are listed in the Environmental Assessment (USFS 2010a).

Six out of eight aquatic MIS species are trout. In general, the key components of trout habitat include cool, clear water; deep pools and cover, typically associated with well-vegetated stream banks and large woody debris; floodplain habitat for rearing and velocity refugia; and the availability of suitable spawning gravels, which should include a minimal amount (<25%) of fine substrate less than 6.35 mm in diameter (Sigler and Sigler 1996, Harig and Fausch 2002, Chapman 1988, and Magee et al. 1996). Spawning is influenced primarily by water temperature and flow, which are influenced by latitude and elevation. Generally, the distance trout migrate to spawn is short and the post-spawning mortality rate is high (Sigler and Sigler 1996).

Lack of recent fish population data on most streams in the Dixie National Forest makes population and MIS habitat assessments difficult, as baseline data on the Dixie National Forest is still being accumulated. The UDWR was collecting the bulk of fisheries data until 2003 with little input from the Dixie National Forest. From 2003 to present, Dixie National Forest personnel have collected fish population data at various sites across the Dixie National Forest in cooperation with UDWR. Monitoring is expected to continue at 10 to 20 streams/stations per year, allowing the Dixie National Forest to revisit all major stream fisheries every four to seven years and determine population trends.

The Sanford Fire affected Cottonwood, Deep, and Deer Creeks on the Powell Ranger District and the Sequoia Fire affected several tributaries of Ash Creek on the Pine Valley Ranger District, where Bonneville cutthroat trout were located (see Section 3.6.3). Aquatic habitat condition data from 2005 indicated that surveyed streams on the Dixie National Forest where the fire occurred (i.e., Antimony, Cottonwood, Deep, Deer, Mill, and Water Canyon Creeks) were lacking invertebrate diversity by several metrics, including low total taxa richness, few

Ephemeroptera/Plecoptera/Trichoptera taxa (mayflies/stoneflies/caddisflies), virtually no longer lived taxa, low predator richness and abundance, and high dominance of relatively few taxa. Most stream sites were found to be dominated by black flies and mayflies, two taxa that tend to colonize streams after disturbances (Wisseman 2006) and monopolize resources. Surveys of Deep, Deer, and Cottonwood Creeks in 2005 found that none of the streams met Land and Resource Management Plan standards for fish and riparian habitat conditions (USFS 2005). Additional streams were surveyed in 2006 (i.e., Harmon and Leap Creeks) and similar conditions were found in the analysis (Wisseman 2007). Trout reintroductions thus far appear successful in at least Deep Creek, Mill Creek, Harmon Creek, and South Ash Creek (Section 3.6.3). Other native fish and aquatic species in these areas are recovering naturally.

BONNEVILLE CUTTHROAT TROUT

Bonneville cutthroat trout are discussed in Section 3.6.3 (Sensitive Species).

COLORADO RIVER CUTTHROAT TROUT

Colorado River cutthroat trout are discussed in Section 3.6.3 (Sensitive Species).

CUTTHROAT TROUT

Cutthroat trout have the greatest North American distribution of all western trout species (Behnke 1992) and are economically important to the fishing industry and for consumption over virtually all of their range (Rodriguez 2008). There are four subspecies of cutthroat trout in Utah, three of which are native (Sigler and Sigler 1996; UNHP 2007). Inland cutthroat occur in high mountain lakes and streams. Most cutthroat trout evolved apart from rainbow and redband trout, and lack isolating mechanisms that would allow them to live with other trout (including nonnative species) without hybridizing. Non-native trout, including rainbow, brown, and brook trout, impact native cutthroat trout primarily through hybridization (rainbow trout) and competition (brown and brook trout). As a result, cutthroat trout are often limited to small headwater streams; however, prior to the introduction of non-native fishes, cutthroat trout were found throughout streams and large river systems (Quist and Hubert 2004). In general, cutthroat trout function better than non-native species in relatively cold, high-altitude headwaters (Behnke 1992). Cutthroat trout occur on all four ranger districts of the Dixie National Forest.

RAINBOW TROUT

The native range of rainbow trout includes drainages of the Pacific coast from Alaska to Mexico. The species is not native to Utah and has been introduced to cold waters throughout the state (Sigler and Sigler 1996). Rainbow trout feed primarily on invertebrates and other fishes. Stream-resident rainbow trout are primarily drift feeders, but will also feed on the surface. Lake-resident rainbow trout are more often piscivorous (fish-eating) than stream-resident trout (Sigler and Sigler 1996). Rainbow trout spawn in the spring, similar to cutthroat trout, and as a result readily hybridize with native cutthroat trout. Because the species is popular with anglers and most Utah rainbow trout do not reproduce in the wild, the UDWR stocks millions of rainbow trout in Utah waters each year (UNHP 2007). To reproduce, rainbow trout require a high amount of dissolved oxygen in the water and temperatures between 7 and 17 ºC. Where rainbow and cutthroat trout co-exist, similarities in spawning time and location often lead to the production of rainbow-cutthroat hybrids (UNHP 2007). Rainbow trout occur on all four ranger districts of the Dixie National Forest.

BROOK TROUT

Brook trout are a coldwater char native to the eastern United States and Canada. Brook trout are more suited to high, cold lakes, and small, cold streams than either rainbow or brown trout (Sigler and Sigler 1996). As a result, they have been stocked in high mountain lakes and streams across Utah and have become established (UNHP 2007). High mountain lakes on the Boulder Mountain area of the Escalante Ranger District support popular recreation fisheries for brook trout. Brook trout are voracious feeders and are omnivorous, feeding on drifting invertebrates in streams and on zooplankton in lakes. Brook trout spawn in late fall and early winter and can successfully reproduce in a small lake with no inlet or outlet (Sigler and Sigler 1996). While brook trout will prey on native cutthroat trout, they are not usually piscivorous. Brook trout more often displace cutthroat trout populations via interference competition (Quist and Hubert 2004). Brook trout are present on all four ranger districts of the Dixie National Forest.

BROWN TROUT

Brown trout are a largely piscivorous fish native to Europe and western Asia. They were introduced to Utah prior to 1900 (Sigler and Sigler 1996). Brown trout are a highly adaptable species present in most streams and reservoirs at the foot of many mountain ranges (Rodriquez 2004). In Utah, the species has been established in many cold-water areas and is a popular sport fish (UNHP 2007). Brown trout prefer cold water with temperatures up to 26ºC, and habitat areas with boulders, cobble, logs, rootwads, and overhead cover. Although they prefer cool lakes and streams, brown trout do not normally inhabit these areas, but are present in many of the lower elevation waters that can be relatively warm and are sometimes polluted. Brown trout are more tolerant of warm water and degraded habitat than other native or non-native salmonids, and are often the only trout present in these areas. Brown trout do not hybridize with native cutthroat trout. However, brown trout exert considerable predation pressure on native cutthroat trout (Quist and Hubert 2004). Brown trout are present on all four ranger districts of the Dixie National Forest.

SOUTHERN LEATHERSIDE

Southern leatherside are discussed in Section 3.6.3 (Sensitive Species).

VIRGIN SPINEDACE

The current distribution of Virgin spinedace is within the mainstem Virgin River and eleven of its tributaries including Moody Wash and Ash Creek, which is downstream of the Dixie National Forest. The largest populations occur in the upper mainstem Virgin River above Quail Creek diversion and in drainages of the Santa Clara River and Beaver Dam Wash (UDWR 2002).

Virgin spinedace are typically found in clear, cool, swift streams that have interspersed pools, runs, and riffles. They seem to prefer pools with some kind of protection such as undercut banks, boulders or debris. In Beaver Dam Wash, for example, Virgin spinedace utilize narrow, shallow runs with large amounts of emergent vegetation, and in the North Fork of the Virgin River, they most often occupy quiet pools (UDWR 2002).

Regular UDWR population monitoring has occurred at eleven different sites for approximately 14 years. Spinedace density estimates have been highly variable over the period of record. Tributary populations such as Ash Creek are relatively susceptible to major fluctuations in population size based on flow and habitat changes. Prior to the drying of Ash Creek in summers 2007 and 2008, Virgin spinedace were found in relatively high numbers from Krom

Diversion to the Virgin River confluence (UDWR 2008b). The only confirmed presence of Virgin spinedace on the Dixie National Forest is in Moody Wash.

Within the 23,000 acres of suitable fisheries habitat on the Dixie National Forest, suitable occupied habitat for Virgin spinedace includes 786 acres on the Pine Valley Ranger District (Moody Wash).

3.6.4.2 Big game

Big game (Rocky Mountain elk and mule deer) are the most visible wildlife on the Dixie National Forest and valuable to recreation resources (Section 3.4); as such they are the focus of several leasing options and conservation measures on the Dixie National Forest, including Dixie National Forest Standards and Guidelines (USFS 1986). The area occupied by big game throughout the year and over an entire life cycle is large because many animals migrate between ranges and move long distances in search of resources or suitable habitat. The area covered by big game often includes many different habitat areas that serve as seasonal ranges, including crucial and substantial summer range, crucial and substantial winter range, and calving (elk) or fawning (mule deer) areas (Table 3.6-13). Calving and fawning areas are relatively abundant on the Dixie National Forest and thus have no associated leasing options; these areas are discussed briefly.

Table 3.6-13 Acres of Mapped Big Game Habitats on the Dixie National Forest

	Pine Valley	Cedar City	Powell	Escalante	TOTAL[1]
Big game winter range	17,967	33,156	49,587	69,759	170,468
Big game summer range	140,142	95,573	148,289	19,214	403,218
Elk calving range	0	288,695	225,521	19,214	533,429
Mule deer fawning range	394,126	364,004	326,397	316,902	1,401,429

[1] May not add up exactly due to rounding

Road density is particularly relevant to big game due to their wide-ranging movements. Road density is discussed below, followed by life history and habitat information for Rocky Mountain elk and mule deer.

ROAD DENSITY

On average, there are about 1.5 miles of road per square mile on the Dixie National Forest (USFS 2004d). However, in several subwatershed areas (6th-level Hydrologic Unit Code) of the Forest, Open Motorized Road Density (OMRD) is above the USFS (1986)-recommended threshold of two miles per square mile of habitat. Above this threshold, habitat effectiveness for big game is thought to decrease. The subwatersheds with the greatest OMRD per square mile of habitat are located in the southern and central Cedar City Ranger District (10 out of about 40 subwatersheds with greater than three miles of road per square mile of habitat) and in the southern Powell Ranger District (four out of about 35 subwatersheds with greater than three miles of road per square mile of habitat). One subwatershed on the Escalante Ranger District (Clay Creek 160300020401) is also above the threshold. These relatively densely roaded areas overlap areas of mule deer (Cedar City, Powell Ranger Districts) and elk (Escalante Ranger District) winter range as well as mule deer summer range (Cedar City, Powell Ranger Districts).

SUMMER AND WINTER RANGES

Winter range for deer and elk on the Dixie National Forest covers approximately 170,000 acres, mainly on the Escalante and Powell Ranger Districts (Table 3.6-13; Figure 3.6-4). Summer range for deer and elk covers over 400,000 acres and occurs on the Pine Valley (35%), Cedar City (25%), Powell (35%), and Escalante Ranger Districts (5%) (Table 3.6-13; Figure 3.6-4).

ROCKY MOUNTAIN ELK

Elk are migratory ungulates that formerly ranged over much of North America. In general, elk require mature, semi-open stands of deciduous and conifer forest, and dense brush understory for feeding, escape, and thermal cover. Elk habitat also includes foothills, plains, valleys, mountain meadows in summer, and travel corridors, although some elk herds do not migrate. In general, elk prefer to live within one-half mile of a water source (UDWR 2005c). Elk are herbivorous, grazing and browsing in herbaceous and brush stages of forests as well as open areas such as meadows, open parklands, and riparian areas. Major predators of elk include humans, mountain lions, and coyotes. Competition for food may occur with domestic livestock, wild horses, and mule deer (Rodriguez 2008).

Seasonal movements and calving areas: Elk usually migrate from high mountain meadows to lower elevations when snow cover increases and food becomes less available, seeking out areas within river bottoms and canyons, and lower mountain meadows. Migration between seasonal ranges generally occurs along well-established routes (USFS 1995b:23). Calving occurs in areas with available water and brushy vegetation that provides dense cover near openings and seclusion from human disturbance. Elk calving areas occur on 533,429 acres, mainly within the Cedar City (54%) and Powell (42%) Ranger Districts (Table 3.6-13). Elk calving occurs from April to June, often in aspen groves, during which time elk are sensitive to human activities. Elk have specific habitat needs for calving, and calving areas are slightly more sensitive than deer fawning areas (USFS 1995b).

UDWR population objectives: Elk herds have increased dramatically in Utah over the past 30 years, although in the past 10 years elk herds have been relatively stable (UDWR 2005c), and in recent years have declined in response to UDWR management strategies aimed at reducing the number of elk in some management units (Rodriguez 2008). Elk habitat occurs across the entire Dixie National Forest and elk are well distributed. The six herd units on the Dixie National Forest are healthy and close to objectives (UDWR 2006c). Elk herds are monitored on hunt units within all four ranger districts by UDWR. Populations that are above objectives are managed by hunting (USFS 2004d).

Oil & Gas Leasing EIS on Lands Administered by the Dixie National Forest

FIGURE 3.6-4
Big Game Habitat

Horizontal Datum = NAD 83 Coordinate System = Zone 12N	1:590,000	1 in = 9 miles

Legend

- Cities
- Freeways
- Highways
- Minor Roads*
- Major Streams & Rivers
- Water Bodies
- County Boundaries
- State Boundaries

National Forest System Lands

- Dixie National Forest
- Wilderness Areas
- Fishlake National Forest

Other Land Administration

- Bureau of Land Management
- GSENM**
- National Park Service
- Private
- State of Utah
- Tribal

Mule Deer & Rocky Mountain Elk

- Crucial Summer Range
- Crucial/Substantial Winter Range

Miles: 0 4 8 12 16

N

Original data was compiled from multiple source data and may not meet the U.S. National Mapping Accuracy Standard of the Office of Management and Budget. For specific dates and/or additional digital information, contact the Forest Supervisor, Dixie National Forest, Cedar City, Utah. This map has no warranties to its contents or accuracy.

*Not all roads are shown. Only some roads are depicted for orientation purposes.
**Grand Staircase-Escalanted National Monument. Managed by the Bureau of Land Management.

MULE DEER

Mule deer are adaptable ungulates that occur in wide variety of habitats. Mule deer occur in early- to intermediate-staged coniferous forests, desert shrublands, chaparral, and grasslands, preferring habitats with a mosaic of vegetation stages that provide cover, open areas, and water (Rodriguez 2008). Mule deer habitat is nearly always characterized by areas of thick brush or trees interspersed with small openings (UDWR 2003). Mule deer are herbivorous, grazing and browsing on new growth of shrubs, forbs, some grasses, and salt or mineral licks. Major predators of mule deer include humans, mountain lions, and coyotes. Competition for food may occur with domestic livestock, wild horses, wild pigs, and black bears (Rodriguez 2008).

Seasonal movements and fawning areas: Mule deer often migrate from lower to higher elevations in spring and summer where water and forage are more available. In winter, mule deer concentrate at lower elevations. Migration between seasonal ranges generally occurs along well-established routes (USFS 1995b:23). Fawning occurs in moderately dense shrublands and forests, dense herbaceous stands, and high-elevation riparian and mountain shrub habitats with available water and forage. Fawn production is closely tied to the abundance of succulent, green forage during spring and summer months (UDWR 2003). Deer fawning areas occur on all ranger districts of the Dixie National Forest and cover 82 percent (1,401,429 acres) of its area (Table 3.6-13). Mule deer fawning on the Dixie National Forest occurs during spring and summer, between 16 May and 1 July, during which time mule deer are sensitive to human activities and disturbance.

UDWR population objectives: Mule deer are the most important game animal in Utah (see Section 3.4, Recreation Resources). Mule deer populations have been declining for the past 30 years, due mainly to loss and degradation of habitat (UDWR 2003), although numbers in the past four years have increased (Rodriguez 2008). Mule deer habitat occurs across the entire Dixie National Forest and mule deer are well distributed. Populations have increased in all six management units on the Dixie National Forest as of 2006 (UDWR 2006c). As for elk, mule deer herds are monitored (populations estimated) on all four ranger districts by the Division of Wildlife Resources and managed by hunting (USFS 2004d).

3.6.4.3 Birds

NORTHERN GOSHAWK

Northern goshawks occur throughout the Dixie National Forest and are discussed in Section 3.6.3.

WILD TURKEY

Wild turkeys are large game birds that use distinct habitats during different periods of the year. Preferred winter habitat contains at least 50 percent mature forest, either ponderosa pine or cottonwood, depending on the subspecies of wild turkey (Merriam's and Rio Grande, both found in southern Utah). Summer and fall habitats consist of mowed hay fields, grazed pastures, glades, or open woods. Nesting habitat is varied, but hens usually nest near the edges of old fields, along trails, in hay fields, or in patches of briar or similar vegetation, and close to a source of permanent water. Nests are frequently abandoned if disturbed (Rodriguez 2008).

Large areas of high value habitat for Merriam's turkey exist in the Pine Valley Mountain Wilderness Area, in the southwest corner of the Powell Ranger District, and in the southwest portion of the Cedar City Ranger District. Critical habitat covers most of the central portion of

the Escalante Ranger District. The southwest corner of the Cedar City Ranger District also is included in a larger critical nesting area. Critical habitat for the Rio Grande subspecies is located off the Dixie National Forest between the Escalante and Powell Ranger Districts and all across the Pine Valley Ranger District (USFS 1995b:25). Wild turkeys occur on all four ranger districts of the Dixie National Forest. Numbers of both subspecies are either stable or have increased over the past 10 years. The UDWR manages wild turkey populations on the Dixie National Forest (USFS 2004d).

NORTHERN FLICKER

Northern flicker is a migratory woodpecker that excavates its nest in dead tree trunks, dead parts of live trees, or in telephone poles. Northern flickers have been found in a variety of habitats, including wooded areas with stands of dead trees, open areas, forest edges, clear-cuts, burns, agricultural lands, and residential areas. Flickers feed mainly on ants, but will consume a variety of other insects. This species migrates to the southern part of its range in the US and to northern Mexico for winter, and has also been found on Grand Cayman, Cuba, and the Nicaraguan highlands (Rodriguez 2008). Northern flickers occur on all four ranger districts of the Dixie National Forest. Approximately 112 line transects were surveyed in 2003, locating 287 northern flickers. In 2004, 110 line transects were surveyed, locating 329 flickers. The end of a five-year drought may have contributed to the flicker population increase in 2004 (USFS 2004d). In 2005, 213 flickers were detected (USFS 2005), in 2006 430 were detected (USFS 2006c), in 2007 559 were detected (USFS 2008b), in 2008 558 were detected (USFS 2009b), and in 2009 194 were detected (USFS 2010c).

3.6.5 Pine Valley Ranger District

Downstream impacts to endangered fish (woundfin and Virgin River chub) that occur in the Virgin River are possible only as a result of activities within this Ranger District, specifically within streams that drain the Pine Valley Mountains into the Virgin River (via Ash Creek). Suitable habitat for California condors and Mexican spotted owls also occurs within the Pine Valley Mountains.

Rainbow trout, brook trout, and brown trout have been introduced onto the Pine Valley Ranger District as sport fisheries. Bonneville cutthroat trout were discovered in 1973 in two tributaries to the Santa Clara River: Water Canyon and Reservoir Canyon creeks (Hepworth et al. 1997, USFWS 2001), and since their discovery, fish from these two creeks have been used to establish populations in eight other Pine Valley Mountain streams (Table 3.6-12). Area populations are stream residents with good recruitment and considered "conservation populations," meaning no risk of hybridization with other salmonids and limited disease risk. While most populations are isolated, there is connectivity between Leeds Creek, Horse Creek, Pig Creek, and Spirit Creek; as well as between South Ash Creek, Harmon Creek, and Mill Creek (USFWS 2001). Leap Creek, Mill Creek, Harmon Creek, and South Ash Creek are recovering from the 2002 Sequoia Fire and occupied mileage is known to be less than indicated in Table 3.6-14 (thus, for these streams, occupied length represents available habitat).

Table 3.6-14 Streams on the Pine Valley Ranger District with Bonneville Cutthroat Trout

Stream	Occupied Stream Length (mi)[1]	Fish/mi
Leeds Creek	7.1	43
Horse Creek	0.9	19
Pig Creek	0.9	26
Spirit Creek	0.9	24
South Ash Creek	0	0

Harmon Creek	0	0
Mill Creek	2.2	26
Leap Creek	0	0
Reservoir Canyon	2.0	118
Water Canyon	0.7	8

[1]Data obtained from Hadley et al. (2010)

Virgin spinedace occurs downstream from the Pine Valley Ranger District but not within the Forest boundary. Sensitive wildlife found on the Pine Valley Ranger District include: Townsend's big-eared bat, bald eagle (wintering), flammulated owl, and northern goshawk. Three-toed woodpeckers are expected to occur in the Pine Valley Wilderness Area although surveys have not yet been conducted. This ranger district contains large areas of sensitive plant species occurrences and habitat primarily in the eastern region of the ranger district, the Pine Valley Mountains, and the Pine Valley Mountain Wilderness Area. Additional smaller areas of sensitive plant species habitat occur north, west, and south of the Pine Valley Mountains (Figure 3.6-3).

3.6.6 Cedar City Ranger District

Utah prairie dog colonies occur in the Cedar City Ranger District. Suitable habitat for California condors and Mexican spotted owls occurs along the western and southern edges of this ranger district and condors have been observed here.

Rainbow trout and brown trout form the base of a popular recreational fishery in several streams and reservoirs on the Cedar City Ranger District, including Duck Creek, Panguitch Lake, and Navajo Lake. Conservation populations of Bonneville cutthroat trout exist within the Threemile Creek drainage on the east side of the ranger district near Panguitch; occupied streams include Threemile Creek (5.0 occupied stream miles), Delong Creek (2.1 occupied stream miles), and Indian Hollow (0.9 occupied stream miles; Hadley et al. 2010). Additional habitat is available in some of these streams. BCT have also been reintroduced to Sandy Creek; however their present status in this previously fishless stream is unknown. Southern leatherside are present in Bear Creek (1.6 miles), Butler Creek (0.9 miles), and Panguitch Creek (11.4 miles), with historic records in Asay, Duck, and Mammoth Creeks.

Sensitive wildlife found on the Cedar City Ranger District include Townsend's big-eared bat, spotted bat, bald eagle (winter and summer, including nesting, on Panguitch Lake), peregrine falcon, northern goshawk, greater sage-grouse, three-toed woodpecker, and flammulated owl. This ranger district contains large areas of sensitive plant species occurrences and habitat: a narrow border exists along the edge of the Markagunt Plateau along the southern edge of the ranger district and includes a small region of the Ashdown Gorge Wilderness Area, and in the northern region of the ranger district, another area of potential habitat exists around Twin Peaks (Figure 3.6-3).

3.6.7 Powell Ranger District

Utah prairie dog colonies are most abundant in the Powell Ranger District. Suitable habitat for California condors occurs throughout the high plateaus of this ranger district. Suitable habitat for Mexican spotted owls occurs mainly in the southern half of the ranger district.

Non-native fish on the Powell Ranger District include rainbow trout, brook trout, cutthroat trout, and brown trout. Tropic reservoir on the East Fork Sevier River supports a popular recreational

fishery for rainbow trout. Prior to the Sanford Fire, two known conservation populations for Bonneville cutthroat trout existed on the ranger district: one in Left Fork Sanford Creek and one in Deep Creek (six miles of occupied habitat in Deep Creek prior to the Sanford Fire; USFWS 2001). The fire extirpated populations in both creeks. In 2005, 2006, and 2008, UDWR moved 40 to 50 Bonneville cutthroat trout from the rescued population in Tenmile Creek into Deep Creek upstream of the Dixie National Forest boundary. The Powell Ranger District also contains suitable boreal toad habitat, within two East Fork Sevier River subwatersheds upstream of Tropic Reservoir. As of 2010 the occupied distribution of BCT in Deep Creek is thought to be approximately 3.0 miles (Hadley et al. 2010). Southern leatherside occur in the East Fork Sevier River immediately downstream of Tropic Reservoir.

Sensitive wildlife on the Powell Ranger District include bald eagle (wintering), peregrine falcon, northern goshawk, greater sage-grouse, three-toed woodpecker, and flammulated owl. Sensitive plant species occurrences and habitat are throughout the southern half of this ranger district along the Paunsaugunt Plateau (Figure 3.6-3).

3.6.8 Escalante Ranger District

Mexican spotted owls are most likely to occur in this ranger district, which contains the only designated critical habitat and PAC for the species on the Dixie National Forest. California condors are also most likely to occur in this ranger district, as it contains the largest amount of suitable “rim” habitat. Some Utah prairie dog colonies also occur in this ranger district.

Non-native fish, including rainbow trout, brown trout, brook trout, and tiger trout have been introduced and presently constitute popular recreational fisheries in the Escalante Ranger District. High mountain lakes on Boulder Mountain are a popular recreation fishery for brook trout. Three known populations of Bonneville cutthroat trout exist: in Center Creek (4.8 occupied stream miles), Ranch Creek (2.9 occupied stream miles), and Rob’s Reservoir (2 acres).

There are eight populations of Colorado River cutthroat trout in streams located entirely on the Escalante Ranger District (Table 3.6-15) as recognized by Hirsch et al. (2006). All populations are in streams that drain into the Escalante River System. Four other conservation populations occur in lakes or reservoirs on the Escalante Ranger District, including Dougherty Lake (2.75 acres), Tall Four Reservoir (0.7 acres), Long Willow Bottom Reservoir (2.9 acres), and Round Willow Bottom Reservoir (7.1 acres). The latter two Reservoirs are also stocked with hybrid sport fish (see Section 3.5).

Sensitive wildlife that can be found on the Escalante Ranger District include: bald eagle (wintering), northern goshawk, greater sage-grouse, three-toed woodpecker, peregrine falcon, and flammulated owl. Suitable habitat for boreal toad is also present in the Boulder Creek drainage. This habitat has not been mapped.

This ranger district contains relatively large areas of sensitive plant species occurrences and habitat. In the southwestern region of the Escalante Mountains, habitat occurs primarily along the western side, while in the northwestern region, habitat occurs along the Aquarius Plateau. Habitat also occurs in most of the eastern region of this ranger district, which contains the Boulder Mountains and the Box Death Hollow Wilderness Area (Figure 3.6-3).

Table 3.6-15 Streams and Reservoirs on the Escalante Ranger District with Colorado River Cutthroat Trout

Stream/Reservoir	Occupied Habitat mi (acres)[1]	Habitat[2]	Fish/mi
Water Canyon	3.0	Poor	44
White Creek	1.7	Good	93
Twitchell Creek	2.2	Good	90
Pine Creek	6.8	Excellent	41
West Branch Pine Creek	2.5	Excellent	56
East Fork Boulder Creek	3.8	Good	49
West Fork Boulder Creek	6.9	Excellent	49

[1] Data obtained from Hadley et al. 2008

3.7 Water and Watershed Resources

3.7.1 Introduction

Water and watershed resources on the Dixie National Forest occur within one of two geographic regions: the Colorado Plateau (primarily in the Virgin River and Escalante River watersheds) or the Great Basin (primarily in the Sevier River watershed). The majority of the Powell and Cedar City Ranger Districts are located in the Great Basin, with only very small portions located in the Colorado Plateau. The Pine Valley and Escalante Ranger Districts are more evenly distributed between the Great Basin and the Colorado Plateau. Watershed boundaries for the main drainages (Hydrologic Unit Code 10) on the Dixie National Forest are given in Figures 3.7-1 through 3.7-4. According to Dixie National Forest GIS data, there are approximately 6,243 miles of streams on National Forest System land within the boundaries of the Dixie National Forest. The GIS metadata defines streams as "linear water features" derived from 1:24,000 Forest Service Cartographic Features Files and validated by Forest hydrologists. This category includes perennial and intermittent streams. In addition, there are 1,971 mapped springs and over 1,079 lakes and reservoirs. The lakes and reservoirs cover approximately 3,909 acres (Table 3.7-1).

There has not been a Forest-wide delineation of wetlands on the Dixie National Forest and the majority of floodplains and riparian areas have not been mapped. As a result, GIS data does not exist for these resources. Commonly, the Dixie National Forest will identify riparian and wetland areas of concern on an activity or project-specific basis. Riparian and wetland areas of concern are identified using a standard set of guidelines contained in Forest Service Handbook 2509.16. The guidelines specify that site-specific stream morphology or riparian conditions may be used to identify areas of concern, or a standard buffer may be applied based on the type of waterbody. The standard buffers specified are: a 300-foot buffer measured out from each side of the stream channel centerline (600 feet total width) for perennial fish bearing streams and a 150-foot buffer measured from each side of the stream channel centerline (300 feet total width) for perennial non-fish bearing streams, wetlands, ponds, lakes, reservoirs, springs, or intermittent streams. To simplify the analysis and ensure that water and watershed resources receive adequate protection, a 300-foot buffer was applied to all waterbodies in the Dixie National Forest's GIS database, including perennial and intermittent streams, lakes, reservoirs, and springs. For streams, the buffer is measured out from the stream's centerline as described above and from the water's edge on lakes and reservoirs. The GIS data only depicts springs as one-dimensional points and, as a result, the buffer around springs is a circular buffer around the mapped point with a radius of 300 feet (600 feet in diameter). As most streams on the Dixie National Forest are steep mountain streams, the 300-foot buffer should adequately encompass

all riparian areas and the majority of floodplains (Chris Butler, Hydrologist, Dixie National Forest, Personal Communication).

A 300-foot buffer is also applied to wetlands (measured out from the edge of the wetland). However, as all wetlands have not been mapped, their distribution, or the acreage that would be encompassed by the 300-foot buffer, is not represented in the maps, tables, or figures presented in this EIS. Due to the steep topography and arid nature of the area, it is likely that wetlands would be located near waterbodies. As a result, many of the wetlands would be contained within the buffer applied to the other types of waterbodies for which GIS data is available. As explained in Chapter 2 (Section 2.3.1), the 300-foot buffer and associated stipulations would be applied to any wetlands outside the mapped 300-foot buffer that are located during future site-specific analysis. Similar to unmapped wetlands, if future site-specific analyses locate riparian areas or floodplains that extend beyond 300-feet from a mapped waterbody, a larger buffer would be applied.

With a 300-foot buffer applied to all waterbodies in the Dixie National Forest's GIS database, there are approximately 410,818 acres designated for the protection of water and watershed resources (Table 3.7-1). In this EIS, the acreage contained within the 300-foot buffer serves as a proxy to spatially represent the actual watershed resource components. This is done because, as mentioned above, the distribution of wetlands, floodplains, and riparian areas on the Dixie National Forest has not been mapped.

Table 3.7-1 Streams, Lakes, Reservoirs, and Springs on the Dixie National Forest and Total Acres within the 300-foot Buffer

Ranger District	Streams (miles)	Lakes and Reservoirs Number (acres)	Springs (number)	Area covered by 300-foot buffer (acres)
Pine Valley	2,080.7	196 (612.4)	786	138,781
Cedar City	1,454.1	372 (1,925.2)	583	83,185
Powell	1,389.8	200 (224.9)	383	96,077
Escalante	1,318.9	311 (1,147.1)	219	92,775
TOTAL	6,243.5	1,079 (3,909.6)	1,971	410,752

3.7.2 Watershed Resources

Wetlands, floodplains, and riparian areas are expected to overlap in many areas and perform similar ecosystems functions; however, some functions are specific to each. To highlight the differences and similarities, each resource will be described separately in further detail. In addition, stream channel morphology is discussed in conjunction with the discussion on floodplains.

3.7.2.1 Wetlands

Properly functioning wetlands regulate the quality and quantity of water delivered to aquatic ecosystems, provide areas of high biological productivity, and provide wildlife habitat (EPA 2001). Wetlands are usually associated with slow moving or stagnant water, which helps improve water quality by providing depositional areas for sediments, organic matter and other pollutants, and prevents these materials from entering lakes and streams. The slow depositional environment associated with wetlands also buffers adjacent waterbodies from periods of high flow by capturing the water and slowly releasing it during dry periods. The storage and release of water during dry periods provides higher base flows in adjacent streams, which improves habitat conditions for aquatic organisms. Further, due to the combination of

shallow water and large amounts of deposited organic matter and nutrients, wetlands are one of the most biologically productive ecosystems on earth (EPA 2001). The high productivity includes a large variety of plant life, which provides the structure and complexity needed by aquatic organisms, terrestrial wildlife, and birds. Wetland vegetation also absorbs and removes excess nutrients that would otherwise be released to lakes and streams.

Wetlands on the Dixie National Forest can be grouped into three general classes: riverine, lacustrine, and palustrine (Brinson et al. 1995, Cowardin et al.1979). Riverine wetlands occur in floodplains and riparian corridors in association with stream channels. As a result, the distribution of riverine wetlands on the Dixie National Forest would often overlap with riparian and floodplain habitats. Lacustrine wetlands occur in the low-lying areas directly adjacent to lakes and reservoirs, and palustrine wetlands consist of all other wetlands not adjacent to streams or lakes. On the Dixie National Forest, palustrine wetlands are usually associated with small depressions and characterized by shallow surface water depths and emergent vegetation. Examples of palustrine wetlands include wet meadows, sedge-dominated fens, seeps, and small ponds (USFS 1995a). Due to a relatively dry climate and steep topography, most wetlands on the Dixie National Forest are typically small and are primarily riverine and lacustrine systems restricted to narrow bands bordering streams, small lakes, ponds, and reservoirs. As a result, it is assumed that the majority of wetlands would be within the 300-foot buffer applied to streams, lakes, reservoirs, and springs. However, wetlands outside of the buffer mapped in this analysis would also have a 300-foot buffer applied during administration of any future lease as described in Section 3.7-1.

3.7.2.2 Floodplains

Stream channels generally consist of an active channel and associated floodplains. The morphology of an active stream channel may change beyond its normal range of conditions due to natural or human-caused perturbations to the stream or watershed conditions. For example, artificially high flows or flow velocities can lead to channel incision, bank erosion, channel widening, and armoring of the streambed. Decreases in stream flow and/or increases in sediment supply can lead to channel aggradation and sedimentation of the streambed that can have negative impacts on aquatic habitat features such as pools, interstitial spaces, and spawning gravels. Floodplains are flat-lying areas immediately adjacent to the active channel that are formed by water that overflows the active channel during periods of high flow (Dunne and Leopold 1978). The connection between stream channels and floodplains is extremely important and has a profound influence on both the geomorphology and ecology of streams. By providing overflow areas during high flow, floodplains reduce stream velocities in the active channel and reduce erosion. Inundated floodplains also provide essential rearing habitat for larval and juvenile fish, and provide much of the biological productivity of some river systems (Thorp and Delong 1994). Further, sediment deposited on the floodplain perpetuates floodplain development and provides nutrients for riparian vegetation.

Large, lowland rivers that are unconstrained by geology have extensive floodplains; however, smaller mountain streams are often constrained by geology and have narrow floodplains (Gregory et al. 1991). The majority of streams on the Dixie National Forest are small and many of the floodplains may be contained entirely within the riparian area and within the 300-foot buffer applied to streams. A possible exception would be the East Fork of the Sevier River near the Dixie National Forest Boundary, which has large, better-developed floodplains (Chris Butler, Hydrologist, Dixie National Forest, Personal Communication). Any floodplains extending beyond the 300-foot buffer applied to streams would have an additional buffer applied, extending 300 feet from its outer edge. Also, as mentioned previously, many floodplains would

likely overlap with riverine wetlands and may be considered jurisdictional wetlands under Section 404 of the Clean Water Act.

3.7.2.3 Riparian Areas

Functionally, riparian areas can be defined as the area between the active stream channel and the outward limits of flooding (Gregory et al. 1991, USFS 1986). As a result, these areas would functionally overlap with floodplains; however, riparian vegetation serves different functions than floodplains. As riparian areas are subject to frequent change, the vegetation is generally diverse and consists of plants that can tolerate a broad range of conditions. Riparian vegetation is extremely important to stream ecosystem function in that it provides shade, woody debris, and leaf litter inputs. Shade levels affect stream temperatures and habitat suitability for aquatic organisms. Further, woody debris provides habitat for aquatic organisms, particularly fish, and in small mountain streams leaf litter input from riparian vegetation is the primary source of organic material. Due to its diversity and complexity, riparian vegetation provides invaluable habitat for a large variety of terrestrial wildlife. It is estimated that less than one percent of the landscape in the western US is covered by riparian vegetation, yet riparian habitats support more species of birds than surrounding uplands (Knopf et al. 1988). As with floodplains, many riparian areas would overlap with riverine wetlands and may be considered jurisdictional wetlands under Section 404 of the Clean Water Act.

On the Dixie National Forest, riparian areas are generally demarcated by willow (*Salix* spp.) stands at the upper elevations of the area. At the lower elevations, riparian areas are characterized by cottonwood (*Populus angustifolia*), bluegrass (*Poa* spp.), redosier dogwood (*Cornus stolonifera*), river birch (*Betula fontinalis*) and scattered Rocky Mountain juniper (*Juniperus scopulorum*; USFS 1995a). Many riparian areas are currently considered to be below their potential in terms of vegetative structure, density, and species diversity. A sample of 50 riparian areas across the Dixie National Forest in 2005 indicated that 64 percent were in a mid- to upper-successional stage. This is below the 70 percent guideline established by the 1986 Land and Resource Management Plan (USFS 2005a). This condition is likely due to overuse and overgrazing by permitted livestock in connection with drought conditions (USFS 1995a, 2005a).

3.7.3 Surface Water

Within the Colorado Plateau, several tributaries head in the Dixie National Forest: Beaver Dam Wash, Santa Clara River, Quail Creek, Ash Creek, North Fork Virgin River, and East Fork Virgin River, which all flow to the Virgin River prior to entering the Colorado; Kanab Creek and its tributary Johnson Wash; the Paria River; and the Escalante River. About 16 percent of the Virgin River watershed area is within Dixie National Forest boundaries and the USFS was one of the stakeholders in the recently completed Virgin River Watershed Management Plan (Washington County Water Conservancy District 2006).

Within the Great Basin, Dixie National Forest lands produce flows that are tributary to the Sevier River or that flow to internal playa-type basins within the Sevier River watershed. Shoal Creek, Pinto Creek, Coal Creek, and Parowan Creek all head in the Dixie National Forest and flow to internal basins located outside of the Forest. Bear Creek, Panguitch Creek, Mammoth Creek, and East Fork Sevier River are tributary to the Sevier River. The Sevier River is noted as being the state's largest river basin, and one of the Nation's most highly utilized, with only a small percentage of initial flow reaching the terminal basin (Utah Department of Water Resources 1999). Much of the water that is ultimately consumed is generated on the Dixie National Forest.

Throughout the Dixie National Forest, a wide range of elevation, topography, geology, and soil types results in diverse hydrologic regimes and water quality. Precipitation also varies widely across the Dixie National Forest, ranging from 10 inches annually in the lower elevations up to more than 40 inches on some of the higher peaks (USFS 1986). At the higher elevations, most precipitation falls as snow, providing the primary source of recharge to groundwater resources and supporting intermittent and perennial stream flows. Intense thunderstorms are common from July through September and produce heavy rains, which can cause flow and flash flooding in ephemeral streams.

3.7.4 Groundwater

The Forest Serivce and BLM have a joint responsibility to address groundwater as it pertains to oil and gas operations. However, BLM is solely responsible for the protection of groundwater associated with downhole operations (i.e., inside a well). The following section describes groundwater resources under Dixie National Forest surface, for which BLM is ultimately responsible.

Groundwater contained in shallow or perched aquifers within the Dixie National Forest is associated with springs, which typically represent discharge of small, locally recharged areas. More extensive regional aquifers are found at depths from several hundred to a thousand feet below ground surface (USFS 1995b). Typical of high elevation lands, much of the Dixie National Forest serves as recharge areas for shallow and regional aquifers, eventually supplying groundwater to the lower elevation, off-Forest lands. Groundwater recharge and flow patterns in the region are determined by geology. As described in more detail in a previous Dixie National Forest report (USFS 1995b), aquifers are associated with the Straight Cliffs, Wahweap, Kaiparowits, and Navajo Sandstone Formations, which are Mesozoic sedimentary formations found at depths underlying the High Plateau area of the Dixie National Forest. Of these, the Navajo is the most important regional aquifer. The overlying Tertiary sediments and igneous intrusives are noted (USFS 1995b) as formations with low primary, but high secondary permeability. These geologic units transmit infiltrated precipitation through fractures and solution channels to the underlying Mesozoic sandstones. Figure 3.7-2 shows Dixie National Forest-generated areas described as “lava fields over sensitive aquifers.” These areas are defined in the GIS metadata as sensitive aquifers defined originally in 1993 in support of oil and gas analysis, but modified dramatically in 2007. These lava fields are primarily associated with the Tertiary volcanics, which have high macro pore space and thus readily transmit infiltrating precipitation (including any surface contaminants). Where they overly a larger aquifer they can serve as a major source of the aquifer’s recharge.

Trans-basin groundwater outflow from the Sevier River Basin to the Colorado River Basin occurs within the Dixie National Forest from the Markagunt and Paunsaugunt Plateaus, with an estimated total annual of about 21,400 acre-feet (Utah Division of Water Resources 1999).

Currently, there are no EPA-designated Sole Source Aquifers in the Dixie National Forest (EPA 2007b). The State of Utah does not classify groundwater or specific aquifers as sole source. None of the areas in the Dixie National Forest have been classified to date. However, as described in more detail below, there have been petitions to classify two aquifers in the Pine Valley Ranger District as Class I aquifers, under Utah’s Groundwater Protection Program, as described in more detail below.

3.7.5 Water Quality

USFS (1986) recognizes that sediment represents a general surface water quality concern throughout the Dixie National Forest. Many Forest streams have naturally high sediment concentrations due to erodible soils and exposed sedimentary bedrock. Management activities, including road construction, timber harvest, and grazing in riparian areas, are noted in USFS (1986) as contributing to water quality degradation. In contrast, the chemical quality of most of the Dixie National Forest streams is good.

The Utah Division of Water Quality designates beneficial use classifications for surface waters within Utah, and protects those waters so as to maintain their designated uses (State of Utah 2007). Classes relevant to streams on the Dixie National Forest include: IC - protected for domestic purposes with prior treatment; 2B - protected for secondary contact recreation such as boating, wading, or similar uses; 3A - protected for cold water species of game fish and other cold water aquatic life, including the necessary aquatic organisms in their food chain; 3C - protected for non-game fish and other aquatic life, including the necessary aquatic organisms in their food chain; 3D - protected for waterfowl, shore birds, and other water-oriented wildlife not included in Classes 3A, 3B, or 3C, including the necessary aquatic organisms in their food chain; and 4 - protected for agricultural uses including irrigation of crops and stock watering. Numeric surface water quality criteria are applied to each of these beneficial use classes by regulation at Utah Annotated Code R317-2-14.

Streams and lakes that the state considers impaired, and thus not able to meet their designated beneficial uses, are reported on the state's 303(d) list, which is updated every other year. Listed water bodies are then scheduled for Total Maximum Daily Load development. Specific Dixie National Forest streams and reservoirs listed on the currently approved 2006 state's 303(d) list are noted below in the individual ranger district sections. Generally, however, most assessed water bodies in the Dixie National Forest are not considered impaired; the ones that are, are primarily listed due to phosphorous.

Groundwater quality varies depending upon the aquifer's geologic properties and the water's proximity to the recharge area. An assessment of available water quality data found that total dissolved solids (TDS) values within portions of their study area, including parts of the Upper Ash Creek and Navajo/Kayenta aquifers, some of which are on Dixie National Forest lands, ranged from 200 to 300 mg/l (Hansen, Allen & Luce, Inc. 2005). The state has also generally considered the Navajo Sandstone aquifer as being of excellent quality in this area (Utah Division of Water Resources 1993).

3.7.6 Water Uses

Surface waters and groundwater produced within the Dixie National Forest are used for various consumptive and non-consumptive purposes, many of which occur outside of the Forest boundaries. In fact, water produced on the high elevation land associated with the Dixie National Forest makes up a large portion of the overall water yield in this part of Utah (USFS 1986). Many local communities obtain culinary and agricultural water from sources located on the Dixie National Forest. Extensive water developments such as reservoirs, diversions, and ditches have been constructed on the Forest to support these and other uses. The primary consumptive uses of surface water include off-Forest irrigation and culinary water supply. On-Forest uses include domestic water supplies for campgrounds and livestock/wildlife watering, and non-consumptive in-stream flows for aquatic habitat maintenance and recreation.

Within the Utah Department of Environmental Quality the Division of Drinking Water (DDW) acts as the administrative arm of the Utah Drinking Water Board and implements the rules which they adopt. The DDW implements a source protection program involving drinking water source watersheds, reviews and approves plans and specifications for construction of facilities for public water systems, and implements the EPA rules relating to drinking water quality, monitoring and treatment.

Public Water Systems (PWSs) are responsible for protecting their sources of drinking water from contamination. R309-600 sets forth minimum requirements to establish a uniform, statewide program for implementation by PWSs to protect their ground-water sources of drinking water, while R309-605 regulates protection of surface water sources. The 1996 amendments to the Safe Drinking Water Act required that all states develop source water assessment programs to assess the risk of accidental contamination of all drinking water sources.

The Utah DDW expressed a desire for cooperation with BLM to formalize a process to protect Drinking Water Source Protection Zones (DWSPZs) in Utah that may potentially be impacted from oil and gas exploration or development. The cooperative effort between DDW and BLM resulted in the BLM issuing Instruction Memorandum (IM) UT 2010-055 in July of 2010.

3.7.6.1 Utah Safe Drinking Water Act Terms

Public Water System (PWS): a system, either publicly or privately owned, providing water through constructed conveyances for human consumption and other domestic uses, which has at least 15 service connections or serves an average of at least 25 individuals daily at least 60 days out of the year and includes collection, treatment, storage, or distribution facilities under the control of the operator and used primarily in connection with the system, or collection, pretreatment or storage facilities used primarily in connection with the system but not under the operator's control.

Community Water System (CWS): a PWS which serves at least 15 service connections used by year-round residents or regularly serves at least 25 year-round residents.

Non-Transient Non-Community Water System (NTNCWS): a PWS that regularly serves at least 25 of the same nonresident persons per day for more than six months per year. Examples of such systems are those serving the same individuals (industrial workers, school children, church members) by means of a separate system.

Transient Non-Community Water System (TNCWS): a non-community PWS that does not serve 25 of the same nonresident persons per day for more than six months per year. Examples of such systems are RV parks, diners or convenience stores where permanent nonresident staff number less than 25, but the number of people served exceeds 25.

Drinking Water Protection Zones

Ground Water Source Zone 1: is the area within a 100-foot radius from the wellhead or margin of the collection area.

Ground Water Source Zone 2: is the area within a 250-day ground-water time of travel to the wellhead or margin of the collection area, the boundary of the aquifer(s) which supplies water to the ground-water source, or the ground-water divide, whichever is closer.

Ground Water Source Zone 3: is the area within a 3-year ground-water time of travel to the wellhead or margin of the collection area, the boundary of the aquifer(s) which supplies water to the ground-water source, or the ground-water divide, whichever is closer.

Ground Water Source Zone 4: is the area within a 15-year ground-water time of travel to the wellhead or margin of the collection area, the boundary of the aquifer(s) which supplies water to the ground-water source, or the ground-water divide, whichever is closer.

Surface Water Zone 1: (A) Streams, rivers and canals: Zone 1 encompasses the area on both sides of the source, 1/2 mile on each side measured laterally from the high water mark of the source (bank full), and from 100 feet downstream of the point of departure to 15 miles upstream, or to the limits of the watershed or to the State line, whichever comes first. If a natural stream or river is diverted into an uncovered canal or aqueduct for the purpose of delivering water to a system or a water treatment facility, that entire canal will be considered to be part of Zone 1, and the 15 mile measurement upstream will apply to the stream or river contributing water to the system from the diversion. (B) Reservoirs or lakes: Zone 1 is considered to be the area 1/2 mile from the high water mark of the source.

Surface Water Zone 2: the area from the end of Zone 1, and an additional 50 miles upstream (or to the limits of the watershed or to the State line, whichever comes first), and 1000 feet on each side measured from the high water mark of the source.

Surface Water Zone 3: the area from the end of Zone 2 to the limits of the watershed or to the State line, whichever comes first, and 500 feet on each side measured from the high water mark of the source.

Surface Water Zone 4: the remainder of the area of the watershed (up to the State line, if applicable) contributing to the source that does not fall within the boundaries of Zones 1 through 3.

For most public water systems, the Utah Department of Environmental Quality's Division of Drinking Water requires that protection zones be designated through an assessment program for drinking water sources. Transient, non-community systems (such as campgrounds) existing before 1993 that have a groundwater source do not have to establish protection zones. The Dixie National Forest relies upon these source protection plans to provide management direction and guidelines for municipal supply watersheds within Forest boundaries. The Dixie National Forest has identified numerous municipal watersheds within its boundaries covering a total of 53,405 acres. They are shown on Figures 3.7-1 through 3.7-4. The GIS metadata indicates that these watersheds were delineated for use in oil and gas analysis in 1993, and the database has subsequently been updated.

3.7.7 Pine Valley Ranger District

3.7.7.1 Watershed Resources

There are 2,080.7 miles of streams and 786 springs mapped on the Pine Valley Ranger District. In addition, there are 196 lakes and reservoirs covering 612.4 acres. The 300-foot buffer

applied to all waterbodies covers 138,781 acres, or 29 percent of the Pine Valley Ranger District. Figure 3.7-1 shows the 300-foot buffer applied to streams, springs, lakes, and reservoirs on the Pine Valley Ranger District.

3.7.7.2 Surface Water

Most of the northern half of the Pine Valley Ranger District is located within the Sevier River Basin, which is part of the Great Basin geographic region. This area (Figure 3.7-1) includes the headwaters of Shoal Creek and its tributaries, and the headwaters of Pinto Creek and its tributaries. Shoal and Pinto creeks each flow into the Escalante Desert, where they infiltrate and/or evaporate. The southern half and most of the eastern end of this ranger district are located primarily within the Santa Clara, Quail, and Ash Creek watersheds. These watersheds are tributary to the Virgin River, which is in the lower Colorado River Basin.

Several of these streams have been gaged within the Dixie National Forest by the United States Geological Survey (USGS), including South Ash Creek, Leap Creek, and Leeds Creek, which are all tributary to Ash Creek and the Santa Clara River. The USGS (2007) provides this flow data, which is briefly summarized below.

South Ash Creek (draining about 11 square miles) was gaged from 1966 to 1998. Average annual flows ranged from 1.3 to 16 cubic feet per second, with the highest monthly average typically occurring in May. Leap Creek drains about 9 square miles at the gaged location near the Forest boundary. During the seven years of record (1994 to 2001), average annual flows ranged from 0.6 to 5.1 cubic feet per second. This stream seems to peak earlier in the year (generally in March) than other gaged streams in the ranger district. Leeds Creek has been gaged since 1964 at a location near the Forest boundary; drainage area is about 15.5 square miles at the gage site. Peak flows typically occur in June, and average annual flows have ranged from 2.1 cubic feet per second in 2002 up to 26.5 in 2005. The Santa Clara River has been gaged for many years, beginning in 1959. At the gaging station located in Pine Valley, which drains 18.7 square miles, average annual flows have ranged from a low of 1.2 cubic feet per second in 2002 to a high of 40.9 in 2005. USFS (1986) notes that the Santa Clara River is one of several Dixie National Forest streams where snowmelt runoff can cause extensive and/or prolonged flooding, particularly in downstream, off-Forest areas. Its peak typically occurs in May.

Though not gaged, estimates of average flow in the Shoal and Pinto Creek watersheds are 17,000 and 16,000 acre-feet per year, respectively (Utah Division of Water Resources 1995).

There are two main reservoirs in this ranger district, both capturing water from Little Pine Creek, which is tributary to Shoal Creek watershed. Lower Enterprise Reservoir has a capacity of about 2,670 acre-feet and Upper Enterprise Reservoir has a capacity of 9,950 acre-feet (Utah Division of Water Resources 1995).

3.7.7.3 Groundwater

The Pine Valley and Bull Valley Mountains within the Pine Valley Ranger District serve to recharge regional aquifers. It has been estimated that most of the 48,100 acre-feet of annual recharge to the Beryl-Enterprise groundwater basin comes from Shoal and Pinto Creeks, whose watersheds are almost entirely within the Pine Valley Ranger District (Utah Division of Water Resources 1995). A number of small springs are located in the higher elevation areas, discharging groundwater from numerous small, perched aquifers. USFS (1986) also notes that there are geothermal waters found at depth within portions of the Pine Valley Ranger District.

In 2005, the Washington County Water Conservancy District petitioned the Utah Board of Water Quality for aquifer classification on a portion of the Ash Creek Basin and a portion of the Quail and Santa Clara basins (Hansen, Allen, and Luce, Inc. 2005). With aquifer classification, Washington County Water Conservancy District hoped to provide a means of reasonable protection of these groundwaters. While the requested class designation (Class IA - Pristine Groundwater where the TDS is below 500 mg/l (ppm) (for the portions of the aquifers within Dixie National Forest boundaries)) would not result in mandatory development prohibitions or use restrictions; it would provide an additional management tool in these areas. The aquifer has not yet been classified.

According to the petition, the Upper Ash Creek aquifer includes land in the Pine Valley Ranger District. Within the ranger district, that aquifer is described as the Tertiary Pine Valley monzonite aquifer, comprised of fractured monzonite, volcanic ashflow, tuff, andesite, volcanic breccia, sandstone, conglomerate, and limestone with an estimated thickness of more than 2,000 feet.

The Extended Aquifer Zone that is associated with the Navajo/Kayenta aquifer addressed in the petition also includes land along the southern boundary of the ranger district (the Navajo/Kayeta aquifer itself is outside of the Dixie National Forest). This zone is defined as "…the developable area (slope less than 30 percent) north of the exposed Navajo formation where the buried Navajo/Kayenta aquifer is estimated to remain unconfined… these formations are shallow enough in the Extended Aquifer Zone that infiltration of surface water may reach the Navajo Aquifer" (Hansen, Allen, and Luce, Inc. 2005).

3.7.7.4 Water Quality

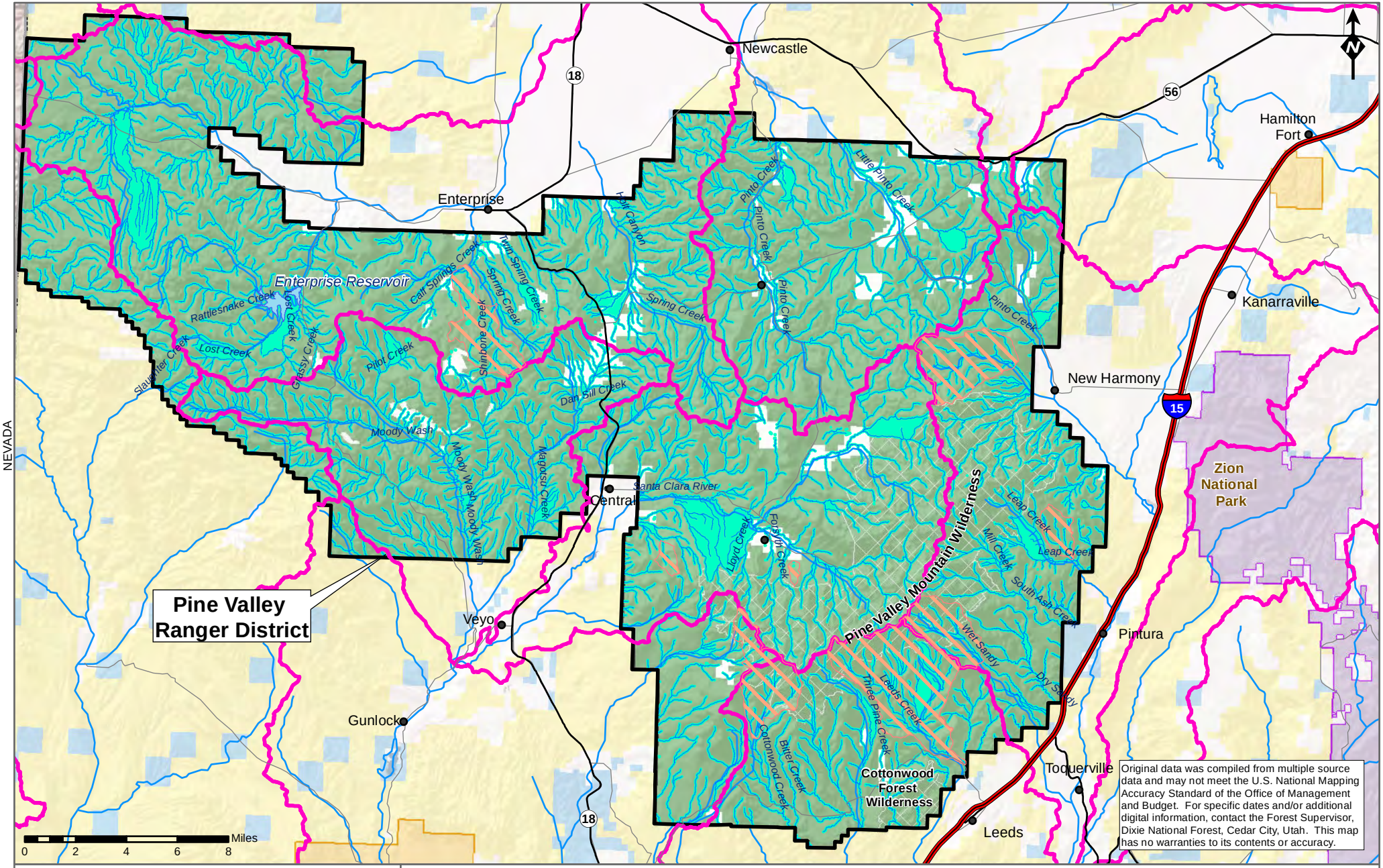
There are no streams or lakes on the Pine Valley Ranger District currently listed as 303d impaired (Utah Division of Water Quality 2006). Newcastle Reservoir, just downstream of the Dixie National Forest boundary, which impounds water from Pinto Creek and Little Pinto Creek, within the Pine Valley Ranger District, is listed as impaired for total phosphorous and dissolved oxygen.

Although not currently listed as impaired, the Santa Clara River has had problems with phosphorus exceedances (USFS 2004e).

Based on Dixie National Forest GIS data showing areas deemed unstable or subject to high erosion, portions of the watersheds in this ranger district may be susceptible to sediment-related water quality problems. These areas are primarily along the eastern and southeastern parts of the ranger district (in the Ash and Quail watersheds), and the parts of the southern ranger district, within tributaries to the Santa Clara River and Beaver Dam Wash.

3.7.7.5 Water Uses

The majority of the stream reaches in the Pine Valley Ranger District have beneficial use designations of 2B, 3A, and 4 (State of Utah 2007). In addition to those three classes, the headwaters of Quail Creek are also designated as drinking waters under Class 1C. Both Upper and Lower Enterprise Reservoirs are designated as Class 2B, 3A, and 4 waters. In addition, Lower Enterprise is used for flood control and Upper Enterprise uses also include municipal and industrial (Utah Division of Water Resources 1995).



Original data was compiled from multiple source data and may not meet the U.S. National Mapping Accuracy Standard of the Office of Management and Budget. For specific dates and/or additional digital information, contact the Forest Supervisor, Dixie National Forest, Cedar City, Utah. This map has no warranties to its contents or accuracy.

Oil & Gas Leasing EIS on Lands Administered by the Dixie National Forest

FIGURE 3.7-1
Water & Watershed Resources of the Pine Valley Ranger District

Horizontal Datum = NAD 83 Coordinate System = Zone 12N	1:320,000	1 in = 5 miles

Legend

- Cities
- Minor Roads (1)
- Highways
- Freeways
- Streams
- Major Streams & Rivers
- Water Bodies

National Forest System Lands
- Dixie National Forest
- Wilderness Areas

Other Land Administration
- Bureau of Land Management
- National Park Service
- Private
- State of Utah
- Tribal

- 300-foot Riparian Buffer
- Watersheds (HUC 10)
- Municipal Watersheds

NOTES
(1) Not all roads are shown. Only some roads are depicted for orientation purposes.

Groundwater (with very limited exceptions) and surface water in the Virgin River watershed is considered completely appropriated (Utah Division of Water Resources 2006).

Numerous municipal watersheds have been designated on the Pine Valley Ranger District, as shown on Figure 3.7-1. They are Central, Enterprise, Leeds, New Harmony, Pine Valley, Pintura, Sawyer Springs, and St. George. On the Dixie National Forest, they cover a combined total of approximately 27,799 acres. The Utah Division of Water Resources' most recent Municipal and Industrial Report for the Kanab Creek/Virgin River Basin (Utah Division of Water Resources 2006) describes community and non-community water systems in the basin, at least some of which have their source on the Pine Valley Ranger District. Among these, Pine Valley Irrigation Company (which supplies culinary water to 100 residential connections) is listed as having a total diversion of 79 acre-feet in 2002, predominantly from spring sources, but supplemented by wells, all apparently on-Forest. Their water rights are for substantially more than this volume. Others who likely receive at least a portion of their water from the Pine Valley Ranger District are New Harmony (82 acre-feet diverted in 2004; Utah Division of Water Resources 2006), St. George, and Enterprise. The Municipal and Industrial Report for 1997 (Utah Division of Water Resources 1998) apparently pre-dates the Pine Valley Irrigation Company system, and the New Harmony system used 108 acre-feet that year.

3.7.8 Cedar City Ranger District

3.7.8.1 Watershed Resources

There are 1,454.1 miles of streams and 583 springs mapped on the Cedar City Ranger District. In addition, there are 372 lakes and reservoirs covering 1,925.2 acres. The 300-foot buffer applied to all waterbodies covers approximately 83,118 acres, or 21 percent of the Cedar City Ranger District. The ranger district is characterized by mountain valleys and high plateaus. Stream surveys conducted in 2004 (USFS 2004e) indicate that changes to stream morphology have occurred on Castle Creek, Little Creek, and Bear Creek. Beetle kill of mature spruce forest may have increased flows on Castle Creek, which has led to widening of the stream channel. In contrast, decreased flows under drought conditions may have led to increased sedimentation and aggradation of the channel on Little Creek. The loss of riparian vegetation on Bear Creek due to grazing has also led to channel widening there. Further, grazing and roads have impacted riparian vegetation on Threemile Creek, which has led to increases in stream temperature (USFS 2004e). Figure 3.7-2 shows the 300-foot buffer applied to streams, springs, lakes, and reservoirs on the Cedar City Ranger District.

3.7.8.2 Surface Water

The majority of the Cedar City Ranger District is within the Sevier River Basin, contributing flows to the main stem of the Sevier River (Figure 3.7-2). The upper Sevier River and its tributaries (including Asay, Mammoth, Panguitch, and Bear Creeks) flow generally northeast off the Markagunt Plateau to the main stem. The Hurricane Cliffs form the northwestern edge of the ranger district and include several streams that drain towards Parowan Valley and Little Salt Lake, which is a closed subbasin of the Sevier River Basin. The headwaters of Coal Creek are also located in the Cedar City Ranger District; Coal Creek terminates in Cedar Valley. The extreme southwestern portion of the ranger district includes the headwaters of some first order drainages within the North Fork Virgin River, and the extreme southwest portion includes the headwaters of the East Fork Virgin River. As noted above, the Virgin River is part of the Colorado River Basin.

Stream flows on the Cedar City Ranger District are typically snowmelt derived with high spring flows during spring snowmelt and low base flows in the summer and fall. While flows in Center Creek and Ashdown Creek increase during spring snowmelt, monsoonal rains can often cause peak flows to occur in summer months. USFS (1986) notes that snowmelt runoff can cause more extensive and/or prolonged flooding in Panguitch and Mammoth Creeks than occurs in some of the other streams in this ranger district.

Several of these streams have been gaged within the Dixie National Forest by the USGS and the flow conditions are briefly described below. Mammoth Creek has been gaged for many years, beginning in 1964. The data shows widely ranging seasonal variation, from an average low monthly flow of 11 cubic feet per second in February, to a high monthly average of 181 in May; the yearly average for this 105 square mile drainage ranged from 8 cubic feet per second in 2002 to 159 cubic feet per second in 2005. Panguitch Creek typically peaks in June, and during twenty years of record, annual average flow ranged from 14 cubic feet per second to 45 cubic feet per second. Stream gaging on Asay Creek, during four years in the 1950s, recorded average annual flows ranging from 20 to 61 cubic feet per second.

The two largest lakes on the Dixie National Forest are found in this ranger district: Panguitch Lake and Navajo Lake. Panguitch Lake is the largest lake on the Dixie National Forest and constitutes 20 percent of the total water yield for the entire Forest. Navajo Lake is a natural lake formed by a lava flow that cut off the natural surface drainage, and its eastern end has been diked. Red Creek Reservoir is another small impoundment located in the northwestern part of the ranger district.

3.7.8.3 Groundwater

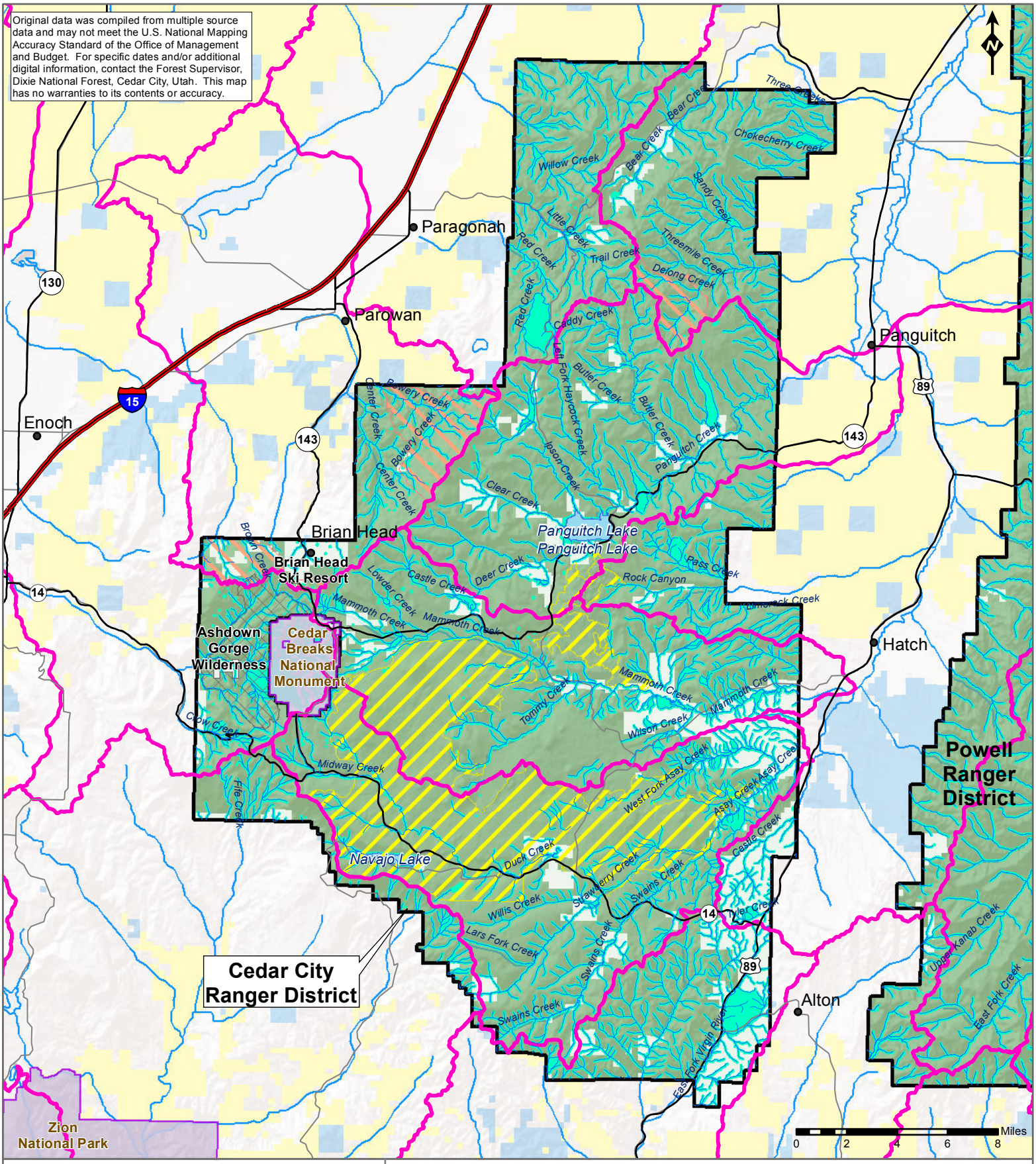
The Markagunt Plateau in the vicinity of Navajo Lakes supports groundwater not only within the Sevier Basin, in which watershed it is located, but also to the Virgin River Basin to the south, via transbasin outflow (Utah Division of Water Resources 1993). According to a previous Dixie National Forest report (USFS 1995c), bedrock solution channels in the Navajo Lakes areas provide a conduit for infiltrated precipitation to be conveyed to either the Sevier or Virgin River watersheds and emerge as springs. Duck Creek, Lower Asay, and Cascade Springs are the three largest of these.

Approximately 58,585 acres in this ranger district are on these lava fields where they are overlying a sensitive aquifer, as shown on Figure 3.7-2). As noted above, these are described as areas of high groundwater recharge associated with the Tertiary volcanics that have high macro pore space and thus readily receive precipitation and have been designated as No Lease (NL) under Alternatives A, B, and C.

The upper Markagunt Plateau also contains springs that are closely tied to the precipitation regime as a function of their recharge area with a moderate storage capacity (USFS 1995c). The Dixie National Forest report also notes that alluvial deposits associated with the larger creeks draining the Markagunt (including Asay, Mammoth, and Bear Valley Creeks) are of sufficient thickness and extent to contain alluvial groundwater. Further, the Land Resource Management Plan (USFS 1986) notes that there are geothermal waters within portions of the Cedar City Ranger District, particularly in the Navajo Lake area.

3.7.8.4 Water Quality

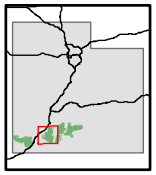
Dixie National Forest water quality monitoring indicates that Bowery Creek, Bear Creek, and Threemile Creek are above the state water quality standard for phosphorous (USFS 2004e). Water quality is also declining in Panguitch Lake and Navajo Lake (USFS 1995c). High



Zion

Oil & Gas Leasing EIS on Lands Administered by the Dixie National Forest

FIGURE 3.7-2
Water & Watershed Resources of the Cedar City Ranger District



Horizontal Datum = NAD 83 Coordinate System = Zone 12N	1:320,000	1 inch = 5 miles

Legend

- Cities
- Minor Roads (1)
- Highways
- Interstates
- Streams
- Major Streams & Rivers
- Water Bodies

National Forest System Lands

- Dixie National Forest
- Wilderness Areas
- Fishlake National Forest
- Brian Head Ski Resort

Other Land Administration

- Bureau of Land Management
- National Park Service
- Private
- State of Utah
- Tribal

- 300-foot Riparian Buffer
- Municipal Watersheds
- Sensitive Aquifers
- Watersheds (HUC 10)

NOTES
(1) Not all roads are shown. Only some roads are depicted for orientation purposes.

phosphorous in Bear Creek may be due to its igneous geology; however, high phosphorous in Bowery Creek and especially Threemile Creek appears associated with sediment influxes accompanying high flow events. Panguitch Lake is one of the few water resources on the Dixie National Forest where human-caused water quality degradation has become a chronic problem. Nutrient levels have often exceeded state water quality standards and accelerated eutrophication has been documented; however, these conditions have improved in recent years. The state's Total Maximum Daily Load study for Panguitch Lake was approved by the EPA in 2004; that document set goals and strategies for total phosphorus reductions.

Streams that may be susceptible to sediment related water quality problems include Coal Creek, Stout Canyon (a small tributary to East Fork Virgin River), and Parowan Creek, as well as numerous other small headwater areas, based on GIS mapping of unstable and high erosion areas.

Noted sediment influxes in Threemile Creek are likely a result of the reduction of riparian vegetation as a result of grazing and dispersed recreational use as mentioned in Section 3.7.8.1 (USFS 2004e). In addition, the loss of riparian vegetation in Threemile Creek and in Bear Creek has led to a decrease in shade levels and an associated increase in stream temperatures above state limits.

Several watersheds in the Cedar City Ranger District have very low baseline amounts of fine sediment due to well-vegetated watersheds overlying extrusive igneous rock, sandstone, and limestone. These watersheds include: Mammoth Creek, Panguitch Creek, and Ash Creek (USFS 1995b). Streams from less vegetated watersheds overlying shale and siltstone, such as tributaries to the North and East Forks of the Virgin River, and streams near the Hurricane Cliffs (Summit Creek and Coal Creek) have higher sediment concentrations (USFS 1995b). In Little Creek, percent fine sediment in the stream channel is greater than 25 percent; which may be a result of drought, which has decreased flows and the sediment transport capacity of the stream (USFS 2004e).

According to the 2006 303(d) list, there are no streams in this ranger district currently listed as impaired (Utah Division of Water Quality 2006). Navajo Lake is currently listed as impaired for dissolved oxygen. Red Creek and Yankee Meadow Reservoirs, which drain toward Parowan Valley, are also listed: Red Creek for dissolved oxygen and Yankee Meadow for dissolved oxygen and pH. Panguitch Lake has been removed from the list due to development and approval of the Total Maximum Daily Load.

3.7.8.5 Water Uses

All of the stream reaches on the Cedar City Ranger District have beneficial use designations of 2B, 3A, and 4 (State of Utah 2007). In addition to those three classes, Duck Creek and stream reaches that are tributary to the North Fork Virgin River are also designated as drinking waters under Class 1C. Both Panguitch and Navajo Lakes are also designated for 2B, 3A, and 4 uses.

Groundwater (with very limited exceptions) and surface water in the Virgin River watershed is considered completely appropriated (Utah Division of Water Resources 2006)

Four municipal watersheds, shown on Figure 3.7-2, with a total acreage of about 12,869 acres have been designated on the Cedar City Ranger District to protect spring sources that supply municipal culinary water to Brian Head, Panguitch, Summit, and Parowan.

3.7.9 Powell Ranger District

3.7.9.1 Watershed Resources

There are 1,389.8 miles of streams and 383 springs on the Powell Ranger District. In addition, there are 200 lakes and reservoirs covering 224.9 acres. The 300-foot buffer applied to all waterbodies covers approximately 96,077 acres, or 25 percent of the Powell Ranger District. The East Fork of the Sevier River near the Dixie National Forest boundary is larger and less constrained by geology than other streams. As a result, there may be some floodplains that extend beyond the 300-foot buffer. In 2002, the Sanford Fire burned portions of the Cottonwood, Deep, Deer, and Sanford creek watersheds. The fire destroyed riparian vegetation, which led to high streambank instability, erosion, and the influx of large amounts of sediment (USFS 2005a). Although streambank instability has begun to improve and sediment levels have decreased, full recovery of the riparian vegetation has been hampered by livestock grazing (USFS 2004e). In some burned areas, riparian areas that were overgrazed are now dominated by rabbitbrush (*Chrysothamnus spp*.), which is a concern for future fires, as it will burn faster and hotter than riparian grasses/forbs/shrubs. Figure 3.7-3 shows the 300-foot buffer applied to streams, springs, lakes, and reservoirs on the Powell Ranger District.

3.7.9.2 Surface Water

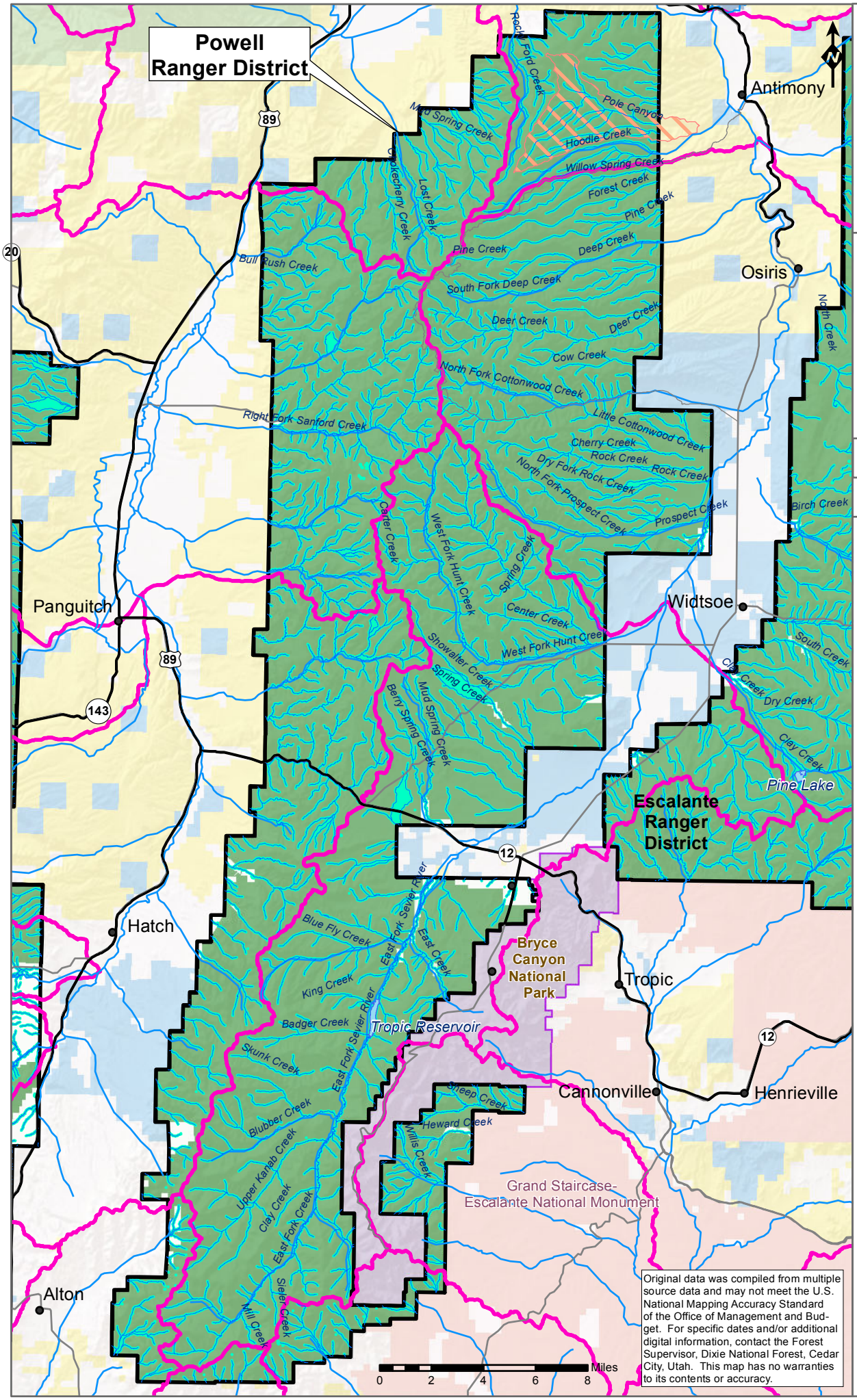
The Powell Ranger District is almost entirely within the Sevier River Basin. The western portion is comprised of many small tributaries to the main stem of the Sevier, many of which are intermittent or ephemeral (Figure 3.7-3). These include Smith Canyon, Sanford Creek, Sand Wash, Limekiln Creek, Red Canyon, and Hildale Canyon. The eastern portion is located in the East Sevier watershed and includes its headwaters as well as numerous smaller tributary streams such as Cottonwood Creek, East and West Forks Hunt Creek, and Blubber Creek. A very small part of the this ranger district drains south into the Upper Colorado River Basin via tributaries to Paria River, Johnson Wash, and Kanab Creek. The Paria River drains directly to the Colorado River, as does Kanab Creek. Johnson Wash is tributary to Kanab Creek.

Most lakes on this district are small. Tropic Reservoir is the largest lake in this ranger district, collecting primarily snowmelt runoff from the headwaters of the East Sevier River. Its capacity is approximately 3,600 acre-feet (Utah Division of Water Quality 2007).

Most of the stream reaches, with the exception of the East Fork Sevier River, are small first-order streams and have not been gaged. The East Fork Sevier River was gaged between 1962 and 1995 at a site near Ruby's Inn upstream of Johns Valley, where the drainage area is about 72 square miles. According to that data, flows typically peak in May or June (USGS 2007). Annual averages ranged from 6 cubic feet per second in 1977 to 45 cubic feet per second in 1980. USFS (1986) notes that snowmelt runoff can cause more extensive and/or prolonged flooding on this river than occurs in some of the other streams on this ranger district.

3.7.9.3 Groundwater

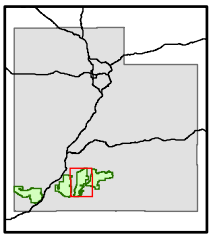
The high plateaus area, of which the Powell Ranger District is part, provides recharge to several water-bearing regional geologic units comprised of Mesozoic sandstones that are found at depth and overlain by Tertiary igneous extrusives. This ranger district also provides recharge to alluvial aquifers associated with the off-Forest Sevier and East Fork Sevier River valleys.



Original data was compiled from multiple source data and may not meet the U.S. National Mapping Accuracy Standard of the Office of Management and Budget. For specific dates and/or additional digital information, contact the Forest Supervisor, Dixie National Forest, Cedar City, Utah. This map has no warranties to its contents or accuracy.

Oil & Gas Leasing EIS on Lands Administered by the Dixie National Forest

FIGURE 3.7-3
Water & Watershed Resources of the Powell Ranger District



1:320,000	1 in = 5 miles

Horizontal Datum = NAD 83
Coordinate System = Zone 12N

Legend

- Cities
- Highways
- Minor Roads (1)
- Streams
- Major Streams & Rivers
- 300-foot Riparian Buffer
- Water Bodies
- Watersheds (HUC 10)
- Municipal Watersheds

National Forest System Lands

- Dixie National Forest
- Wilderness Areas
- Fishlake National Forest

Other Land Administration

- Bureau of Land Management
- GSENM (2)
- National Park Service
- Private
- State of Utah
- Tribal

NOTES
(1) Not all roads are shown. Only some roads are depicted for orientation purposes.
(2) Grand Staircase-Escalante National Monument Managed by the Bureau of Land Management.

Though topographically within the Sevier Basin, the Paunsaugunt Plateau also provides groundwater to the Kanab Creek Basin to the south, via transbasin outflow (Utah Division of Water Resources 1993).

3.7.9.4 Water Quality

According to the 2006 303(d) list, some streams in the Powell Ranger District are currently listed as impaired (Utah Division of Water Quality 2006). Included in this most recent list are the tributaries to the Paria River (which are listed for TDS).

Based upon Dixie National Forest GIS data, there is a substantial area in the southern half of this ranger district that is considered as unstable or as a high erosion area; streams crossing this area may be more susceptible to sediment-related water quality problems.

3.7.9.5 Water Uses

All of the stream reaches within the Sevier Basin portion of the Powell Ranger District have beneficial use designations of 2B, 3A, and 4, as does the portion of the ranger district within the Johnson Wash and Kanab Creek watersheds (State of Utah 2007). The small portion of the ranger district within the Paria River watershed is designated as 2B, 3C, and 4.

Groundwater and surface water in the Kanab Creek and Johnson Wash watersheds are considered completely appropriated (Utah Division of Water Resources 2006).

A single municipal watershed (6,471 acres within the Powell Ranger District) has been designated on the northeast corner of the Powell Ranger District to protect municipal culinary water for Antimony (a very small portion of Antimony's municipal watershed is located on the Escalante Ranger District). This watershed is shown on Figure 3.7-3.

3.7.10 Escalante Ranger District

3.7.10.1 Watershed Resources

There are 1,318.9 miles of streams and 219 springs mapped on the Escalante Ranger District. In addition, there are 311 lakes and reservoirs covering 1,147.1 acres. The 300-foot buffer applied to all waterbodies covers approximately 92,775 acres, or 21 percent of the Escalante Ranger District. Roads and recreational use on Carcass and Pleasant creeks have impacted riparian areas and led to stream channel widening (USFS 2004e). Figure 3.7-4 shows the 300-foot buffer applied to streams, springs, lakes, and reservoirs on the Escalante Ranger District.

3.7.10.2 Surface Water

The majority of streams on the Escalante Ranger District drain into the Escalante River, which is in the Upper Colorado River Basin. Tributary streams that head in this ranger district include Deer Creek, Boulder Creek, Birch Creek, Upper Valley Creek, and Pine Creek (Figure 3.7-4). In addition, some areas in the southwest corner of the ranger district drain into the Paria River drainage, and some streams on the northwestern side of the ranger district drain into the East Fork Sevier River.

While some of these stream reaches have been gaged at various times, most have fairly short periods of record. Pine Creek is an exception, as it has been gaged essentially continuously since 1951 (USGS 2007). Pine Creek flow typically peaks in May and is at its lowest during the

winter months. Annual averages vary widely, and have ranged from 0.77 cubic feet per second in 1955 to 13.4 cubic feet per second in 2005.

One of the prominent features in this district is Boulder Mountain, which is one of the largest high elevation plateaus in the United States. This plateau is dotted with hundreds of small lakes at elevations from 10,000 to 11,000 feet. Some of the larger lakes and reservoirs include Pine Lake, Cyclone Lake, Jacobs Valley Reservoir, Roundy Reservoir, Grass Lake, and North Creek Reservoir (USFS 1995a). Jacobs Valley Reservoir was constructed in 1911 and has a capacity of 1,967 acre-feet. It is located in the Pine Creek watershed. Also in the Pine Creek Basin, Roundy Reservoir is much smaller, with a capacity of 150 acre-feet (Utah Division of Water Resources 2000).

3.7.10.3 Groundwater

The high plateaus area, of which the Escalante Ranger District is part, provides recharge for several water-bearing regional geologic units comprised of Mesozoic sandstones that are found at depth and overlain by Tertiary igneous extrusives. Outcrops of the Straight Cliffs Aquifer (which includes the Straight Cliffs, Wahweap, and Kaiparowits Formations) occur in the Paunsagaunt Plateau within the Escalante District. A 1995 Forest Service report (USFS 1995b) notes that the Aquarius Plateau, including the Escalante Ranger District, overlies highly transmissive igneous rock, which results in a large percentage of precipitation leaving the Plateau as groundwater in bedrock aquifers. There is essentially no alluvial groundwater found in this ranger district.

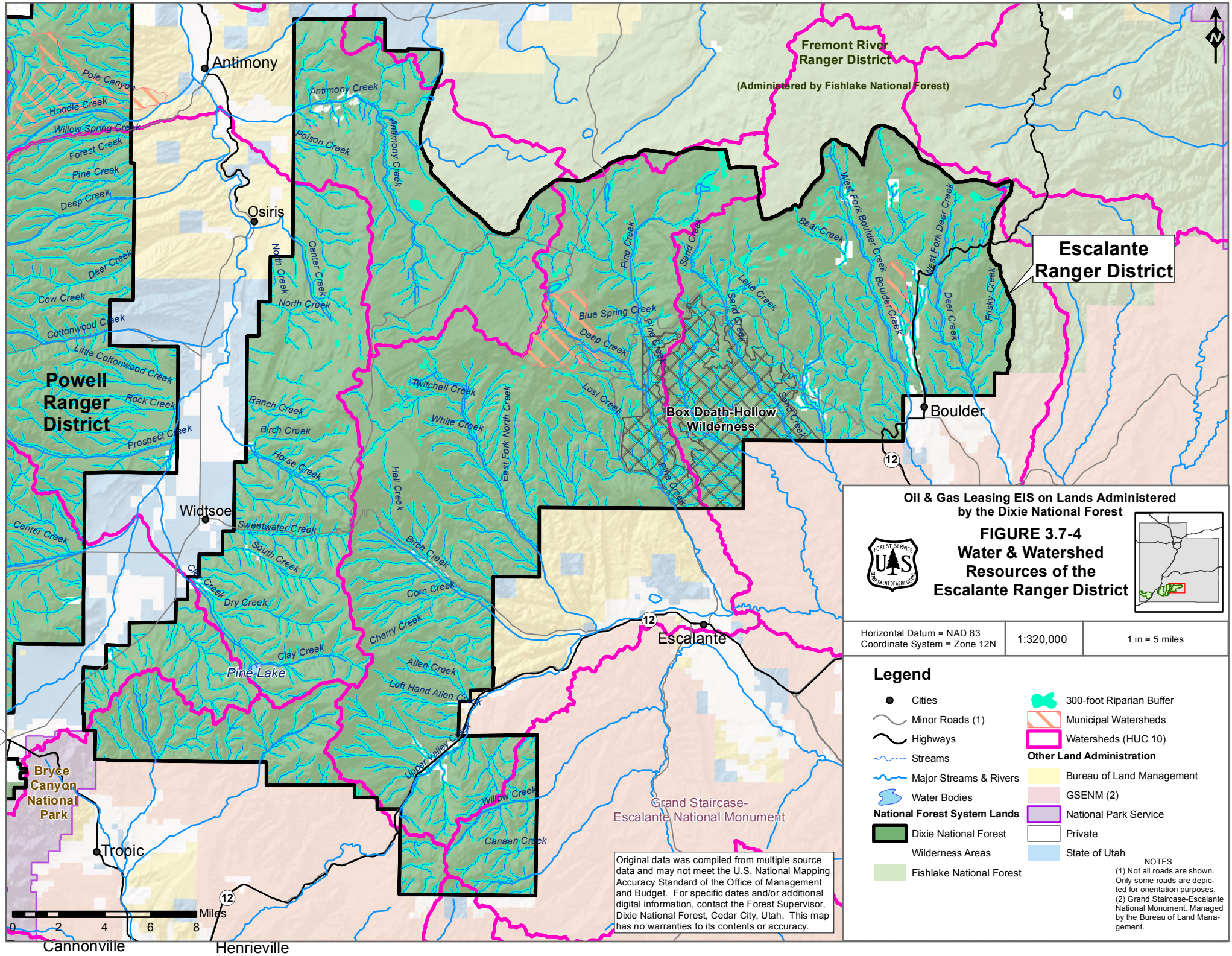
3.7.10.4 Water Quality

Water quality monitoring by the Dixie National Forest in portions of the Escalante River drainage indicates that phosphorous is above state limits in both the East and West Forks of Boulder Creek (USFS 2004e). From the few samples taken, it is difficult to establish a link to the source; however, igneous geology in the area could lead to high background phosphorous levels (USFS 2004e). In addition, many of the more western streams draining into the Escalante River drainage have higher sediment concentrations due to less vegetated watersheds overlying shale and siltstone (USFS 1995b).

According to the 2006 303(d) list, some streams in the Escalante Ranger District are currently listed as impaired (Utah Division of Water Quality 2006). Included in this list are some reaches of the Escalante River and its tributaries, which are listed for temperature downstream of the Dixie National Forest. The Escalante River Watershed Water Quality Management Plan (Millennium Science and Engineering, Inc. 2005) is awaiting EPA approval; that document assessed reaches of Birch Creek and North Creek, including stretches within the Dixie National Forest, as potential contributors to the downstream temperature problem.

3.7.10.5 Water Uses

The stream reaches within the Sevier River watershed and the majority of the Escalante River portions of the Escalante Ranger District have beneficial use designations of 2B, 3A, and 4 (State of Utah 2007). The small portion of the very southeast corner of the ranger district within Alvey Creek that is tributary to the Escalante River and the Paria River watershed in the southwest portion is designated as 2B, 3C, and 4. Jacob's Valley Reservoir is protected under 2B, 3C, 3D, and 4 classes of beneficial use.


Fremont River Ranger District
(Administered by Fishlake National Forest)
Escalante Ranger District
Powell Ranger District
Box Death-Hollow Wilderness
Antimony
Osiris
Widtsoe
Boulder
Escalante
Tropic
Cannonville
Henrieville
Bryce Canyon National Park
Grand Staircase-Escalante National Monument
Pine Lake
Pole Canyon
Hoodle Creek
Willow Spring Creek
Forest Creek
Pine Creek
Deep Creek
Deer Creek
Cow Creek
Cottonwood Creek
Little Cottonwood Creek
Rock Creek
Prospect Creek
Center Creek
Antimony Creek
Poison Creek
North Creek
Ranch Creek
Birch Creek
Horse Creek
Twitchell Creek
White Creek
East Fork North Creek
Hall Creek
Sweetwater Creek
South Creek
Dry Creek
Clay Creek
Corn Creek
Cherry Creek
Allen Creek
Left Hand Allen Creek
Upper Valley Creek
Willow Creek
Canaan Creek
Blue Spring Creek
Lost Creek
Sand Creek
Lake Creek
Bear Creek
West Fork Boulder Creek
Boulder Creek
West Fork Deer Creek
Deer Creek
Frisky Creek
0 2 4 6 8 Miles
12
Oil & Gas Leasing EIS on Lands Administered by the Dixie National Forest
FIGURE 3.7-4
Water & Watershed Resources of the Escalante Ranger District
Horizontal Datum = NAD 83
Coordinate System = Zone 12N
1:320,000
1 in = 5 miles
Legend
Cities
Minor Roads (1)
Highways
Streams
Major Streams & Rivers
Water Bodies
National Forest System Lands
Dixie National Forest
Wilderness Areas
Fishlake National Forest
300-foot Riparian Buffer
Municipal Watersheds
Watersheds (HUC 10)
Other Land Administration
Bureau of Land Management
GSENM (2)
National Park Service
Private
State of Utah
NOTES
(1) Not all roads are shown. Only some roads are depicted for orientation purposes.
(2) Grand Staircase-Escalante National Monument. Managed by the Bureau of Land Management.
Original data was compiled from multiple source data and may not meet the U.S. National Mapping Accuracy Standard of the Office of Management and Budget. For specific dates and/or additional digital information, contact the Forest Supervisor, Dixie National Forest, Cedar City, Utah. This map has no warranties to its contents or accuracy.

3.8 Soils and Geologic Hazards

3.8.1 Introduction

This section describes five soil and landform categories by ranger district, including steep slopes, erosive soils, unstable slopes, rockfall areas, and caves. The data used to identify areas of soils and geologic hazards comes from completed Order 3 soil surveys of the Dixie National Forest (unpublished) as well as the State Soil Survey Geographic Database (STATSGO) data (NRCS 2005). These surveys encompass a spatial GIS coverage, which includes a National Soils Information System (NASIS) database, mapping unit, and taxonomic unit descriptions. These Order 3 soil surveys have soil boundaries plotted by interpretation of aerial maps and remotely sensed data. Boundaries were verified by traversing representative areas (USFS 2004f). In addition, steep slope analysis used 98.4x98.4 feet (30x30 meter) Digital Elevation Model projections using both analog and stereo aerial imagery. These data were used to determine the acreage of areas with steep slopes, areas of erosive soils, areas with unstable slopes or soils, and areas prone to rockfall. These soil and geologic features were noted as concerns because they can be unstable and prone to erosion, landslides, or mass wasting. Oil and gas development in these areas can lead to potentially hazardous conditions, and reclaiming disturbance that occurs on sensitive soils/geologic hazards can be slower than on more forgiving lands leading to long-term scars, potential invasion of noxious weeds, and degradation of vegetative resources.

Also included in the analysis of geologic conditions are cave resources. These diverse and sensitive subterranean landforms support flora, fauna, and unique geological resources, and are significant sources of culinary water and stream flow from the Dixie National Forest. Potential resource concerns related to oil and gas exploration, drilling, and production include water pollution; air pollution; changes to the temperature, barometric pressure, and humidity of cave ecosystems; collapse of caverns causing surface subsidence; and explosions due to build-up of trapped natural gas (BLM 2006c).

Soils and geologic hazards and cave resources are presented and discussed in this report by ranger district. Table 3.8-1 lists the number of acres with sensitive soils and geologic hazards in each ranger district and includes the percentage of those lands within each ranger district. Figure 3.8-1 shows the location of these areas on the Dixie National Forest.

3.8.2 Soils Resources

Soils are composed of a complex mixture of mineral matter, organic matter, and living organisms. Surface soil horizons (i.e., layers) differ from underlying geologic/rock material as the result of geologic processes and interactions of geologic materials with the climate and living organisms. Soils on the Dixie National Forest are diverse and are a reflection of soil parent material, landform processes, vegetation, and a mountainous, continental climate characterized by variable precipitation and temperature extremes (USFS 1995a). Soils on many slopes can be limited, or shallow, and in general, soils are deepest along low gradient slopes, valley bottoms, and in glacial basins (USFS 1986).

3.8.3 Geological Resources

The geology of the Dixie National Forest has been discussed thoroughly in USFS (1995a). The following provides a summary of that information. The Dixie National Forest extends from southwestern Utah to south central Utah just west of Capitol Reef National Park. It spans a

zone of geologic transition from the block faulting and complex rock types of the Basin and Range physiographic province in the west to the gently warped plateau and sedimentary strata of the Colorado Plateau physiographic province in the east. The boundary between the provinces in southwest Utah generally parallels Interstate 15 between the towns of St. George and Parowan (USFS 1995a). Elevations are generally greater than 6,000 feet and include the Pine Valley Mountains and the Kolob-Markagunt, Sevier-Paunsaugunt, and Aquarius-Kaiparowits Plateaus (USFS 1995f).

The Basin and Range province is characterized by steeply faulted horsts (an upthrown area between two parallel faults) and thick, sediment filled grabens (a downthrown block between two parallel faults). The Pine Valley Ranger District is located in the Basin and Range province (USFS 1995e). The remaining portions of the Dixie National Forest are located in the Colorado Plateau province, which consists of a series of plateaus, mesas, and buttes formed from horizontal to gently dipping strata with major faults, monoclinal folds, anticlines and synclines, domes, and basins. Streams have eroded deep canyons and escarpments occur in many areas. Extrusive igneous rocks occur around the province while volcanic cones and flows are common. Some alpine glaciations have occurred in a few of the highest areas such as around Boulder Mountain and the Aquarius Plateau on the Escalante Ranger Districts and in the Brian Head area on the Cedar City Ranger District (USFS 1995e). Short growing seasons limit soil development in these areas.

Table 3.8-1 Acres of Sensitive Soils and Geologic Hazards on the Dixie National Forest, by Ranger District

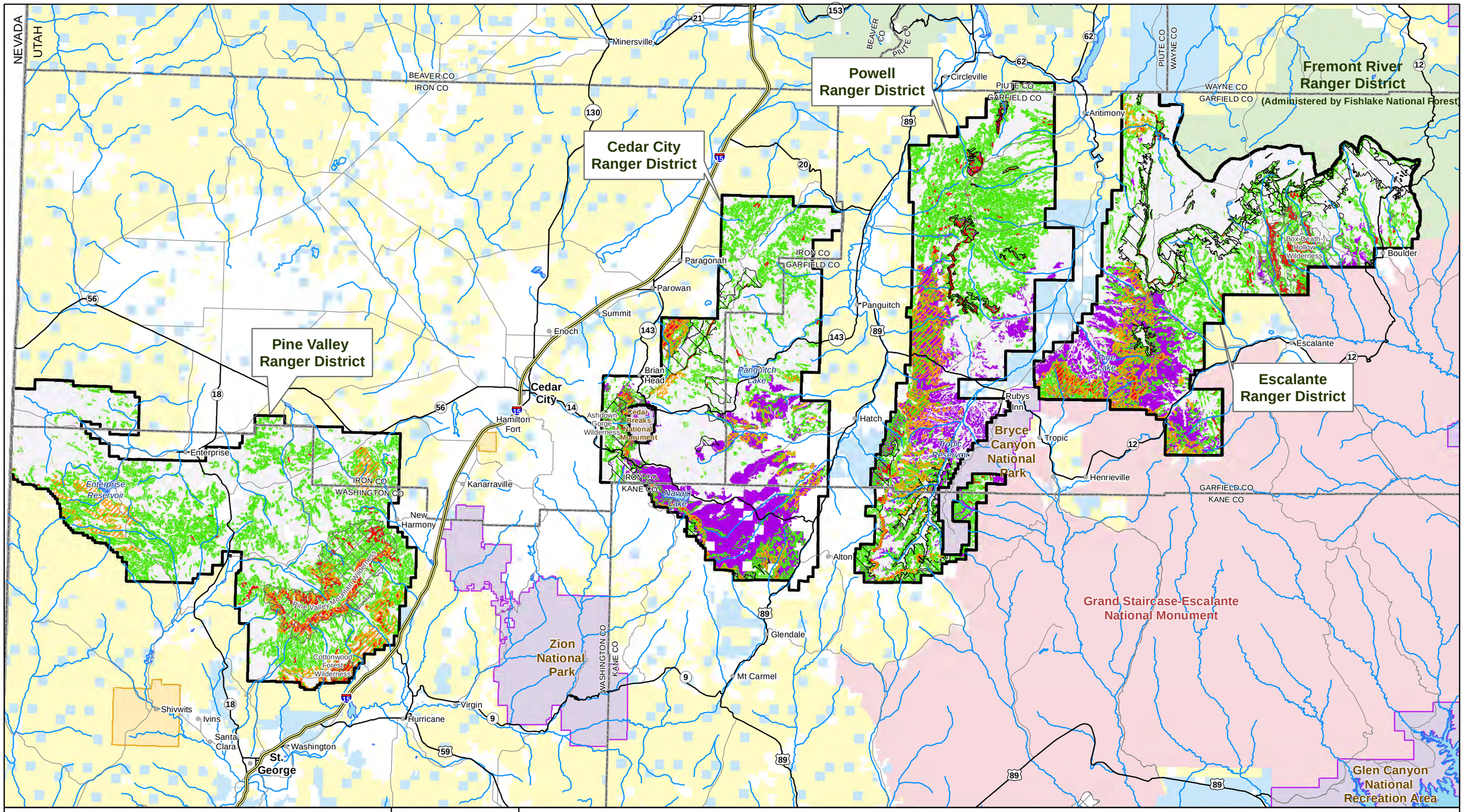
Ranger District	Acres of Public Land Defined As Having Sensitive Soils, Not Taking Into Account Any Overlap:					Total Acres of Public Land	
	Steep Slopes	Erosive Soils	Unstable Soils	Prone to Rockfall		Sensitive Soils in Ranger District, with each acre counted only once	All Lands in Ranger District
Pine Valley	126,058	35,410	0	7,857		**144,023**	463,020
Cedar City	56,174	12,085	13,758	1,373		**79,201**	353,424
Powell	108,476	26,357	8,041	2,865		**126,415**	383,899
Escalante	91,769	22,111	22,190	5,058		**112,193**	430,897
TOTAL Acres[1]	**382,477**	**95,964**	**43,988**	**17,153**		**461,831**	**1,631,240**

[1]Note that Total Acres of Steep, Erosive, Unstable, and Rockfall soils is 539,582 acres, but there are only 461,831 acres of sensitive soils. This is because there is some overlap: some areas are both steep and erosive. The column "Sensitive Soils in Ranger District …" counts each acre of sensitive soils only once.

3.8.4 Soil and Geologic Conditions Identified for further evaluation

The following soil and geologic conditions were used to identify sensitive areas on the Dixie National Forest. Their definitions are explained below.

Steep slopes: Steep slopes are defined as those slopes that are at 35 percent (20 degrees) or steeper, based on analysis of Digital Elevation Models. For this EIS, these projections used



Oil & Gas Leasing EIS on Lands Administered by the Dixie National Forest

FIGURE 3.8-1
Sensitive Soils & Geologic Hazards

Horizontal Datum = NAD 83 Coordinate System = Zone 12N	1:590,000	1 in = 9 miles

Legend

- Cities
- Freeways
- Highways
- Minor Roads*
- Major Streams & Rivers
- Water Bodies
- County Boundaries
- State Boundaries

National Forest System Lands

- Dixie National Forest
- Wilderness Areas
- Fishlake National Forest

Other Land Administration

- Bureau of Land Management
- GSENM**
- National Park Service
- Private
- State of Utah
- Tribal

- Areas of High Erosion Potential
- Claron Formation
- Rockfall Hazard
- Slopes >35%
- Unstable Areas

Miles: 0 4 8 12 16

Original data was compiled from multiple source data and may not meet the U.S. National Mapping Accuracy Standard of the Office of Management and Budget. For specific dates and/or additional digital information, contact the Forest Supervisor, Dixie National Forest, Cedar City, Utah. This map has no warranties to its contents or accuracy.

*Not all roads are shown. Only some roads are depicted for orientation purposes.
**Grand Staircase-Escalanted National Monument. Managed by the Bureau of Land Management.

both analog and stereo aerial imagery to create contour lines. Approximately 382,477 acres of the Dixie National Forest are comprised of slopes at or steeper than 35 percent.

Erosive soils: Erosive soils "consist of steep slopes, shallow soils, sparse vegetation, and are subject to rapid runoff." Runoff rates are determined by factors including previous human impacts, vegetative cover (less cover generally equals more runoff), water infiltration rate, soil texture, and the soil erodibility factor (K factor, as used by the Natural Resources Conservation Service (NRCS)).

A given soil may have a high inherent erodibility, but if it occurs on flat or low gradient slopes and has a rapid permeability, it would have a low erosion hazard ranking (BLM and USFS 2001). However, wet soils can be unstable and prone to slumping even on relatively flat ground if the inherent strength of soils is low. Soils derived from swelling clays become slippery and are prone to failure along planes of weakness, such as where a slope steepens, or along the edges of gullies and washes. Volcanic ash, when loose and granular in texture, is prone to slippage when wet or dry. The same is true for shale-derived channers: flat, platy rocks from less than one inch to several inches across. Steep slopes, large particle size, very small particle size, minimal vegetation coverage, water infiltration, and road cuts all aggravate weak soil structure.

Where the underlying C horizon or bedrock forms a relatively smooth surface dipping in the same direction as the slope, water can act as a lubricant on this sliding plane, allowing overlying layers to slip. This typically happens after prolonged wet periods. Two examples of massive slides occurring in the Intermountain West due to water and sliding planes are at Thistle, Utah and Gros Ventre, Wyoming.

The Dixie National Forest estimates that 95,964 acres are covered with highly erodible soils (see Table 3.8-1).

Unstable Slopes: Unstable slopes are "lands which are prone to mass failure under natural conditions..., and where human activities...are likely to increase landslide distribution in time and space" (Reid et al 1994). The GIS data depicting unstable soils used in this EIS are based on an analysis of areas that show "evidence of recent mass movement, fresh cracks are discernible, and probability of increased additional movements is high." These GIS data also include "areas that show discernible evidence of past landslide activity [that are] gaining stability but [may include] areas subject to reactivation of mass movements." Landslides occur anywhere the cohesiveness of the soil or bedrock cannot hold the material against gravity, often due to high precipitation, high elevation, steep slopes, and slide-prone geologic materials (USFS 1995a). They can be natural or human triggered and can occur when the slope has been steepened or when the moisture regime has changed. These areas are unsuited for road and well pad construction due to the high likelihood of slope failure. According to GIS data provided by the Dixie National Forest, unstable slopes may occur on approximately 43,988 acres of the Dixie National Forest (see Table 3.8-1).

The geologic units that commonly have slope failure in southwestern Utah include the Sevier River Formation; Tertiary volcanic rocks including the Bullion Canyon volcanics, Mt. Dutton Formation, and Mt. Belknap volcanics; Claron Formation; Tropic Shale; Carmel Formation; Chinle Formation, primarily the Petrified Forest Member; Moenkopi Formation; Wheeler Shale; and the Chisholm Formation. These formations include abundant clay weathered from parent shales and tuffs, and are affected by weathering and erosion. They are particularly prone to

landslides where slope angle, precipitation, aspect, and geologic structure are favorable (USFS 1995f).

Rockfall areas: According to the GIS metadata, areas mapped as having a high potential for rockfall have steep slopes of over 80 percent, or 38 degrees, covering at least five acres. Typically, rockfall occurs where there is exposed and poorly cemented rock. Rock fragments detach from parent bedrock along joints, bedding planes, or other zones of weakness. Newly detached or previously detached rockfall can roll or bounce downslope, causing damage. Rockfalls are abundant in southwestern Utah, especially in the Navajo Sandstone, the sandstone members of the Kayenta and Moenave formations, and in the upper Cenozoic basalts and rhyolites (USFS 1995f). The Dixie National Forest estimates that 17,153 acres (see Table 3.8-1) have high rockfall hazard.

Caves and Cave Resources: A cave is any naturally formed void, cavity, recess, natural pit, sinkhole, or other feature that is large enough to permit a person to enter, whether or not the entrance is naturally formed or human-made. The term includes any extension or component of a cave or system of interconnected cave passages that occur beneath the surface of the earth or within a cliff or ledge, and/or natural subsurface water and drainage systems. The Federal Cave Resources Protection Act of 1988 protects cave and cave resources identified by federal agencies as significant based on the following six categories: biota, cultural, geologic/mineralogic/paleontologic, hydrologic, recreational, and educational or scientific. Cave resources include any material or substance occurring naturally in caves, such as animal life, plant life, paleontological deposits, sediments, minerals, speleogens (relief features on the walls, ceiling, and floor of any cave that are part of the surrounding bedrock), and speleothems (any natural mineral formation or deposit occurring in a cave; USFS 2003b). Cave resources on the Dixie National Forest have not been thoroughly mapped.

3.8.5 Soil Terminology Used in the Text

Alluvium: Sediment deposited by running water on which a soil then develops. It may occur on terraces well above present streams or in the normally flooded bottomland of existing streams. Remnants of very old stream terraces may be found in dissected country far from any present stream (NRCS 2007a).

Badland: A moderately steep to very steep barren land dissected by many intermittent drainage channels. Ordinarily, the areas are not stony. Badland is most common where streams cut into soft geologic material. It is often found in steep, deep arroyos, up to 600 feet or more deep. Potential runoff is very high and erosion is active (NRCS 2007a).

Channers: Small, cobble-sized rocks that are angular instead of rounded due to being derived from shale or limestone.

Colluvium: Poorly sorted debris that has accumulated at the base of slopes, in depressions, or along small streams through gravity, soil creep, and local wash. It consists largely of material that has rolled, slid, or fallen down the slope under the influence of gravity. Accumulations of rock fragments are called talus. The rock fragments in colluvium are usually angular, in contrast to the rounded, water-worn cobbles and stones in alluvium and glacial outwash (NRCS 2007a).

Epipedon: A diagnostic soil horizon (identifiable layer) used to characterize a soil that has formed at the surface of the earth and occurs nowhere else in the soil, unless the soil is buried under water, wind, or volcanic deposits. An epipedon is defined mostly in terms of soil color,

content of organic matter and base saturation (relative amounts of base ions such as calcium, magnesium, sodium, and potassium as compared to the acidic ion, hydrogen). Two common epipedons found on the Dixie National Forest are called “mollic” and “ochric” (NRCS 2007a).

Mollic epipedon: A dark colored, rich, loamy surface horizon with at least 2.5 percent organic matter and at least 4-10 inches depth before other soil horizons, such as a clay or calcium-rich horizon, are encountered (NRCS 1998). This is a good cropland soil.

Ochric epipedon: A soil that is lighter colored (often reddish or yellow-brown) than the mollic epipedon. It is too thin, dry, or lacks enough organic material to be classified as mollic. It is common on the Dixie National Forest. The surface layer is well developed and easily identifiable because it is generally darker than deeper horizons when viewed in a soil test pit, road cut, etc., (NRCS 1998). Other common epipedons in southwest Utah are the Entic or Aridic epipedons. The layering in these soils is less obvious as the soils are less developed (NRCS 2007c).

Residuum: The term "residuum" is used when the properties of the soil indicate that it has been derived from rock that underlies it and when evidence is lacking that it has been modified by movement. The surrounding landscape and elevation are often helpful in identifying whether material has weathered in place and is thus residuum (NRCS 2007a).

Rock outcrop: Exposures of bare bedrock other than lava flows and rock-lined pits. Some areas are large, broken by small areas of soil while others are extensive (acres in size). Most rock outcrops are hard rock, but some are soft (NRCS 2007a).

Soil complex: A group of two or more dissimilar soil types occurring in a regularly repeating pattern. Each time the soil complex is mapped, one can assume that each major component is present, though their proportions may vary (NRCS 2007a).

Soil map unit: The delineation of a soil or group of soils marked on a soils map. Different soil maps have different levels of detail, depending on map scale, but whatever the scale, the basic grouping of soils is considered the map unit (NRCS 2007a).

3.8.6 Pine Valley Ranger District

The Pine Valley Ranger District is located on the west side of the Dixie National Forest in the Basin and Range province and covers 463,020 acres of public land. There are 126,058 acres (27 percent) on the ranger district that are considered steep (greater than 35 percent slopes), 35,410 acres (eight percent) listed as erosive, and 7,857 acres (one percent) listed as prone to rockfall. There are seven main areas of steep, erosive, or rock-fall prone soils on the ranger district. No areas of unstable soils or slopes have been identified on the Pine Valley Ranger District.

Pine Valley Mountain is a prominent landmark on the southeast side of the Pine Valley Ranger District, which contains the majority of steep slopes, erosive soils, and rockfall areas within the ranger district. The steep, southeast-facing escarpment of Pine Valley Mountain is the only part of the ranger district identified as having rockfall hazard. This escarpment is dominated by soil map unit number s8175 (Rock Outcrop-Pinitos family-Montez-Canlon family soils association). The Pinitos soils are very deep, well-drained, moderately permeable soils that developed in eolian and alluvial material derived from sandstone and shale on hills, fan terraces, cuestas, and mesas. The Montez series consists of deep, well-drained soils that formed in granite

colluvium and residuum at high elevations on slopes. Canlon series consist of shallow, well-drained and somewhat excessively drained, moderately permeable soils derived from lime-cemented sandstone and caliche on ridgelines and slopes. Rock outcrops occur on slopes and ridge tops. These soils have either a clay or rock layer below the A horizon and are moderate to excessively drained with areas of rapid runoff. Precipitation ranges from 15 to 23 inches, and elevations range from 6,700 to 9,500 feet (NRCS 2007b). Table 9.4-2 in Specialist Report 9.0 (Soil Resources) summarizes characteristics for these and other soils described in this report.

The north side of the Pine Valley Mountains is labeled as s8176 (Rock outcrop-Olot family-Gralic family-Falcon family-Eyre family soil association). Most of this area is within designated wilderness. These soils are derived from volcanics and sandstone, tend to be quite steep (2 to 90 percent) and range from 4,000 to 10,000 feet in elevation. The Olot and Gralic series are moderately deep, well-drained soils that formed in volcanic ash, colluvium, and residuum weathered from basalt and are somewhat acidic. The Falcon and Eyre families of soils are shallow and weathered from fractured sandstone and arkosic materials and are neutral to acidic. There is very little clay accumulation in these soils. The A horizon is typically a fine to coarse sandy loam with a weak, granular structure. Pumice and volcanic ash are common. Deeper layers are blockier but lack stickiness or plasticity. Precipitation ranges from 17 to 37 inches annually (NRCS 2007b).

The low elevation southeast corner of the ranger district is dominated by soil map unit numbers s8186 (Rock outcrop-Redbank family-Mespun-Caval), s362 (Rock outcrop), and s8219 (Tobish-Tacan-Nehar-Collbran family). These soils are sandstone-derived and include mostly fine sandy loams and some stony loams. These soils are associated with red soils typical of Wingate and Moenkopi formations and the blonder Navajo, Kayenta, and Dakota formations. These soils are very deep, to deep, moderately to rapidly permeable, with slow runoff. Although they are deep, there are shallow areas (in some areas depth to rock friable sand, or unaltered gravels is only about five inches) indicating association with alluvial deposits. These soils have many steep and erosive areas due to their association with recent floodplains, dune formations, and fine, poorly cemented parent material. Elevation ranges from 3,500 to 7,000 feet and precipitation ranges from 8 to15 inches annually (NRCS 2007b).

To the west of the Pine Valley Mountains are the Bull Valley Mountains. These are on the west side of the Pine Valley Ranger District and are also dominated by steep slopes. West of the crest of the Bull Valley Mountains, south of Upper Enterprise Reservoir and Pine Park Campground, the land is a finely dissected upland of Tertiary volcanic flows and ash deposits. This soil map unit is numbered s5598 (Pioche-Motoqua-Gabvally map units). Soils are very shallow to shallow, well drained, with very high runoff and slow permeability. They are associated with hills and mountainsides and have slopes of 2 to 70 percent. They are formed from residuum and colluvium of volcanic rocks, including andesite, rhyolite, and tuff. The typical soil is a gravelly to stony loam with a mollic epipedon, a clay horizon starting between about 8 to 16 inches, and welded tuff or other volcanic rock parent material at about 15 or 16 inches. Elevation ranges from 5,500 to 8,600 feet and precipitation is about 13 inches per year (NRCS 2007b).

The hills around Ox Valley, located north of the Bull Valley Mountains and east of Lower Enterprise Reservoir, also contain steep slopes. These valleys are somewhat broader and are filled in with alluvial material from surrounding volcanic and shale rocks. Quaternary basaltic flows are also present here. This soil map unit is numbered s8178 (Security family-Podmor family-Pastorius family-Fughes family-Dalcan family soil complex). Soils are moderately deep, to deep, well drained, and moderately permeable with rapid to very rapid run-off. Most of these

soils are associated with hills and mountainsides and have slopes of 0 to 65 percent. The Pastorius soils are found on flat river terraces. The other soils are formed from residuum and colluvium of basalts (Dalcan), granite and gneiss (Security), shales (Fughes), and quartzite (Podmor) and are on more sloping terrain. Soils range from loams to cobbly loams and have a mollic epipedon. There is often a clay horizon below about 20 inches. The C horizon ranges from 23 to 60 inches or more in depth. Elevation ranges from 6,500 to 10,000 feet and precipitation is 18 to 20 inches per year (NRCS 2007b).

To the east of Ox Valley and north of Pine Valley Mountain, at the north end of the Pine Valley Ranger District is a highland cut by Spring Creek and South Fork Pinto Creek. Harrison Peak is the most prominent peak in this area. Soil map unit number s8180 (Wye family-Sampson family-Pastorius family-Nehar family-Muzzler family-Mokiak family-Bernal family soil complex) dominates this area. The Sampson, Pastorius, and Bernal soils are flat lying. The first two are found in stream channels and flat river terraces and the last is found on mesa tops. The Wye, Nehar, Muzzler, and Mokiak soils components more likely to be associated with steep areas are typically found on mountain slopes and rolling hills with between 15 to 70 percent slope. Nehar soils are on alluvial fans and are formed alluvium and residuum weathered from coarse-grained acid igneous rock, quartzite conglomerate, and with minor influence from basalt. The Muzzler soils are shallow while Mokiak soils are moderately deep, to deep. All three are well-drained soils that formed in place above igneous bedrock on mountain and hillsides. The Wye soils are deep, well-drained soils formed in material weathered from limestone. There is often a clay horizon and run-off is slow to moderate, with moderate permeability. Elevations are between 4,300 and 7,300 feet, with precipitation between 13 to 16 inches annually (NRCS 2007b).

The northeast corner of the ranger district contains another area of steep slopes and erosive soils, dominated by soil map unit number s8179 (Rock outcrop-Motoqua family-Falcon family-Dotsero family-Bernal family soil association). The mountains in this area include Flat Top Mountain, Granite Mountain, Stoddard Mountain, and Iron Mountain. These peaks are made up of Quaternary and Tertiary intrusive and extrusive volcanics, with soils derived from basaltic tuffs and sandstone. Soils range from loams to sandy or cobbly loams that are shallow to very shallow and medium to excessively drained with moderate permeability. These soils are found on mountainside slopes, sloping mesas, and benches and have slopes ranging from 1 to 64 percent. The Falcon series is the highest elevation soil in this soil map unit and is very shallow. It is found on ridgelines and has excessive drainage and moderate permeability to the rock layer, which is about 14 inches from the surface. Precipitation ranges from 13 to 17 inches and elevation ranges from 4,000 to 9,000 feet (NRCS 2007b).

3.8.7 Cedar City Ranger District

The Cedar City Ranger District lies east of Interstate 15. There are a total of 353,424 acres of public land on the ranger district. Within the ranger district there are 56,174 acres (16 percent) of steep slopes, 12,085 acres (3 percent) of erosive soils, 13,758 acres (4 percent) of unstable slopes, and 1,373 acres (less than 1 percent) prone to rockfall. This ranger district has most of the documented caves, which are discussed at the end of this section.

The west side of the ranger district is the same north-south trending escarpment, the Markagunt Plateau, which makes up Cedar Breaks National Monument. The land drops off to the west from a high point of over 11,000 feet at the rim to 6,000 feet near Vermillion Castle. The most widespread soils issue in this area is unstable slopes, while areas of steep slopes are confined to ridgelines and escarpments. This band of steep and unstable slopes is dominated by the Winnemuca-Seth-Faim soil map unit (s8216), which is characterized by volcanically derived

(basaltic) soils with moderate to rapid run-off and moderate to slow permeability. All soil map units have a mollic epipedon with clay horizon below. Annual precipitation ranges from 15 to 20 inches (NRCS 2007b).

Stout Canyon, draining out of the south end of the plateau, and Little Creek Peak, Bear Creek, and the Hurricane Cliffs at the north end of the ranger district areas of steep, rockfall-prone, unstable soils, and/or erosive soils. These soils are derived from sedimentary sandstones and shales, basaltic volcanics, and pyroclastic materials. Soils map units in these areas are s8232 (Syrett-Swapps-Skutum-Pahreah-Badland) and s8231 (Toman-Harol-Fughes-Dalcan-Bushvalley). These soils are moderately deep, well-drained, moderately permeable soils of gently to steeply sloping benches and the sideslopes of mesas. They formed in colluvium and residuum weathered from sedimentary rocks. Elevation ranges from 6,500 to 10,000 feet and precipitation ranges from 13 to 25 inches (NRCS 2007b).

The central and eastern portions of the ranger district are on top of the plateau, are flat lying, and dominated by stable soils. Lava fields, discussed in Section 3.7 (Water Resources) and shown in Figure 3.7-2, are associated with Tertiary volcanics and are only present on the Cedar City Ranger District.

Caves and Cave Resources: There are several lava tubes and limestone caves located on the Cedar City Ranger District. Some have been mapped. Two caves are open to the public. Ice Cave is a lava tube that is open most of the year and supports icicles year-round. Mammoth Cave is a large limestone cave that is closed during spring to protect a nursery of Townsend's big-eared bats, but re-opens in June. Both caves have gates to protect cave resources.

3.8.8 Powell Ranger District

The Powell Ranger District is located east of Panguitch, Utah. Of the 383,899 acres of public land on this ranger district, there are 108,476 acres (28 percent) of steep slopes, 26,357 acres (7 percent) of erosive soils, 8,041 acres (2 percent) of unstable slopes, and 2,865 acres (less than 1 percent) prone to rockfall, mostly located on the southwest side and the central northern portion of the ranger district. The ranger district is dominated by the Paunsaugunt Plateau on the south and the Sevier Plateau on the north.

The rim of the Paunsaugunt Plateau is near the western and southern boundaries of the Powell Ranger District. This rim itself has many areas of high rockfall potential. Virtually all the slopes to the west of and below the plateau rim are listed as steep and/or unstable. The soil map unit found here is the same as that found near Stout Canyon on the Cedar City District (s8232), and is described above.

East Fork Creek and its tributaries drain northward through the Paunsaugunt Plateau. This steep-sided drainage basin is outlined with a thin band of steep slope areas, which are surrounded by larger areas of unstable or erosive soils along the rim and in the canyon bottom. Bryce Canyon National Park is east of the East Fork and separates almost entirely a small segment of the ranger district that is located east of the National Park. This distinct area is highly dissected and riddled with steep slope areas. In short, most of the southern third of the Powell Ranger District is dominated by unstable soils. Soil map unit s8234 (Syrett-Swapps-Skutum-Sheege-Pahreah-Badland soil map unit) is similar to that found at the south end of the Cedar City Ranger District at Stout Canyon (NRCS 2007b).

North of the Paunsaugunt Plateau is an area of lower elevation. The western half of this area, centered around Red Canyon, is dominated by, and contains the most extensive area of erosive soils. Red Canyon is eroding back into the Paunsaugunt Plateau, creating a narrow, incised canyon of deep but poorly cemented red soils at its headwaters. This soil map unit, s8233 (Zyme-Vanet-Syrett-Rock outcrop-Badland map units), is made up of shallow to very shallow, well-drained soils. These soils range from 6,700 to 8,800 feet elevation. They generally have an ochric or mollic epipedon and are typically gravelly loams derived from limestone and shales. A clay horizon may occur at a depth of about 7 to 11 inches (Vanet). Lithic contact is between 23 to 38 inches and is typically shale or limestone (Syrett). Badlands soils are found on the slopes of benches and the sideslopes of mesas and range from 3 to 80 percent slope. Precipitation ranges from 13 to 22 inches (NRCS 2007b).

The Sevier Plateau, on the north end of the Powell Ranger District, is dominated by Mount Dutton to the north, Cottonwood Peak in the middle, and Adams Head to the south. These peaks form a narrow plateau that is dissected by several ephemeral drainages on the west, north, and east. The west-facing side of the escarpment is rimmed with rockfall areas that extend from the north end to the center of the ranger district. Both sides of the peaks are dominated by steep slope areas, although the west side is consistently steep, while the east side is more of a mosaic of steeper and flatter ground. The entire plateau is grouped within soil map unit s8237 (Winnemucca-Echard-Callings-Behanin-Beardall map units; NRCS 2007b). All these soils are deep, well drained, and slowly permeable. All are formed in alluvium and colluvium from volcanic materials except the Beardall, which is formed from limestone-derived glacial colluvium and residuum. Slopes range from 1 to 65 percent, with steep slopes being common. These higher-elevation soils receive 18 to 35 inches of precipitation (NRCS 2007b).

The largest areas of stable soils on the Powell Ranger District are found in the east central portions.

3.8.9 Escalante Ranger District

The Escalante Ranger District is located east of Johns Valley and north of the Grand Staircase-Escalante National Monument. Of the 430,897 acres of public land on this ranger district, there are 91,769 acres (21 percent) of steep slopes, 22,111 acres (five percent) of erosive soils, 22,190 acres (five percent) of unstable soils, and 5,058 acres (one percent) prone to rockfall, mostly located on the southern and southeastern sides of the ranger district.

The Aquarius Plateau dominates the north central portion of the Escalante Ranger District and is made up of mostly flat, stable lands located above 10,500 feet elevation. However, the rim of the plateau is steep, and the slopes just below the rim, to the south and west of the plateau, have extensive areas of unstable soils made up of alluvium and colluvium eroded principally from the volcanic rocks and ash of the plateau above. This is the most common soil concern on the ranger district. These areas fall almost exclusively within one soil map unit, s8172 (Tatiyee family-Security family-Scout family-Quilt family-Parkay family-Jemez family-Hesperus family soil map units). These soils are moderately to very deep and well to excessively drained. Slopes range from 5 to 70 percent. Precipitation ranges from 18 to 34 inches annually (NRCS 2007b).

At about 9,000 feet elevation at the east end of the Escalante Ranger District, and nearly 10,500 feet on the southwest end of the ranger district the igneous lava flows and erosional alluvium, colluvium, and residuum give way to sedimentary rocks of Eocene (Wasatch Formation), Paleocene (Currant Creek Formation), and Cretaceous age (Dakota, Mancos, Mesa Verde group) that are the headwaters of the canyons of the Escalante River. These lands extend

across the southern third of the ranger district. Steep slopes and rockfall areas are common, especially within and to the east of the Box-Death Hollow Wilderness (USFS 1995f)

The eastern third of these sandstone/shale bedrock areas is dominated by the s8225 (Yenlo-Mikim-Lazear-Clapper-Cannonville-Bayfield) soil map unit. These soils are derived from sandstones and shales and are typically loamy to sandy loam in texture. Soils are relatively deep (NRCS 2007b). The middle third of the sandstone/shale bedrock areas, located to the west of Box-Death Hollow wilderness, is dominated by soil map unit s8174 (Windwhistle family-Telephone family-Seleez family-Security family-Rock outcrop-Bond family-Atchee family). These soils are typically shallower and more sandy to cobbly in texture with more granitic parent material derived from erosional forces. There are sloping dune areas and cuestas (NRCS 2007b). The western third of the sandstone/shale bedrock areas includes the Escalante Mountains, a relatively narrow ridgeline that is being eroded from both east (Escalante drainage) and west (Sevier River). The two most prominent peaks are Table Cliff Plateau (10,300 feet) and Barney Top (10,450 feet). The lowest elevation lands on the eastern flanks of the Escalante Mountains are covered by the same s8225 soil map unit noted above and have numerous isolated areas of steep slopes associated with canyon rims (NRCS 2007b).

The Escalante Mountains ridge crest is dominated by the s8234 (Syrett-Swapps, Skutum, Pahreah-Badland) soil map unit. Soils are both steep and erosive. In areas other than the barren, eroding Badlands, soils are generally moderately deep, well drained, and moderately permeable sandy to gravelly loams. They are found on gently to steeply sloping benches and the sideslopes of mesas. These soils are both steep and erosive. A ring around the summit of Barney Top also has unstable soils. Precipitation ranges from 19 to 25 inches (NRCS 2007b).

The last area of steep and erosive soils is found in the southwest corner of the Escalante Ranger District at the headwaters of East Canyon, which drains to the Paria River. This soil map unit, s8233 (Zyme-Vanet-Syrett-Rock outcrop-Badland map units), is made up of shallow to very shallow, well-drained soils. These soils range from 6,700 to 8,800 feet in elevation. They generally have an ochric or mollic epipedon and are typically gravelly loams derived from limestone and shales. A clay horizon may occur at about 7 to11 inches depth (Vanet). Lithic contact is between 23 to 38 inches and is typically shale or limestone (Syrett). Badlands soils are found on the slopes of benches and the sideslopes of mesas and range from 3 to 80 percent. Precipitation ranges from 13 to 22 inches annually (NRCS 2007b).

3.9 Vegetation

3.9.1 Introduction

The Dixie National Forest contains 1.8 million acres of diverse vegetation across a wide range of elevations, from 2,800 feet near St. George to over 11,000 feet on Mount Dutton. Vegetation is characterized mainly by low-growing shrub, pinyon pine and juniper, mixed stands of aspen and conifers (pine, spruce, and fir), and high elevation plateaus that contain sagebrush and grassland meadows, high-altitude forests, and gently rolling hills (USFS 1995d:2; Utah Office of Tourism 2007).

In addition to major vegetation communities, there are several unique vegetation areas or those with special designations that serve specific purposes on the Dixie National Forest. These include soil crusts, the Red Canyon Botanical Area, the Side Hollow Study Area, and five Research Natural Areas.

3.9.2 Major Vegetation Communities

Vegetation communities on the Dixie National Forest can be broadly classified into eight types: pinyon-juniper, aspen/conifer, ponderosa pine, mountain brush, sagebrush steppe, spruce-fir, grassland/meadow, and desert scrub (Figure 3.9-1). The number of acres of each major vegetation community occurring within each ranger district is described in Table 3.9-1; communities are described in more detail below.

Table 3.9-1 Acres of Major Vegetation Communities on the Dixie National Forest

Ranger District	Pinyon-juniper	aspen conifer	pine wood	moun-tain brush	sage steppe	spruce fir	grass meadow	desert scrub	Other[1]	TOTAL[2]
Pine Valley	234,615	33,465	4,032	142,193	16,875	0	479	10,904	20,287	462,850
Cedar City	33,743	96,313	66,450	36,511	47,543	33,683	12,647	0	26,146	353,036
Powell	56,655	49,428	26,283	0	117,774	35,530	24,032	0	74,175	383,877
Escalante	97,668	69,096	76,423	5,361	49,517	53,631	12,364	488	66,309	430,857
Total	422,681	248,302	173,188	184,065	231,709	122,844	49,522	11,392	186,917	1,630,620

[1] Includes water bodies and rocky areas with little vegetation.
[2] Total acreage of vegetation includes all areas within the administrative boundary not including private lands. The totals do not match the overall acreages in each ranger district (i.e., listed in Chapter 2) due to the differing sources of data.

PINYON-JUNIPER

Single needle or two-needle pinyon pine-Utah juniper (*Pinus monophylla* or *P. edulis* - *Juniperus osteosperma*; "pinyon-juniper") woodland is the most abundant vegetation type on the Dixie National Forest, covering 422,681 acres (26% of the Dixie National Forest). *P. monophylla* lies within the Great Basin, mainly west of Enterprise, Utah, on the Pine Valley Ranger District. Two-needle pinyon (*P. edulis*) is found on the Colorado Plateau, mainly east of Enterprise, within the Pine Valley, Cedar City, Powell, and Escalante Ranger Districts. Pinyon-juniper woodland occurs on most lower slopes and hillsides and usually includes a prominent shrub component of sagebrush (*Artemisia tridentata*), rabbitbrush (*Chrysothamnus nauseosus*), curleaf mountain mahogany (*Cercocarpus ledifolius*), prickly pear (*Opuntia polyacantha*), blackbrush (*Coleogyne ramosissima*), or antelope bitterbrush (*Purshia tridentata*). The relatively larger pinyon tends to favor higher elevations, while Utah juniper becomes dominant at lower elevations. Similar to ponderosa pine (*Pinus ponderosa*), pinyon-juniper is greatly affected by human disturbance because of its presence at low elevations. Stands of pinyon-juniper may be dense or open, even or mixed age, and multi- or single-stemmed. Common associates include rockcress (*Arabis perennans*), sulfur buckwheat (*Eriogonum umbellatum*), snakeweed (*Gutierrezia sarothrae*), Indian ricegrass (*Achnatherum hymenoides*), Carpet phlox (*Phlox hoodii*), trumpet gilia (*Gilia aggregata*), and red paintbrush (*Castilleja chromosa*; USFS 1995d:4).

ASPEN/CONIFER

Aspen/conifer vegetation covers 248,302 acres (15% of the Dixie National Forest). Lower elevations of the subalpine zone are characterized by aspen (*Populus tremuloides*) stands and mixed coniferous forest of subalpine fir (*Abies lasiocarpa*), Engelmann spruce (*Picea engelmannii*), scattered ponderosa pine, and Douglas-fir (*Pseudotsuga menziesii*). Aspen is an aggressive pioneer species that usually occurs in swales or along drainages. In general, seral aspen stands are being replaced by spruce-fir over time due to changes in disturbance patterns (i.e., fire suppression and livestock grazing). Aspen forest may contain mature trees, but well-developed stands are usually characterized by a prominent spruce-fir understory. Other

understory species include mountain snowberry (*Symphoricarpos oreophilus*), currant (*Ribes spp.*), common juniper (*Juniperus communis*), and lupine (*Lupinus argenteus*). Limber pine (*Pinus flexilis*) characterizes dry, rocky ridges, often in conjunction with scattered patches of common juniper. Other conifers that characterize the transition zone between high elevation spruce-fir forest and lower elevation ponderosa pine forest include white fir (*Abies concolor*), Douglas-fir, limber pine, and ponderosa pine. Small meadows and rock outcrops occur throughout this vegetation type (USFS 1995d:3, 11).

PONDEROSA PINE AND WOODLAND

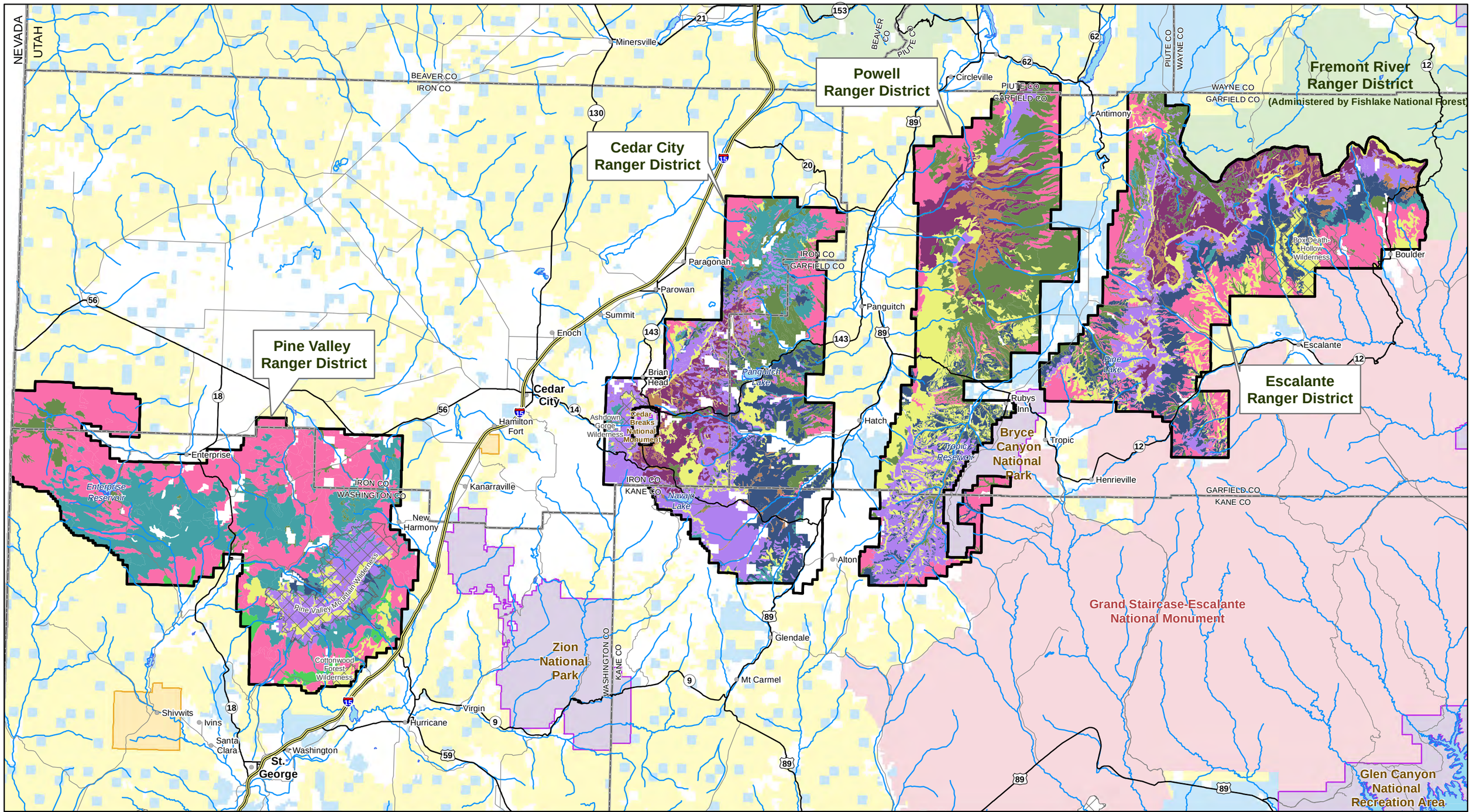
Ponderosa pine forest and woodland covers 173,188 acres (11% of the Dixie National Forest) across much of the montane zone, especially on the drier plateaus and south-facing slopes. Like aspen, it is both a seral and climax community, but relatively more disturbed by humans due to its location on lower elevations. Where ponderosa pine is the climax species within a community, a more open, park-like density occurs, in contrast to seral ponderosa pine forests, which are denser. In general, the understory is open and contains a few shrubs, including Ross's sedge (*Carex rossii*), June grass (*Koeleria cristata*), wild buckwheat (*Eriogonum spp*.), stemless goldenweed (*Hymenoxys acaulis*), and scattered patches of Gambel oak (*Quercus gambelii*). Ponderosa pine ranges from 10 to 24 inches and up to 40+ inches diameter at breast height (DBH) and from 60 to 80 feet in height on many sites. Larger trees (40 to 50 inches DBH) occur on the more mesic areas (USFS 1995d:3, 11).

MOUNTAIN BRUSH

Mountain brush vegetation covers 184,065 acres (11% of the Dixie National Forest). This community is most commonly transitional vegetation between pinyon-juniper woodlands and cooler, high elevation forests, and occurs mainly in the Pine Valley Ranger District. Over 55,000 acres (30%) of the mountain shrub type is dominated by Gambel oak. Mountain mahogany (*Cercocarpus* spp.) -dominated communities, scattered throughout the Dixie National Forest, are also included in the mountain brush type. Within the mountain brush type, there is the hard-leaved chaparral area that is unique in Utah and occurs only on the east-facing slopes of Pine Valley Mountain, from approximately Leeds Canyon north through the Browse Research Natural Area (see discussion under Browse Research Natural Area).

SAGEBRUSH STEPPE

Sagebrush steppe covers 231,709 acres (14% of the Dixie National Forest), and most often occurs on sideslopes. Sagebrush species on the Dixie National Forest include mountain big sagebrush (*Artemisia tridentata var. vaseyana*), basin big sagebrush (*A. tridentata var. tridentata*), Wyoming big sagebrush (*A. tridentata var. wyomingensis*), black sagebrush, (*A. nova*), and silver sagebrush (*A. cana*). Sage steppe usually contains several grass and shrub associations. Common grasses include mountain wheatgrass (*Agropyron dasystachyum*), needlegrass (*Stipa comata*), sand dropseed (*Sporobolus cryptandrus*), blue grama (*Bouteloua gracilis*), Letterman's needlegrass (*Stipa lettermanii*), western wheatgrass (*Agropyron smithii*), Indian ricegrass, galleta (*Hilaria jamesii*), and cheatgrass (*Bromus tectorum*); shrub associations include rabbitbrush (*Chrysothamnus* spp.), snakeweed (*Gutierrezia sarothrae*), winterfat (*Krascheninnikovia lanata*), horsebrush (*Tetradymia canescens*), and antelope bitterbrush (UDWR 2005).



Oil & Gas Leasing EIS on Lands Administered by the Dixie National Forest

FIGURE 3.9-1
Major Vegetation Communities on Dixie National Forest

Horizontal Datum = NAD 83 Coordinate System = Zone 12N	1:590,000	1 in = 9 miles

Legend

- Cities
- Freeways
- Highways
- Minor Roads*
- Major Streams & Rivers
- Water Bodies
- County Boundaries
- State Boundaries

National Forest System Lands

- Dixie National Forest
- Wilderness Areas
- Fishlake National Forest

Other Land Administration

- Bureau of Land Management
- GSENM**
- National Park Service
- Private
- State of Utah
- Tribal

Vegetation Types***

- Aspen/Conifer
- Desert Shrub
- Grassland/Meadow
- Mountain Brush
- Other
- Pinyon-Juniper
- Ponderosa Pine/Woodland
- Sage Steppe
- Spruce Fir

Miles: 0 4 8 12 16

N

Original data was compiled from multiple source data and may not meet the U.S. National Mapping Accuracy Standard of the Office of Management and Budget. For specific dates and/or additional digital information, contact the Forest Supervisor, Dixie National Forest, Cedar City, Utah. This map has no warranties to its contents or accuracy.

*Not all roads are shown. Only some roads are depicted for orientation purposes.
**Grand Staircase-Escalanted National Monument. Managed by the Bureau of Land Management.
***SOURCE: Dixie National Forest. 4/17/2007. Vegetation types condensed.

SPRUCE-FIR

Engelmann spruce and subalpine fir ("spruce-fir") stands cover 122,844 acres (eight percent of the Dixie National Forest) and are found at higher elevations where the climate is cooler and more humid. Spruce-fir vegetation on the Dixie National Forest is composed of relatively large and longer-lived Engelmann spruce (up to 40 inch DBH, 70 feet tall) and relatively smaller subalpine fir, which is somewhat shade-tolerant and usually dominates the understory. If the site is moist, Engelmann spruce is most abundant, while in drier areas pure stands of subalpine fir may occur. Above 11,000 feet elevation, Engelmann spruce may or may not contain a subalpine fir understory. Other understory species vary depending on substrate and elevation, but commonly include arnica (*Arnica cordifolia*), bluebell (*Mertensia* spp.), meadowrue (*Thalictrum* spp.), Ross's sedge (*Carex rossii*), and vetch (*Vicia americana*; USFS 1995d:3).

GRASSLAND/MEADOW

Grassland/meadow vegetation covers 49,522 acres (three percent of the Dixie National Forest), and occurs over a wide elevation range depending on site history (logging, fire) and moisture regimes. In general, wet and semi-wet freshwater meadows are frequently encountered on mountain rangelands where water concentrates and spreads, occurring in conjunction with springs and plateaus where rapid drainage is impeded. Sedges *(Carex spp.*) generally dominate these areas with rush (*Juncus arcticus*), dandelions (*Taraxacum officinale*), phlox (*Phlox spp.*), starlily (*Leucocrinum montanum*), and wild iris (*Iris missouriensis*). High elevation meadows are characterized by grasses and sedges, as well as scattered shrubs of currant (*Ribes spp.*), cinquefoil (*Potentilla fruticosa*), and elderberry (*Sambucus racemosa*; USFS 1995d:4).

DESERT SCRUB

Mojave desert scrub vegetation on the Dixie National Forest occurs mainly in the Pine Valley Ranger District and covers 11,392 acres (one percent of the Dixie National Forest); major species include blackbrush (*Coleogyne ramosissima*), desert peach (*Prunus fasciculate*), and Mormon tea (*Ephedra sp.*). Blackbrush dominates the desert scrub areas of the Dixie National Forest.

3.9.3 Gypsum Soils and Biological and Chemical Soil Crusts

In many dry areas where vegetation is sparse, such as in the Pine Valley Ranger District of the Dixie National Forest, biological soil crusts are present in the open spaces between plants. Biological soil crusts are a complex mosaic of cyanobacteria, lichens, and mosses. Crust components form a matrix that stabilizes and protects soil surface from erosion, retains soil moisture, discourages annual weed growth, fixes atmospheric nitrogen, and contributes organic matter to the soil. Soil crusts of the Colorado Plateau are generally composed of non-heterocystic cyanobacteria (*Microsoleus*) and nitrogen-fixing lichens (*Collema*). Calcareous and gypsiferous soils, or outcrops comprised of fine-textured soils with high concentrations of sulfate and calcium, generally support a high coverage of species-rich crust (BLM 2001). Biological crusts are most likely to occur at sites with salt desert shrub, blackbrush, pinyon-juniper, or sagebrush vegetation; low herbaceous plant density but dominated by bunchgrasses; low annual precipitation (less than 12 inches); fine silt loams and clays; stable embedded rocks; relatively long fire interval (greater than 50 years); and mid- to late-seral succession conditions (Rosentreter and Pellant *draft*). Because biological soil crusts take a relatively long time to develop, the presence, absence, and abundance of early- or late-successional taxa in the crust can provide information regarding a site's disturbance history (BLM 2001). Biological soil crusts on the Dixie National Forest have not been mapped.

Physical and chemical soil crusts are formed by different processes than biological soil crusts and tend to form a hard, impermeable layer on the soil surface that lacks the biological characteristics discussed above. Chemical crusts do not contain nutrients that make the soil more fertile or contain photosynthetic life, but generally indicate that the amount of organic matter in the soil has decreased or that erosion has occurred. They seal the soil surface, reduce the rate of water infiltration, and can increase runoff, often impeding seedling emergence. Physical crusts are most common on soils containing silt, clay, and loam (USFS 2001). Physical and chemical crusts on the Dixie National Forest have not been mapped.

3.9.4 Special Areas

RED CANYON BOTANICAL AREA (2001)

The Red Canyon Botanical Area measures 203.3 acres and is located on the Powell Ranger District (Figure 3.9-2), on the eastern fringe of Red Canyon, south of Highway 12. It is three miles south/southwest of the Red Canyon Research Natural Area, which is administratively separate and does not overlap the Red Canyon Botanical Area. The Red Canyon Botanical Area is a small watershed characterized by soils derived from the pink Tertiary Claron (Limestone) Formation and seven endemic, rare plant species that are confined to these substrates (discussed in Section 3.6). Bristlecone pine (*Pinus longaeva*) trees are present in the area, which is characterized by barren slopes, hills, plateau, and cliffs with limited vegetation cover and soils derived from the highly erosive Claron Limestone (USFS 2000b).

The Red Canyon Botanical Area is under management prescription 10C, which was added to the 1986 Land and Resource Management Plan by amendment in 2001. Ensuring the persistence of sensitive plants is the main objective of the Red Canyon Botanical Area. Management objectives of the greater Red Canyon area include monitoring the impacts of off-highway-vehicles and regulating recreational activities and road construction (USFS 2000b). The Red Canyon Botanical Area itself contains no trails and is mainly a viewing site, although walking in the area is permitted.

SIDE HOLLOW PONDEROSA PINE PROVENANCE STUDY AREA (1987)

The Side Hollow Ponderosa Pine Provenance Study Area (Side Hollow Study Area) measures 4.5 acres and is located on the Escalante Ranger District (Figure 3.9-2) within an IRA. The Side Hollow Study Area contains ponderosa pine trees of various origins that are part of a genetic study that began in 1987, using seed collected from 97 stands in Arizona, Colorado, Idaho, New Mexico, and Utah. The purpose of the Side Hollow Study Area is to provide a common environment for the growth of ponderosa pine trees from various seed sources. Specific objectives of the study include identifying stands in southern Region 4 forests based on seed source data, refining seed transfer systems and performance data in the Forest Vegetation Simulator model, and evaluating seed performance in response to global warming (USFS 2006b).

3.9.5 Research Natural Areas

Research Natural Areas are part of a national network of ecological areas designated for research, education, or to maintain biological diversity on federal lands (FSM 4063). The management objectives associated with Research Natural Areas are to preserve and maintain the biological and genetic diversity within “exemplary” vegetation types, and over the long term (and beyond the Dixie National Forest), to set aside at least one example of all the habitat or vegetation community types represented on Region 4 National Forest lands. As “examples” of

common or important vegetation, Research Natural Areas provide baseline reference sites for assessing long-term ecological changes as well as the effects of management techniques and practices applied to similar ecosystems. As such, natural physical and biological processes are allowed to prevail in order to maintain natural conditions, and human intervention is used only if it is deemed necessary to maintain what the Research Natural Area was established to protect (USFS 2007j). Within these areas, leasing for mineral development, including oil and gas, is at the discretion of the Regional Forester and Station Director (FSM 4063). The location (Figure 3.9-2) and size (Table 3.9-2) of Research Natural Areas on the Dixie National Forest are provided in more detail below. All Research Natural Areas occur within "Very High" Scenic Integrity Objective areas. All are surrounded by, within, or adjacent to designated Wilderness or IRAs.

Table 3.9-2 Location and Size (acres) of Research Natural Areas on the Dixie National Forest

Research Natural Area	Pine Valley Ranger District	Cedar City Ranger District	Powell Ranger District	Escalante Ranger District
Red Canyon	-	-	531	-
Timbered Cinder Cone	-	225	-	-
Table Cliff	-	-	-	1,445
Browse	2,055	-	-	-
Upper Sand Creek	-	-	-	540
TOTAL (4,796 acres)	**2,055**	**225**	**531**	**1,985**

The following information was taken from USFS (1986) and Establishment Records for each Research Natural Area.

RED CANYON RESEARCH NATURAL AREA (1987)

The Red Canyon Research Natural Area encompasses an entire small watershed containing xeric forests, woodlands, and shrublands near the lower western edge of the Paunsaugunt Plateau. The Red Canyon Research Natural Area does not include any part of the Red Canyon Botanical Area (Section 3.9.4). Two major geologic and physiological types occur in the eastern and western portions of the Red Canyon Research Natural Area, characterized by limestone and basalt, respectively. The eastern area is a highly dissected terrain with steep gravelly slopes, hoodoos, low cliffbands, and small washes, with some small mixed conifer forested flats in the extreme northeast. The main understory plant is greenleaf manzanita (*Arctostaphylos patula*). The nearly barren habitats in the eastern portion support most of the rare plant populations in the Research Natural Area. The area contains at least thirteen plant taxa that are endemic or otherwise rare; four are sensitive species (*Cryptantha ochroleuca, Eriogonum aretioides, Penstemon bracteatus,* and *Silene petersonii*) (discussed in Section 3.6). The western portion of the area is comprised of the gentle to moderately steep basalt slopes of Black Mountain. These slopes are little dissected by drainage courses, unlike in the east. The Red Canyon Research Natural Area is completely within an IRA. The main objectives of the Red Canyon Research Natural Area are to preserve the biotic features of the area and support research or educational uses (USFS 1987). Regarding oil and gas, the potential for development was deemed medium at the time of designation as the Research Natural Area occurred within two simultaneous offering tracts. These leases could be leased in the future with appropriate protective stipulations.

TIMBERED CINDER CONE RESEARCH NATURAL AREA (1990)

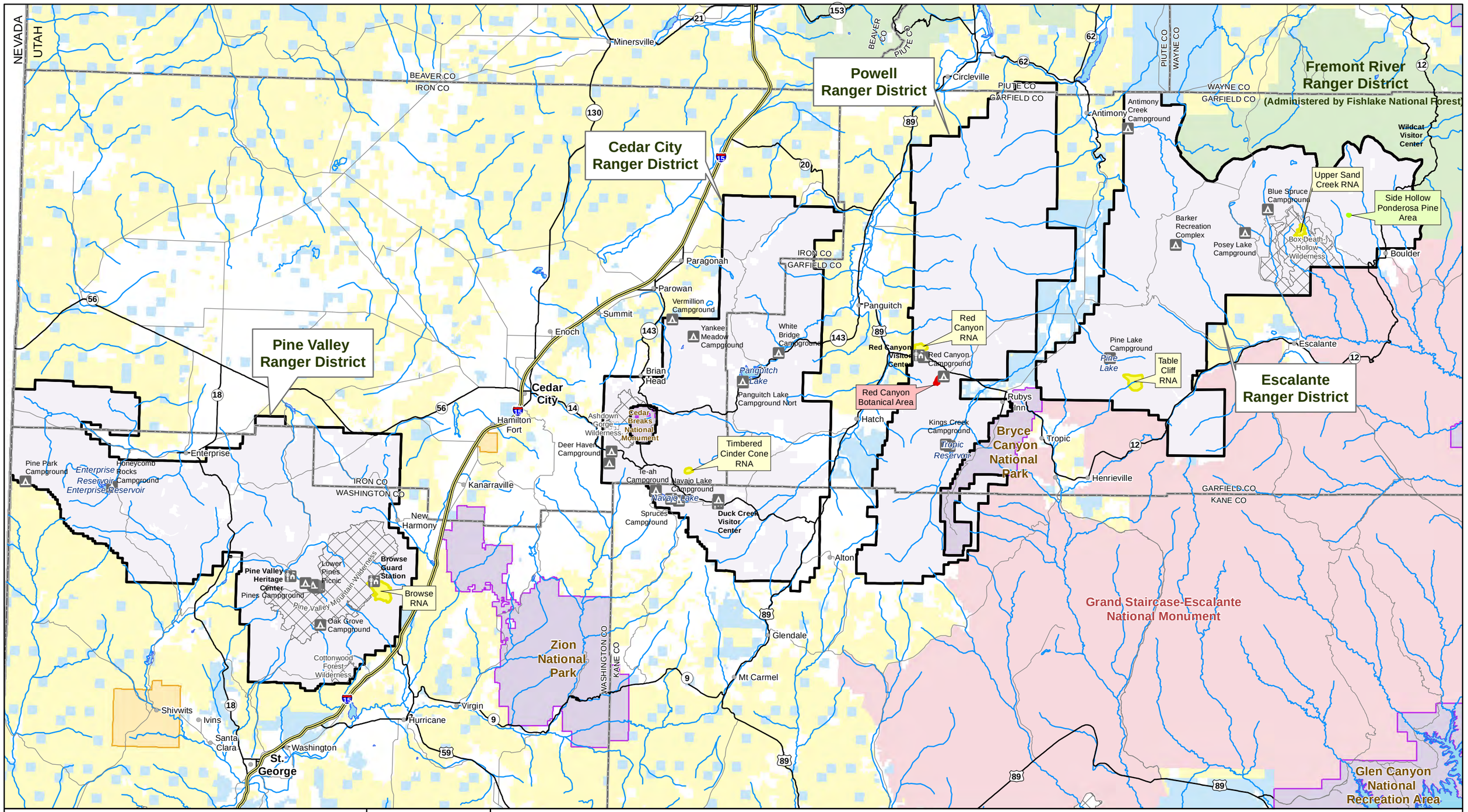
The Timbered Cinder Cone Research Natural Area is an untouched and little-known stand of spruce-fir that occupies a small cinder cone (lava field) on the Markagunt Plateau east of Cedar City. It is within an Inventoried Roadless Area and underlain by a sensitive aquifer. The Timbered Cinder Cone has been protected from livestock and human disturbances due to its inaccessibility. The consequent integrity of this location led to its designation as a Research Natural Area. The major objective of the Timbered Cinder Cone Research Natural Area is to preserve a typical, yet uncommon landform and the commercial forest types that occur in the area. Regarding oil and gas, new leases were viewed as a potential conflict at the time of designation although none were or have been made to date. When the establishment record was approved, the Research Natural Area was to be withdrawn from mineral entry (USFS 1990b); however, it has not yet been withdrawn.

TABLE CLIFF RESEARCH NATURAL AREA (1991)

The Table Cliff Research Natural Area is located on the Escalante Ranger District and encompasses a portion of the Henderson Creek drainage at the southern end of the Aquarius Plateau. Approximately 90 percent of the Table Cliff Research Natural Area is within an IRA. The major features of the Table Cliff Research Natural Area include pristine subalpine forests (primarily Engelmann spruce and subalpine fir), old bristlecone pine groves, extensive mixed-conifer woodlands that are unusually diverse, and expansive cliffs below the Table Cliff Plateau. The area is practically undisturbed due to its rugged and densely forested lands. The major objectives of the Table Cliff Research Natural Area are to preserve: 1) an erosional and depositional landform unique to this part of the Colorado Plateau, 2) bristlecone pine trees, 3) commercial and noncommercial forest, and 4) rare plant species. Regarding oil and gas, areas surrounding the Research Natural Area have a number of mineral developments, including oil, and the Table Cliff Plateau itself is underlain with coal at a very great depth (USFS 1991).

BROWSE RESEARCH NATURAL AREA (1998)

The Browse Research Natural Area is located near the Browse Guard Station on the eastern side of the Pine Valley Mountains, and contains evergreen chaparral vegetation (which resembles communities in the South and West) and a diversity of other vegetation types. Two thirds of the Browse Research Natural Area is within an IRA. To the east, the Pine Valley Mountain Wilderness Area is adjacent and overlaps two acres of the Browse Research Natural Area. The exterior boundary corresponds with generally well-defined ridge crests and drainage courses for most of its length. The major objectives of the Browse Research Natural Area are to: 1) preserve and maintain the terrestrial forest, woodland, and shrubland habitat types, riparian woodlands, and distinctive landform, soil, and geology; and 2) provide a reasonably accessible reference site for basic, non-manipulative studies of biotic patterns, ecological processes, natural disturbance regimes, and community succession (USFS 1998a). Regarding oil and gas, the withdrawal of the Browse Research Natural Area from mineral entry was not deemed necessary at the time of establishment. Mineral lease applications, including oil and gas, were to be reviewed and recommendations made to the BLM regarding necessary measures and leasing options to protect surface resources. Regarding existing leases, the Forest Service was to honor all existing and lawful renewals of mineral or oil and gas leases, and manage them as the priority land management feature for as long as the leases existed which would have violated the direction in the Land and Resource Management Plan (1986; for NSO in Research Natural Areas). Those leases have not been renewed.



Oil & Gas Leasing EIS on Lands Administered by the Dixie National Forest

FIGURE 3.9-2

Locations of Special Areas & Research Natural Areas

Horizontal Datum = NAD 83 Coordinate System = Zone 12N	1:590,000	1 in = 9 miles

Legend

- Cities
- Freeways
- Highways
- Minor Roads*
- Major Streams & Rivers
- Water Bodies
- County Boundaries
- State Boundaries

Forest Sites

- Campgrounds
- Visitor Centers

National Forest System Lands

- Dixie National Forest
- Wilderness Areas
- Fishlake National Forest

Other Land Administration

- Bureau of Land Management
- GSENM**
- National Park Service
- Private
- State of Utah
- Tribal

Vegetation: Special Designations

- Red Canyon Botanical Area
- Research Natural Areas
- Side Hollow Ponderosa Pine Area

Miles: 0 3 6 9 12

Original data was compiled from multiple source data and may not meet the U.S. National Mapping Accuracy Standard of the Office of Management and Budget. For specific dates and/or additional digital information, contact the Forest Supervisor, Dixie National Forest, Cedar City, Utah. This map has no warranties to its contents or accuracy.

*Not all roads are shown. Only some roads are depicted for orientation purposes.
**Grand Staircase-Escalanted National Monument. Managed by the Bureau of Land Management.

The hard-leaved chaparral area that occurs only on the east facing slopes of Pine Valley Mountain, from approximately Leeds Canyon north through the Browse Research Natural Area, is the only true evergreen chaparral in the state. Hard-leaved chaparral in Utah resembles a vegetation type more common in central Arizona and California. Chaparral vegetation dynamics are closely linked to stand replacement disturbances such as fire, and tend to regenerate on a 50-100 year cycle. Despite a recommendation from the Nature Conservancy in 1985, the area was not carried forward as a Research Natural Area in the 1986 plan due in part to altered conditions from the 1986 fire and political uncertainties about water use. Later, recreation pressures (mid-1990s) and issues with private land holdings within the area (2006) prevented the designation of RNA status. The Pine Valley Ranger District has an interest in minimizing human impacts in the area, limiting access beyond primitive recreation, and allowing natural ecosystem processes to occur.

UPPER SAND CREEK RESEARCH NATURAL AREA (1998)

The Upper Sand Creek Research Natural Area is a broad ridge crest/peninsular bench 11 miles north of Escalante, perched above the deep sandstone canyons of Sand Creek and Death Hollow. The Box-Death Hollow Wilderness Area nearly surrounds the Upper Sand Creek Research Natural Area; 15 acres of the Upper Sand Creek Natural Area is within Wilderness. The remaining portion of the Upper Sand Creek Natural Area is reserved for carbon dioxide gas development. The Area is most distinguished by the presence of open, park-like stands of mature ponderosa pine with low, shrubby, and grassy understories. Lower elevations contain open forests of ponderosa pine and manzanita on sandstone substrates, and pinyon-juniper woodlands on south-facing slopes. The main objectives of the Upper Sand Creek Research Natural Area are to: 1) preserve and maintain the moderately productive ponderosa pine forest, typical examples of mixed-conifer, less-productive ponderosa pine, and pinyon-juniper communities, and distinctive landform, soil, and geology; and 2) provide a reference site for basic, non-manipulative studies (USFS 1998b). Regarding oil and gas, the Dixie National Forest was to honor all existing and lawful renewals of mineral or oil and gas leases at the time of Research Natural Area designation, and manage such activities as the priority land management feature for as long as the leases existed, which would have violated the direction in the Land and Resource Management Plan (1986; for NSO in Research Natural Areas). The portion of the Upper Sand Creek Research Natural Area within a CO_2 lease is not available for leasing because the lease expired in 1999. The Upper Sand Creek Research Natural Area is not available for future leasing.

3.9.6 Invasive Nonnative Plants and Noxious Weeds

Invasive nonnative plants are species that have been introduced to an area and have survived and reproduced to the point that their presence causes economic or environmental harm to the native plant communities. Noxious weeds are either native or nonnative species that are legally prohibited or restricted at the federal, state, or county level, due to their harmful economic and environmental effects.

Invasive nonnative plants and noxious weeds ("invasive plants") are found on the Dixie National Forest, especially on disturbed ground. Disturbed soils along roads are the most vulnerable areas to invasions, although grazing (by livestock and wildlife) and recreation also contribute to proliferation. Invasive plants tend to appear along disturbed road banks because many invasive species can tolerate exposed and disturbed sites more effectively than natives can. Invasive plants displace native plant communities by out-competing native grasses, forbs, and shrubs for water, space, and nutrients. The largest number of invasive plant infestations occurs on the Pine Valley Ranger District (Table 3.9-3; Section 3.9.7). Species listed as noxious weeds are

officially designated and published as noxious by the State of Utah under Section 4-17-3 of the Utah Noxious Weed Act. These species are noted in Table 3.9-3. Other noxious weeds on the state list that may occur on the Dixie National Forest, but that have not been mapped include Bermudagrass (*Cynodon dactylon*), diffuse knapweed (*Centaurea diffusa*), Johnsongrass (*Sorghum halepense*), musk thistle (*Carduus nutans*), quackgrass (*Agropyron repens*), Russian knapweed (*Centaurea repens*), and yellow starthistle (*Ceantaurea solstitalis*; Belliston et al. 2004).

Utah counties also maintain noxious weed lists of additional species, which are not on the state list. County-listed noxious weeds that may occur on the Dixie National Forest include western whorled milkweed (*Asclepias subverticuillata*; Washington and Iron Counties), silver leaf nightshade (*Solanum elaeagnifolium*; Washington County), puncturevine (*Tribulus terrestris*; Iron County), bull thistle (*Cirsium vulgare*; Iron County), saltcedar (*Tamarix ramoissima*; Iron County), and Russian olive (*Elaeagnus angustifolia*). Garfield County has no noxious weeds currently listed, but saltcedar and Russian olive are being considered for listing.

Table 3.9-3 Mapped acres of Invasive Plant Infestations on the Dixie National Forest

Species	Invasive type	Acres			
		Pine Valley	Cedar City	Powell	Escalante
Whitetop *Cardaria draba*	noxious weed[1]	5	37	2	2
Nodding plumeless thistle *Carduus nutans*	nonnative	16	41	28	0
Spotted knapweed *Centaurea maculosa*	noxious weed[1]	25	2	0	4
Field bindweed *Convolvulus arvensis*	noxious weed[1]	158	2	0	0
Broad-leaved pepperweed *Lepidium latifolium*	noxious weed[1]	56	0	0	0
Scotch cottonthistle *Onopordum acanthium*	noxious weed[1]	1,423	0	0	0
Dalmation toadflax *Linaria genistifolia ssp. dalmatica*	nonnative	0	17	0	0
Hardheads *Acroptilon repens*	nonnative	0	0	1	0
Canadian thistle *Cirsium arvense*	noxious weed[1]	0	0	0	1
TOTAL (1,819 acres)		**1,683**	**99**	**31**	**7**

[1] Officially designated and published as noxious by the State of Utah under Section 4-17-3 of the Utah Noxious Weed Act

3.9.7 Pine Valley Ranger District

The upper slopes of the Pine Valley Mountains, reaching 10,000 feet in elevation, are comprised of ponderosa pine, Douglas-fir, and aspen on north-facing slopes, with mountain brush (antelope bitterbrush, mountain mahogany) and sagebrush on south-facing slopes. Additional ponderosa pine interspersed with occasional aspen, Engelmann spruce, and

subalpine fir communities occur at higher elevations. Most of the ranger district (51%) is comprised of steep hills covered by pinyon-juniper woodland in addition to mountain mahogany scrub at higher elevations and mountain brush (31% of the ranger district) throughout. There are extensive areas of oak brush near Browse, New Harmony, and Ox Valley. Benchlands and bottomlands contain scattered ponderosa pine, aspen, and Douglas-fir including extensive sagebrush, antelope bitterbrush, and perennial grassland vegetation (USFS 1995d:4-5). The hard-leaved interior chaparral area is located between the Browse Research Natural area and Leeds Canyon.

The Browse Research Natural Area occurs along the eastern flank of the Pine Valley Mountains. The highest concentration (92 percent) of invasive plants on the Dixie National Forest is within the Pine Valley Ranger District (Table 3.9-3). Scotch cottonthistle covers 1,423 total acres. Invasive plant occurrences in the Pine Valley Ranger District are scattered throughout the District, and include Grass Valley (field bindweed), Browse (scotch cottonthistle), Old Irontown (scotch cottonthistle), Willow Spring (scotch cottonthistle), Moody Wash (scotch cottonthistle), Ox Valley (field bindweed), Page Ranch (scotch cottonthistle), Rocky Top (scotch cottonthistle), and Page Ponds (scotch cottonthistle). The Pine Valley Ranger District appears to contain the largest potential for gypsum beds that contain biological crusts, such as along Forest Road 031, but these areas have not been mapped.

3.9.8 Cedar City Ranger District

The Cedar City Ranger District is dominated by the Markagunt Plateau, reaching over 11,000 feet in elevation, which contains lava rock, spruce-fir, and aspen/conifer forest. Grassland on the plateau is characterized by alpine grasses at higher elevations and sagebrush at lower elevations, with a prominent forb component in both communities. Barren lava flows contain sparse stands of mixed conifer, and slumplands containing mixed conifer and aspen forest also occur on the high plateau (USFS 1995d: 5). There are many dry meadows along the plateau sideslopes, along with sagebrush and perennial grasslands (USFS 1995d:5, 6). Most of the Cedar City Ranger District is composed of aspen/conifer (27%) and ponderosa pine woodland (19%). Whitetop, nodding plumeless thistle, and dalmatian toadflax infestations occur in this ranger district (Table 3.9-3). The Timbered Cedar Cone Research Natural Area occurs within the Cedar City Ranger District.

The Cedar City Ranger District has received, to date, the most impact of the spruce beetle outbreak over the past 10 years (Figure 3.9-3). High levels of Engelmann spruce mortality have changed both the physical appearance of the landscape (Figure 3.9-4) and the development of vegetation communities over time. Mortality rates in some places on the Cedar City Ranger District are as high as 100 percent of all Engelmann spruce over five inches in diameter. Due to spruce beetle mortality, many dead trees have an increasing risk of fall as this species is known to stand many years despite being dead, and there is an increasing risk of high severity fire as deadfall accumulates on the ground.

Figure 3.9-3 Acres of spruce mortality on the Dixie National Forest, 1995-2006

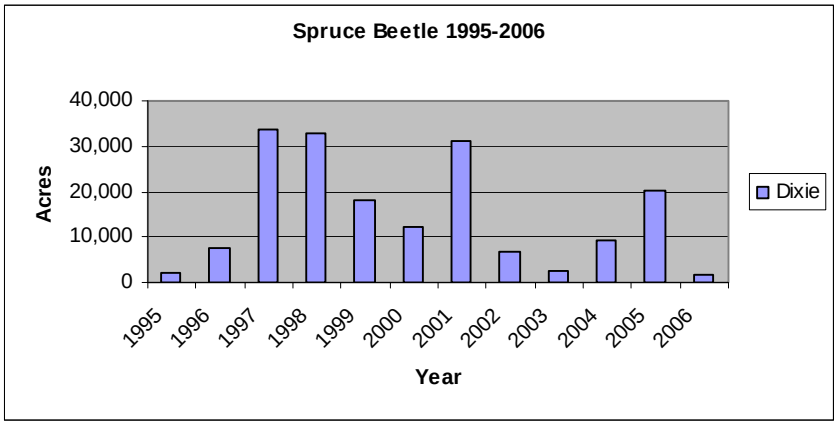


Figure 3.9-4 Visual Impact of Spruce Beetle Mortality on the Landscape

Rock garden/bristlecone pine is a unique vegetation area that occurs on 14,000 acres of the Dixie National Forest, within the Cedar City, Powell, and Escalante Ranger Districts (Figure 3.6-3). Rock garden/bristlecone pine areas contain the ancient Rocky Mountain bristlecone pine trees and few other shrubs or herbaceous plants. Rocky mountain bristlecone pine is an extremely long-lived tree that occurs on dry, upper montane and subalpine slopes. In the Mammoth Creek area (Cedar City Ranger District), bristlecone have been dated around 747 BC. Where limber pine and bristlecone pine co-occur, limber pine may dominate the rockier, drier ridges. The main mode of dispersal for bristlecone pine is by Clark's nutcrackers that bury the seed. Many sensitive plants on the Dixie National Forest (see Technical Report 6.0 – Sensitive Species) grow on the limestone "rock garden" substrate.

3.9.9 Powell Ranger District

The Powell Ranger District is dominated by the Paunsaugunt Plateau and the Sevier Plateau, which rise to over 11,000 feet. These plateaus are characterized by spruce-fir and aspen forest on north-facing slopes, with mountain brush and sagebrush on southern exposures (USFS 1995d:7). The vegetation of the Sevier Plateau is highly varied, with types such as riparian corridors and wet meadows, sage steppe in the lower elevations, boreal forests and old-growth ponderosa pine in the mid-elevations, and aspen/conifer and spruce-fir forest in the higher elevations. The lowest bottomlands and alluvial fans are characterized by sagebrush scrub (USFS 1995d:7), which is the dominant vegetation within the ranger district (25%). Nodding plumeless thistle is the dominant invasive plant in this ranger district (Table 3.9-3). The Red Canyon Botanical Area and Red Canyon Research Natural Area are located within the Powell Ranger District.

3.9.10 Escalante Ranger District

The lowest elevations in the Escalante Ranger District are composed of ponderosa pine benchlands and low hills with occasional aspen and mixed conifer vegetation. Pinyon-juniper woodland and oakbrush can be found on steep hills, rocklands, and badlands. Sagebrush scrub, containing widely dispersed ponderosa pine and antelope bitterbrush, is located on the bottomlands, alluvial fans, and pediments (USFS 1995d:7). The Escalante Ranger District is composed of many types of vegetation that are well represented: pinyon-juniper (23%), pine woodland (18%), aspen/conifer (16%), spruce-fir (12%), and sagebrush steppe (11%). There are relatively few invasive plant infestations in this ranger district (Table 3.9-3). The Side Hollow Study Area and both the Table Cliff Research Natural Area and Upper Sand Hollow Research Natural Area are located within the Escalante Ranger District. Rock garden and bristlecone pine communities also occur in this ranger district and some contain sensitive plant populations (Figure 3.6-3). Gypsum beds that contain biological crusts occur along Hells Backbone Road, but these areas have not been mapped.

3.10 Transportation

3.10.1 Introduction

The Dixie National Forest transportation system is essential in providing safe and efficient access to and through National Forest System lands. It provides access for the public and administration of land management objectives. The system provides a balanced mix of road and trail access for recreation, special uses, management, and fire protection activities while supporting forest management objectives. User experience, safety, and resource protection are emphasized in transportation system planning, design, and operation.

The transportation system provides the access needed to maintain facilities and infrastructure such as buildings, recreation facilities, municipal water systems, dams, reservoirs, range improvements, mine sites, oil and gas wells, electronic and communication sites, utility corridors, transmission lines, and gas and water lines. The roads of a transportation system affect nearly all other resources. Most improvements to existing roads result from the need by forest management for resource development and/or administration of a resource. In planning for the development of a resource, such as oil and gas, a roadway would be used for transportation and to accommodate overland and/or underground pipelines, and communication facilities (USFS 1986).

3.10.2 Transportation Terms

The following terms are used throughout this section. They are provided here so that readers may familiarize themselves with common Forest Service transportation terms and give the reader a better understanding of the information contained in this section (USFS 1986).

National Forest System Road: A forest road other than a road which has been authorized by a legally documented right of way held by a state, county, or other local public road authority.

Temporary Road: A road necessary for emergency operations or authorized by contract, permit, lease, or other written authorization that is not a Forest System road and that is not included in a Forest Transportation Atlas.

Unauthorized Road: A road that is not a Forest System road or a temporary road and that is not included in a Forest Transportation Atlas.

Forest Transportation Atlas: A display of the system of roads, trails, and airfields of an administrative unit.

3.10.3 Road Maintenance Levels

Dixie National Forest roads are maintained to varying standards depending on the level of use and management objectives. Roads may currently be maintained at one level with plans for maintenance at a different level at some future date. The operational maintenance level is the maintenance level currently assigned to a road considering today's needs, road condition, budget constraints, and environmental concerns. The objective maintenance level is the maintenance level to be assigned at a future date considering future road management objectives, traffic needs, budget constraints, and environmental concerns. The objective maintenance level may, or may not be, the same as the operational maintenance level. The transition from operational maintenance level to objective maintenance level may depend on reconstruction. There are five maintenance levels used by the Forest Service to determine the work needed to preserve the investment in the road (USFS 2003c).

Level 1: Basic custodial maintenance is performed to protect the road investment and to keep damage to adjacent resources to an acceptable level. Drainage facilities and runoff patterns are maintained at Level 1; roads are administratively closed and sometimes physically blocked to traffic.

Level 2: Roads in this maintenance level are normally characterized as single lane, primitive type facilities intended for use by high clearance vehicles. Passenger car traffic is not a consideration. The functional classification of these roads is normally local.

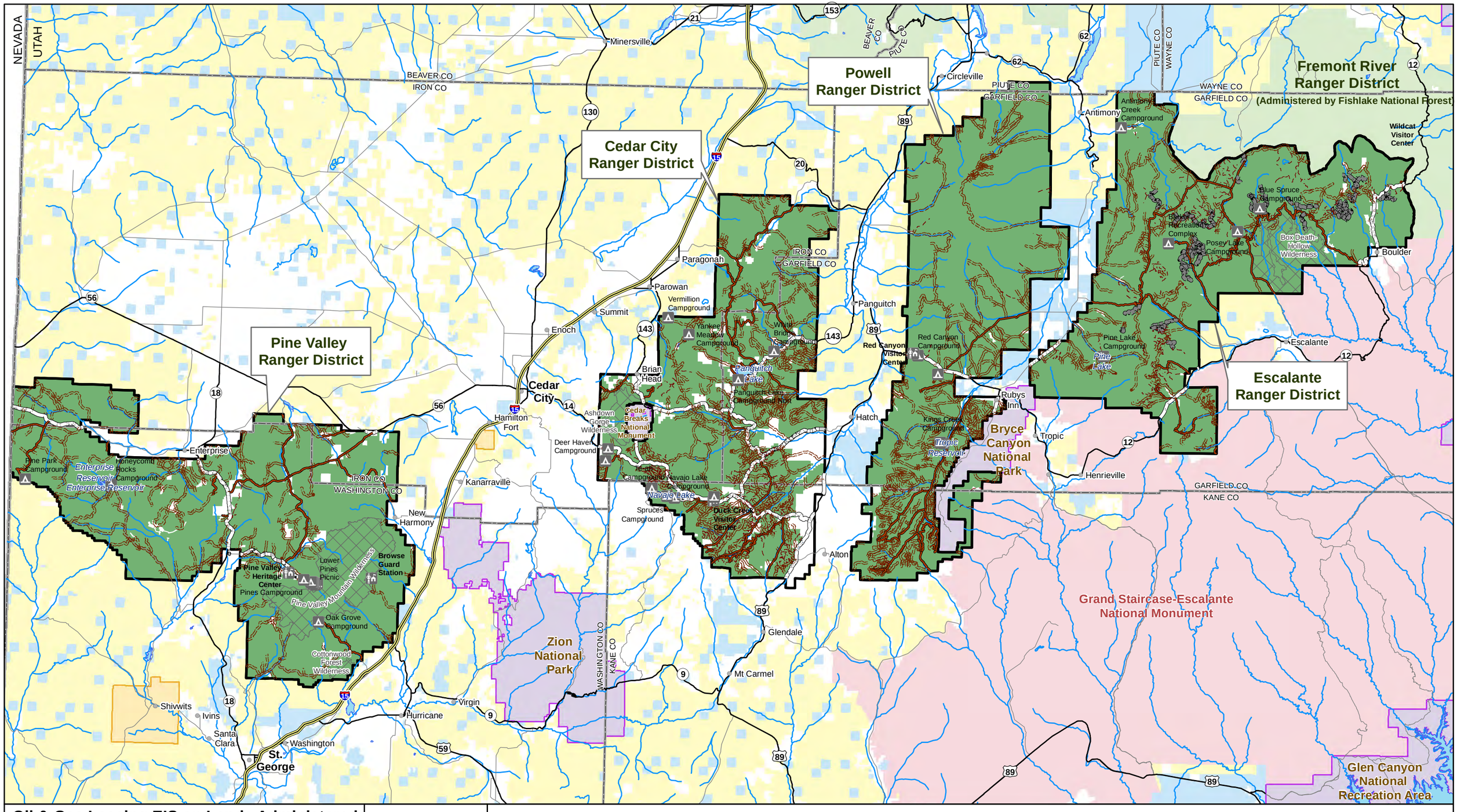
Level 3: Roads at this maintenance level are normally characterized as low speed, single-lane roads with turnouts and spot surfacing. Some roads may be fully surfaced with either native or processed material. The functional classification of these roads is normally local or minor collector. User comfort is not a consideration at this maintenance level.

Level 4: This level is assigned where management direction requires the road to provide a moderate degree of user comfort and convenience at moderate travel speeds. Traffic volumes are normally sufficient to require a double lane aggregate-surfaced road. Some roads may be single lane and some may be paved and/or dust abated. The functional classification of these roads is normally collector or minor arterial.

Level 5: This level is assigned where management direction requires the road to provide a high degree of user comfort and convenience. These roads are normally double lane, paved facilities. Some may be aggregate surfaced and dust abated. Functional classification of these roads is normally arterial.

3.10.4 State and Federal Highways

Several federal, state, and county roads provide access to the Dixie National Forest. These roads are not part of the National Forest System and are not under the management directive of the Forest Service. These roads are under federal and state management and include: Interstate 15, US Highway 89, and State Highways 12, 14, 18, 20, 22, 56, 62, 143, and 148 (USFS 1995a).



Oil & Gas Leasing EIS on Lands Administered by the Dixie National Forest

FIGURE 3.10-1
Transportation System

Horizontal Datum = NAD 83 Coordinate System = Zone 12N	1:590,000	1 in = 9 miles

Legend

- Cities
- Freeways
- Highways
- Minor Roads*
- Major Streams & Rivers
- Water Bodies
- County Boundaries
- State Boundaries

Forest Sites

- Campgrounds
- Visitor Centers

National Forest System Lands

- Dixie National Forest
- Wilderness Areas
- Fishlake National Forest

Other Land Administration

- Bureau of Land Management
- GSENM**
- National Park Service
- Private
- State of Utah
- Tribal

Forest Roads

Maintenance Class

- 1 - Basic Custodial Care (Closed)
- 2 - High Clearance Vehicles
- 3 - Suitable for Passenger Cars
- 4 - Moderate Degree of User Comfort
- 5 - High Degree of User Comfort
- 6 - Seasonal Road

Miles: 0 3 6 9 12

Original data was compiled from multiple source data and may not meet the U.S. National Mapping Accuracy Standard of the Office of Management and Budget. For specific dates and/or additional digital information, contact the Forest Supervisor, Dixie National Forest, Cedar City, Utah. This map has no warranties to its contents or accuracy.

*Not all roads are shown. Only some roads are depicted for orientation purposes.
**Grand Staircase-Escalanted National Monument. Managed by the Bureau of Land Management.

3.10.5 Existing Forest Transportation System: Motorized Travel Plan (2009)

The Record of Decision for the Dixie National Forest Motorized Travel Plan, signed in April 2009 (USFS 2009c), designated approximately 2,700 miles of roads on the Dixie National Forest open to public motorized use and approximately 1,000 miles of roads available for permited activities and for official resource activities (i.e., administrative use). Excluding the Teasdale Ranger District (administered by the Fishlake National Forest), there are approximately 2,400 miles of roads on the Dixie National Forest open to the public (i.e., Maintenance Level 2-5; Figure 3.10-1) and 900 miles open to administrative use only (i.e., Maintenance Level 1; Figure 3.10-1). Table 3.10-1 lists the miles of public road (Level 2-5) within each ranger district.

Table 3.10-1 Total System Miles (Maintenance Level 2-5) by Ranger District

Ranger District	System Miles
Cedar City	794
Escalante	499
Pine Valley	487
Powell	596
Total	**2,376**

3.10.6 Existing Oil and Gas Roads

Most oil and gas roads in the Upper Valley field are not physically closed to the general public and are classed as local roads. Roads from the local roads that provide access to individual well sites or tank batteries are managed under the field development plan. None of the roads within this production field are managed under special use permits. Oil pipelines and power lines that extend beyond the production field are covered by special use permits issued to the oil and gas leaseholders. The roads to the individual well sites or batteries are typically reclaimed or managed as intermittent service facilities after they are no longer needed for oil and gas activity. Intermittent service roads are closed to traffic, graded, and maintained for drainage; those with native surfacing are scarified and seeded during reclamation. Reclaimed oil and gas roads are rehabilitated to near-natural condition (USFS 1995a). Most of the existing oil and gas roads were permitted and opened in the late 1960s and are not typical of current forest management.

3.10.7 Traffic Volume

The Utah Department of Transportation collected traffic statistics on State Highway road sections throughout Utah during 2004-2006 (UDOT 2006). These data are summarized below by ranger district.

Table 3.10-2 Annual Average Daily Traffic on Utah Highways occurring on the Dixie National Forest

Highway	Pine Valley	Cedar City	Powell	Escalante
State Highway 18	1,640			
State Highway 14		838		
State Highway 148		527		

State Highway 143		820		
US Highway 89		1,398		
State Highway 12 Red Canyon			2,442	
State Highway 12 Upper Valley				1,190
State Highway 12 Boulder				547

Source: UDOT 2006

3.10.8 Gravel Sources

Gravel sources on the Dixie National Forest are not readily available. An active gravel pit exists on the Pine Valley Ranger District near Enterprise; this pit is used as a gravel source for Forest roads. Three small gravel pits occur on the Cedar City District, but the source material has nearly all been removed. Gravel sources are more readily available on lower elevation, BLM-administered lands adjacent to the Dixie National Forest.

3.10.9 Pine Valley Ranger District

Main access through the Pine Valley Ranger District is via the following roads (USFS 1995a): State Highway 18 (St. George to Beryl Junction), Interstate 15 (St. George to Cedar City), and State Highway 56 (Cedar City to Beryl Junction). Annual Average Daily Traffic on Highway 18 through the Pine Valley Ranger District from Central to Enterprise during the period 2004 – 2006 was 1,640 (UDOT 2006).

3.10.10 Cedar City Ranger District

Main access through the Cedar City Ranger District is via the following roads (USFS 1995a): Interstate 15 (Cedar City to State Highway 20), US Highway 89 (Glendale to State Highway 20), State Highway 143 (Parowan to Panguitch), State Highway 148 (State Highway 14 to State Highway 143 through Cedar Breaks NM), State Highway 14 (Cedar City east to US Highway 89), and State Highway 20 (Interstate 15 to US Highway 89). Annual Average Daily Traffic on State Highway 14 through the Cedar City Ranger District from the western boundary to the Iron – Kane County border during the period 2004 – 2006 was 838; on Highway 148 from State 14 to Cedar Breaks National Monument it was 527; on Highway 143 it was 820; and on Highway 89 from Glendale to Hatch it was 1,398 (UDOT 2006).

3.10.11 Powell Ranger District

Main access through the Powell Ranger District is via the following roads (USFS 1995a): State Highway 89 (Glendale to State Highway 20), State Highway 20 (Interstate 15 to State Highway 89), State Highway 12 (US Highway 89 to Torrey), State Highway 22 (Otter Creek Reservoir to State Highway 12), and State Highway 62 (US Highway 89 to Otter Creek Reservoir). Annual Average Daily Traffic on State Highway 12 through the Powell Ranger District during the period 2004 – 2006 was 2,442 (UDOT 2006). Much of this traffic is likely associated with visitation to Bryce Canyon National Park. Average annual visitation at the Park during the period 1997 – 2006 was 1,027,638 (NPS 2007b).

3.10.12 Escalante Ranger District

Main access through or to the Escalante Ranger District is via the following roads (USFS 1995a): State Highway 12 (US Highway 89 to Torrey), State Highway 22 (Otter Creek Reservoir to State Highway 12), and State Highway 62 (US Highway 89 to Otter Creek Reservoir). Annual Average Daily Traffic on State Highway 12 through the Escalante Ranger

District from Henrieville to Escalante during the period 2004 – 2006 was 1,190 and through Boulder was 547 (UDOT 2006).

3.11 Socioeconomic Resources

3.11.1 Introduction

This description of socioeconomic conditions is a summary of more detailed information contained in Specialist Report 12.0 (Socioeconomic Resources). Resources on National Forest lands serve agricultural, recreational, industrial, business, and residential uses. These can include grazing permittees relying on the availability of suitable forage for grazing livestock, outfitters/guides for various wildlife and recreation-related uses relying on Forest resources for all or part of their living, and many local communities relying on employment and income generated from the existence and/or use of Forest resources. Residents of the area and repeat visitors may also place intangible, heritage values on the natural resources of the Forest. Further, Native American Tribes use the Forest for the purposes of hunting animals or gathering traditional plant materials important to their cultural traditions.

The affected environment potentially impacted by oil and gas development on the Dixie National Forest extends beyond the Forest boundaries. Little economic activity actually occurs within Forest boundaries, but instead takes place in the nearby communities. Six Utah counties lie within or in proximity to the Dixie National Forest: Garfield, Washington, Iron, Kane, Wayne, and Piute. These counties make up the six-county analysis area for this EIS, with the majority of the Forest located in Garfield, Iron, and Kane Counties. The Pine Valley Ranger District is located in Washington County, although a portion extends north into the western part of Iron County. The Cedar City Ranger District lies in the eastern part of Iron County, the western part of Garfield County, and the northwestern corner of Kane County. The majority of the Powell Ranger District lies in Garfield County, although minor portions extend north into Piute County and south into Kane County. The Escalante Ranger District is the easternmost portion of the Dixie National Forest and lies in Garfield County. These counties, and their associated communities, would be those most immediately affected should oil and gas leasing lead to additional exploration and development on the Dixie National Forest.

The primary data sources used to evaluate the social and economic resources related to oil and gas leasing on the Dixie National Forest and anticipated impacts included economic data collected and published by government agencies. Data from the US Department of Commerce, Bureau of the Census, 2000 Decennial Census were used to characterize the area's population, age, race and ethnicity, household type, and housing.

Personal income data were obtained from the US Department of Commerce, Bureau of Economic Analysis. Agricultural production data were obtained from the US Department of Agriculture, National Agricultural Statistics Service.

Employment and income for the study area was characterized using data from the Utah State Department of Workforce Services; the US Department of Labor; Bureau of Labor Statistics (2008); and US Department of Commerce, Bureau of Economic Analysis.

The Utah oil and gas industry was described using data published by the Utah Division of Oil, Gas and Mining and the Bureau of Economic and Business Research at the University of Utah.

Economic impact modeling was conducted using the Regional Input-Output Modeling System (RIMS II) developed by the Bureau of Economic Analysis.

3.11.2 Counties

3.11.2.1 Garfield County

Garfield County is located in south central Utah. The western half of the county is characterized by high forested plateaus separated by populated valleys. The eastern half is lower in elevation and mostly desert with very little population. Garfield County is one of the most sparsely populated counties in Utah. Geographically, Garfield County is the fifth largest county in Utah, but it has the fifth smallest population. Most of the county's residents are clustered near the high alpine environment on the west side of the county where the majority of water and private land can be found (State of Utah 2003). Communities within close proximity to Dixie National Forest lands include Panguitch, Hatch, Tropic, Antimony, Escalante, and Boulder. Panguitch is the largest, with an estimated 2006 population of 1,485.

Garfield County is characterized by vast rangelands that include some of Utah's largest forest reserves, and a low rate of private land ownership. Only 5.1 percent of the county is privately owned. Nearly 90 percent of the land in the county is federally administered; of this the Forest Service oversees about 30 percent. Portions of three ranger districts administered by the Dixie National Forest lie in Garfield County, including nearly all of the Escalante and Powell Ranger Districts and about half of the Cedar City Ranger District.

Garfield County's economy is driven by tourism and agriculture (primarily cattle and lumber). The leisure and hospitality sector (tourism) accounts for more than 36 percent of all non-farm jobs in the county. Agriculture accounts for almost 11 percent of all jobs (farm and non-farm). The county's largest employer is Ruby's Inn, a resort located near Bryce Canyon that employs between 250 and 500 people. Bryce Canyon National Park currently receives approximately one million visitors annually, about 200 times the permanent population of the county.

The only oil production currently underway in the vicinity of Dixie National Forest, Upper Valley, is in Garfield County. The field is producing about 200,000 barrels per year.

3.11.2.2 Iron County

Iron County is located in the southwestern portion of the state, stretching from the arid West Desert to high mountain plateaus. Most of the county is high desert with shrub steppe vegetation such as juniper and sagebrush. At the eastern end of the county, the Markagunt Plateau rises to conifer forests. The southern border of the county is in the foothills of the Pine Valley Mountains.

Iron County has the highest proportion of land in private ownership of the six counties in the Analysis Area (35.7 percent). Federal agencies administer 57.5 percent of the land in the county. Approximately 240,000 acres of Dixie National Forest are located in the county and include small segments of the Pine Valley Ranger District and about half of the Cedar City Ranger District. Communities in close proximity to Forest lands include Brian Head, Parowan, Paragonah, Kanarraville, Newcastle, Summit, and Cedar City. Cedar City is the largest of these, with an estimated 2006 population of 25,665.

When the early attempts at iron ore mining in the Cedar City area were less than successful, the settlers turned to agriculture. Cedar City gradually evolved into a transportation hub for

supplying other communities in southwestern Utah and southeastern Nevada in addition to its natural position on the route from Salt Lake City to southern California. The Union Pacific Railroad extended a spur to Cedar City in the 1920s and after 70 years of planning, iron ore mining became successful in Iron County.

In the early 1960s, the federal government announced tentative plans that Interstate 15 might bypass Cedar City. This led to the business interests in Cedar City to devise ways to lure travelers off of the freeway and into the city. Fred Adams, a theatre professor at the then College of Southern Utah, has previously worked at the Shakespearean Festival in Ashland, Oregon and suggested a similar festival in Cedar City. The inaugural Utah Shakespearean Festival was held in 1962. The festival has since grown in size and has become a major economic driving force in the Iron County economy (Seegmiller 1998).

Since 1990, Iron County has been among the fastest growing counties in Utah. With a 2007 population of 44,813 it is the second largest county in the six-county analysis area. Iron County's population growth has been influenced by immigration of workers and retirees and the accreditation of Southern Utah University in 1991, with a subsequent increase in the county's student population.

Iron County has a balanced and broadly diversified economy. Cedar City is the most populated city in the county and is a regional trade center and supplier of services. Government is the largest sector of the economy. About 40 percent of government employment is Southern Utah University. The Iron County economy is influenced by the presence of Interstate 15, Southern Utah University and, to a lesser extent, the Utah Shakespearean Festival and the Utah Summer Games. There is also a noticeable manufacturing sector and major agricultural operations in the western part of the county.

3.11.2.3 Kane County

Kane County is located on the south central border of Utah, sharing its southern border with the State of Arizona. Similar to Garfield County, Kane County is also dominated by federal land (82.9 percent), most of which is managed by the BLM. Included in the county are portions of the Grand Staircase-Escalante National Monument, Glen Canyon National Recreation Area, the southern end of Bryce Canyon, and the southeastern corner of Zion National Park. Segments of the Cedar City Ranger District and Powel Ranger District lie in Kane County.

Communities closest to Forest lands include Alton, Glendale, and Orderville. Although the county's population has increased annually since 2003, with a total of 6,440 residents, the county is still largely rural and sparsely populated. Population in the county is concentrated in Kanab (population in 2006 was 3,754), located about 30 miles south of the Dixie National Forest.

Kane County was originally settled in the 1860s and 1870s and the population essentially relied on agriculture and ranching until well into the 20th century. Formation of several National Parks resulted in increased tourism in the 1930s and Kanab became a center for filming Hollywood westerns. The construction of Glen Canyon Dam just south of the state line in Arizona in the early 1960s was a major change in Kane County. Glen Canyon City was founded to house the construction workers and has since been renamed Big Water. With Lake Powell and the Grand Staircase-Escalante National Monument located partially within its borders, Kane County relies heavily on tourism, which accounts for almost 30 percent of non-farm jobs.

3.11.2.4 Piute County

Piute County is located in south central Utah and is centered on the Sevier River Valley. Its western boundary is near the crest of the Tushar Mountains. Grass Valley (Otter Creek) lies between the Sevier Plateau in the center of the county and the Parker Range on the eastern border.

Federal agencies administer about 74 percent of the land in the county, including the Fishlake National Forest and a very small segment of the Powell Ranger District of the Dixie National Forest. Circleville, Kingston, and Junction are the only communities in the county that are in close proximity to Dixie National Forest. Of these, Circleville is the largest, with an estimated 466 residents.

Piute County is small, largely rural, and sparsely populated. It is the sixth smallest county as measured by land area (484,652 acres) and second smallest by population (1,385 residents in 2007). From 2000 to 2007, population in the county declined by 3.6 percent. Although population growth has been positive since 2003, population is still below the 2000 census estimate.

Throughout most of the 19th and 20th centuries, the county's economy was reliant on agriculture and mining. Metals and minerals were a significant part of the local economy during World War I and World War II, but have since declined. Agriculture is still a mainstay of the economy. The latest available data indicate that farm earnings accounted for just over one-third of earnings in the county. Government is also a major contributor to employment in Piute County. Despite some job growth in the county, a large share of Piute County residents commutes to other counties for employment.

3.11.2.5 Washington County

Washington County lies in the extreme southwestern corner of Utah and is known for its hot, dry weather. Seventeen percent of the county is privately owned, the second highest rate in the six county area. Federal agencies administer nearly 75 percent of the land, which includes Zion National Park and 400,000 acres of the Dixie National Forest. The Paiute Tribe has a 28,000-acre reservation centered on Shivwits, northwest of St. George, which accounts for about two percent of the land in Washington County.

The largest portion of the Pine Valley Ranger District lies in Washington County. The communities in closest proximity to the Dixie National Forest are La Verkin, Leeds, Toquerville, New Harmony, and Enterprise. Of these, La Verkin is the most populous with 4,142 residents.

While it began as an agricultural region, tourism, retirement and the development of second homes changed the character of the county in the mid-1960s. This trend was encouraged by the completion of Interstate 15 freeway from Salt Lake City to St. George and on to Las Vegas, Nevada and Los Angeles, California in 1973. Presently, Washington County is the most urbanized of the six counties in the study area and closely resembles the economies of northern Utah counties.

Since the early 1970s, Washington County has experienced phenomenal growth, increasing in population from 13,900 in 1970 to 140,908 in 2007. This growth has occurred largely through net in-migration. Nearly 80 percent of the county's growth has come from net immigration over this 37-year period. With an estimated 2006 population of 67,614, St. George is the most populated place in the county.

After the 2000 Decennial Census, the county was declared a Metropolitan Area by the federal government. As with most metropolitan areas, the economy is well diversified. The largest sector is trade/transportation/utilities, followed by construction, a reflection of the county's strong population growth. Agriculture, once integral to the county's economy, now accounts for less than one percent of the area's jobs.

3.11.2.6 Wayne County

Located in southeastern Utah, Wayne County lies entirely within the Colorado Plateau, with dry plateaus and deep canyons in the eastern and central sections and high mountain peaks interspersed with agricultural valleys on the western end. Almost all of Wayne County (96.5 percent) is controlled by federal agencies, the second highest percentage of any county in Utah. Over half of these lands are administered by the BLM. The Forest Service administers about 10 percent, or about 160,000 acres, including portions of Fishlake National Forest, Glen Canyon National Recreation Area, Canyonlands National Park, and Capitol Reef National Park.

Communities closest to the Dixie National Forest include Torrey, Teasdale, Grover, Loa, and Bicknell. Bicknell is the larger of these, with an estimated 356 residents in 2006.

Because such a large amount of Wayne County is public land, its population density is among the lowest in the state. As such, the county is still largely rural and sparsely populated. In 2007, an estimated 2,635 people lived in Wayne County, an increase of just 126 residents from the 2000 census estimate.

Agriculture was a dominant industry in the county into the 1980s. In recent years, agriculture's share of employment has dropped sharply, but still accounts for 14 percent of all jobs in the county. The creation of National Parks and National Forest spawned a large tourism industry, which currently accounts for 20 percent of all jobs in the county. Over the last few years, youth rehabilitation/wilderness programs have helped diversify the county's economy. Presently, the health care and social assistance sector, which includes youth rehabilitation programs, is the largest employment sector.

3.11.3 Land Ownership

The federal government is the prominent land administrator in each of the subject counties. The combined acreage of counties in the study area totals 11,594,437, of which the federal government administers 9,242,293 acres, or about 80 percent. The majority of federal land in the study area is under the jurisdiction of the BLM (Table 3.11-1).

Garfield County has the most land administered by Forest Service at just over one million acres; all of which are on the Dixie National Forest. All of the Forest Service land in Iron and Washington Counties is also on the Dixie National Forest. In Piute and Wayne Counties, there are lands administered by both the Fishlake and Dixie National Forests. Glen Canyon National Recreation Area (Lake Powell), administered by the National Park Service, occurs within Garfield, Kane, and Wayne Counties. This acreage is in addition to that listed for National Parks in Table 3.11-1. The wilderness areas listed in Table 3.11-1 are administered by both the BLM and the Forest Service. This is in addition to the acreage listed for these respective agencies.

Table 3.11-1 Land Ownership by County

	Garfield County	Iron County	Kane County	Piute County	Washington County	Wayne County
Bureau of Land Management	1,489,829	957,731	1,633,909	163,947	629,170	893,447
USFS	1,011,544	236,507	125,342	196,026	345,188	159,976
National Recreation Area	305,563	0	381,627	0	0	98,370
Wilderness, USFS and BLM	25,100	7,083	21,426	0	54,744	0
National Parks	142,199	8,859	18,265	0	132,018	198,973
Bankhead-Jones Lands	8,094	0	0	0	0	0
Total Federal Lands	2,982,329	1,210,180	2,180,569	359,973	1,158,477	1,350,765
State Parks	1,520	0	1,746	0	6,297	0
State Wildlife Lands	684	5,804	0	4,340	0	753
State Trust Lands	159,544	136,558	107,466	58,594	97,628	170,151
Total State Lands	161,747	142,362	109,212	62,934	103,925	170,904
American Indian Lands	0	2,507	0	0	27,590	0
Private Lands	168,334	757,556	263,594	61,745	264,140	55,595
Total Acres	3,312,409	2,112,606	2,553,375	484,652	1,554,131	1,577,264

Source: Utah Governor's Office of Planning and Budget, Federal Land Payments in Utah.

3.11.4 Demographics

3.11.4.1 Population

Table 3.11-2 provides the population for each county in 2000, 2006, and 2007. There is considerable variation in population among counties, ranging from fewer than 1,500 persons in Piute County to nearly 141,000 persons in Washington County. Since 2000, some counties have experienced little or no growth (Piute and Garfield) while others expanded rapidly (Washington and Iron).

Within the study area, Washington County reported the largest population increase and has been one of the fastest growing counties in Utah for many years. Iron County experienced exceptional growth, increasing at a rate faster than the statewide rate since the mid-1990s.

Table 3.11-2 Population Statistics for Selected Years

County	Population 2007	Population 2006	Percent change from 2006 to 2007	Population 2000	Percent change from 2000 to 2007
Garfield	4,872	4,772	2.1	4,735	2.9
Iron	44,813	43,424	3.2	33,779	32.7
Kane	6,440	6,294	2.3	6,046	6.5
Piute	1,385	1,373	0.9	1,435	-3.5
Washington	140,908	134,899	4.5	90,354	56.0
Wayne	2,635	2,535	3.9	2,509	5.0
Total	**201,053**	**193,297**	**4.0**	**138,858**	**44.8**

Source: 2000, 2000 Decennial Census; 2006, 2007, Utah Population Estimates Committee.

While the population in all of the subject counties is projected to increase, Washington and Iron Counties will account for virtually all (97.7 percent) of the growth projected in the six-county area over the next decades. As shown in Table 3.11-3, Washington County is expected to sustain an average annual growth rate of 3.8 percent from 2000 to 2060, with a projected population of more of 860,000 by 2060. Iron County is projected to grow at an average annual rate of 2.7 percent, increasing to more than 168,000 by 2060. Population growth for the remaining counties is projected to be much lower, with the smallest gains occurring in Piute County, which is projected to increase at an annual rate of less than one percent from 2000 to 2060. Based on these projections, by 2060 96.6 percent of the population in the subject counties will be concentrated in Washington and Iron Counties, up from 65.1 percent in 2000.

Despite the perception that these places are rural, the majority of the population in the subject counties lives in urban areas due to the presence of St. George and Cedar City. The 2000 Decennial Census determined that 69.9 percent of the population lived in urban areas (Table 3.11-4). Five urban areas were identified by the 2000 Decennial Census. These are St. George with a population of 62,630, Cedar City (21,978), Hurricane (8,246), Kanab (2,734), and Colorado City (1,505). The US Bureau of the Census defines urban areas as census blocks with a population density of at least 1,000 persons per square mile, adjacent blocks with population densities of 500 persons per square mile, and adjacent blocks with lower population densities if they meet certain criteria established by the Bureau of the Census. Boundaries of urban areas do not correspond to the city limits for which the areas are named. The population figures given above are for the urban areas and are not the city populations.

Table 3.11-3 Population Projections, 2000-2060

County	2000	2010	2020	2030	2040	2050	2060	AAGR[1] 2000-2060
Garfield	4,763	5,092	5,843	6,823	7,656	8,738	10,356	1.3
Iron	34,079	50,601	68,315	87,644	110,257	137,240	168,383	2.7
Kane	6,037	6,893	8,746	10,394	12,034	14,267	17,276	1.8
Piute	1,436	1,396	1,526	1,690	1,817	2,035	2,404	0.9
Washington	91,104	168,078	279,864	415,510	559,670	709,674	860,378	3.8
Wayne	2,515	2,698	2,912	3,395	3,879	4,556	5,608	1.3
Total	**139,934**	**234,758**	**367,206**	**525,456**	**695,313**	**876,510**	**1,064,405**	**3.3**

[1] AAGR: Average Annual Growth Rate

Source: Utah Governor's Office of Planning and Budget, 2008 Baseline Projections; may differ from US Bureau of the Census projections

Table 3.11-4 Urban and Rural Population, 2000

	Garfield County	Iron County	Kane County	Piute County	Washington County	Wayne County	Six-County Total
Population	4,735	33,779	6,046	1,435	90,354	2,509	138,858
Percent Urban	0	65.1	45.2	0	80.1	0	69.9
Percent Rural	100.0	34.9	54.8	100.0	19.9	100.0	30.1

Source: 2000 Decennial Census, Summary File 1, data element P2.

As defined by the US Office of Management and Budget, there are two Core Based Statistical Areas in the study area. Washington County comprises the St. George Metropolitan Area and Iron County comprises the Cedar City Micropolitan Area. Metropolitan Areas are counties with at least 50,000 persons living in an urban area. Micropolitan Areas are counties with between 10,000 and 50,000 persons in an urban area. Adjacent counties may also be included in each classification if they meet criteria for commuting to or from the central counties.

3.11.4.2 Race and Ethnicity

The six-county analysis area is relatively homogeneous demographically. Overall, 91.5 percent of the population in the study area is white. Of the minority population in the area, 55 percent are Hispanic and about 18 percent are American Indian. Washington and Iron Counties had the largest minority populations at 8.9 percent and 8.7 percent of their total respective populations in 2000. The smallest minority population was in Wayne County.

3.11.4.3 Median Age

Within the subject counties, only Iron County has a median age lower than the state median of 27.1. The median age in the remaining counties is significantly higher than the state, ranging from 38.9 in Piute County to 33.8 in Garfield County. The comparatively low median age in Iron County is the result of a large student population due to the presence of Southern Utah University. The age structure of Garfield, Piute, and Wayne Counties is common to many rural communities: aging populations with under-representation of young working-age persons, which occurs when young people leave the community in search of economic and educational opportunities elsewhere. The high median age in Washington County is the result of retirement-age migration, which has been ongoing for several decades.

3.11.4.4 Households

Compared to the State of Utah, the six-county area has a slightly lower average household size, 2.98 persons per household compared to 3.13 persons per household for the state. Reflecting the large student population, the largest households in the area are in Iron County, with an average of 3.11 persons per household. Iron County also has the lowest percentage of one-person households in the six-county area. In comparison, Garfield, Kane, Piute, and Wayne have a higher than average percentage of single-person households, reflecting the aging populations in those counties.

3.11.4.5 Education

Each of the subject counties has a school district that is defined along county lines (Table 3.11-5). The school districts are governed by elected school boards and operate independently of county governments. Total enrollment in public schools in the six-county study area was 36,897 during 2007, up 28 percent from the 2000 enrollment of 28,791. The growth in school enrollment is concentrated in the Iron and Washington County School Districts. The other four districts have experienced flat or declining enrollments in recent years.

There are two state institutions of higher learning in the study area. Southern Utah University is located in Cedar City and Dixie State College in St. George. Southern Utah University offers associate's, bachelor's and master's degrees. Dixie State College was granted baccalaureate degree status in 2000. Formerly, the college was a two-year institution. Currently, the college offers 10 bachelor's degrees in addition to associate degrees and certificate programs.

Table 3.11-5 School District Enrollments, 1995-2007

School District	1995	2000	2005	2006	2007
Garfield County School District	1,167	1,115	940	938	933
Iron County School District	6,238	7,176	8,230	8,486	8,643
Kane County School District	1,491	1,335	1,194	1,188	1,178
Piute County School District	368	354	302	298	300
Washington County School District	17,418	18,261	23,189	24,297	25,295
Wayne County School District	602	550	514	531	548
Total	27,284	28,791	34,369	35,738	36,897

Source: Utah State Office of Education

3.11.5 Health Care

There are four hospitals located in the six counties. No hospitals are located in Piute or Wayne Counties, and there is one hospital in each of the remaining four counties. The Garfield Memorial Hospital and Clinics is located in Panguitch. The Dixie Regional Medical Center is located in St. George. The Valley View Medical Center is located in Cedar City. The Garfield Memorial Hospital and Clinics and the Valley View Medical Center are operated by Intermountain Healthcare, Inc., a nonprofit organization based in Salt Lake City. The Kane County Hospital is located in Kanab (Directory of America's Hospitals 2008).

3.11.6 Employment

Total employment in the six-county area reached 90,206 during 2006, up 42 percent from the 2000 figure of 63,370 (Table 3.11-6). The average unemployment rate in the study area is similar to that for Utah as a whole, although unemployment varies among the counties. Washington County and Iron County typically fare better than their counterparts in the six-county area as a result of having broad-based economies and strong population growth. As such, the unemployment rates in these two counties tend to parallel the Utah average. In contrast, employment in Garfield, Kane, Piute, and Wayne Counties tends to be concentrated in seasonal industries (tourism and agriculture), which results in an unemployment rate that is higher than the state average. Examining employment by industry provides information about important industries in the individual counties (Table 3.11-7).

Table 3.11-6 Labor Force and Unemployment for Selected Years

	1995	2000	2004	2005	2006
State of Utah					
Civilian Labor Force	1,014,959	1,136,036	1,230,539	1,263,774	1,311,073
Employment	979,367	1,097,915	1,169,163	1,211,803	1,272,801
Unemployment	35,592	38,121	61,376	51,971	38,272
Unemployment Rate	3.5%	3.4%	5.0%	4.1%	2.9%
Garfield County					
Civilian Labor Force	2,645	2,469	2,655	2,681	2,668
Employment	2,320	2,301	2,447	2,487	2,536
Unemployment	325	168	208	194	132
Unemployment Rate	12.3%	6.8%	7.8%	7.2%	4.9%
Iron County					
Civilian Labor Force	13,024	16,809	18,755	19,738	20,753
Employment	12,586	16,262	17,892	18,964	20,170
Unemployment	438	547	863	774	583
Unemployment Rate	3.4%	3.3%	4.6%	3.9%	2.8%

	1995	2000	2004	2005	2006
Kane County					
Civilian Labor Force	2,712	3,011	3,245	3,242	3,399
Employment	2,479	2,896	3,064	3,082	3,280
Unemployment	233	115	181	160	119
Unemployment Rate	8.6%	3.8%	5.6%	4.9%	3.5%
Piute County					
Civilian Labor Force	490	623	868	845	877
Employment	461	595	830	811	850
Unemployment	29	28	38	34	27
Unemployment Rate	5.9%	4.5%	4.4%	4.0%	3.1%
Washington County					
Civilian Labor Force	32,846	39,148	52,061	56,553	61,128
Employment	31,783	37,771	48,543	54,242	59,369
Unemployment	1,063	1377	2,518	2,311	1,759
Unemployment Rate	3.2%	3.5%	4.8%	4.1%	2.9%
Wayne County					
Civilian Labor Force	1,326	1,310	1,354	1,327	1,381
Employment	1,243	1,250	1,265	1,255	1,322
Unemployment	83	60	89	72	59
Unemployment Rate	6.3%	4.6%	6.6%	5.4%	4.3%
Six County Area					
Civilian Labor Force	53,043	63,370	78,938	84,386	90,206
Employment	50,872	61,075	74,041	80,841	87,527
Unemployment	2,171	2,295	3,897	3,545	2,679
Unemployment Rate	4.1%	3.6%	4.9%	4.2%	3.0%

Source: Bureau of Labor Statistics (2008), Local Area Unemployment Statistics.

In 2006, the number of non-farm jobs in Garfield County totaled 2,260. The county's economy is highly concentrated in tourism and government. In fact, Garfield County relies on tourism and recreation more than any other county in the state. In 2006, 36 percent of all non-farm employment in Garfield County was in the leisure/hospitality sector. The seasonal nature of the tourist economy explains the county's high unemployment rate, 4.9 percent compared with the statewide rate of 2.9 percent in 2006. Government is the second largest sector, accounting for 26 percent of all non-farm jobs. When combined, employment in these two sectors accounted for more than 60 percent of all non-farm jobs in Garfield County in 2006. Major employers in Garfield County include Ruby's Inn, Garfield County School District, South Central Utah Telephone, Garfield Memorial Hospital, and the federal government.

Non-farm jobs totaled 16,808 in Iron County in 2006. Government is the largest employment sector in Iron County, accounting for 25 percent of all non-farm jobs in 2006. A large portion of these jobs are with Southern Utah University. Iron County's population growth has generated strong housing demand, as reflected in the construction sector. From 2005 to 2006, employment in the construction sector increased 29 percent, averaging 1,839 during 2006. Almost 18 percent of all non-farm jobs in the county are in the megasector trade/transportation/utilities. Iron County also has a stronger than average manufacturing sector, which provided 1,839 jobs in 2006. Major employers in Iron County include Southern Utah University, Iron County School District, Valley View Medical Center, Wal-Mart, and Convergys.

With Lake Powell and the Grand Staircase-Escalante National Monument partially within its border, Kane County relies heavily on tourism. Of the 3,092 non-farm jobs in the county in

2006, 28 percent were in leisure/hospitality. Apart from retail trade, the only other large employment sector in Kane County is other services, which includes an animal rescue organization employing more than 250 people. Job growth in the county has remained strong over the past two years, fueled by an expanding construction sector, which increased 28 percent from 2005 to 2006. Major employers in Kane County include Best Friends Sanctuary, Kane County School District, Aramark, Kane County Hospital, and Stampin' Up.

Of the six counties, Piute County has the smallest number of jobs in the non-farm sector. Largely due to significant out-commuting, non-farm employment in 2006 totaled just 333. Government is the largest non-farm sector, accounting for 44 percent of all non-farm jobs. Most of these are in the public school systems. More so than the other counties, self-employment and agricultural employment are significant portions of the employment picture in Piute County, but are not captured in non-farm employment data. Major employers in Piute County are Piute County School District, Dalton Brothers Trucking, Storm Ridge Ranch School, Piute County, and the State of Utah.

Washington County's economy is large and well diversified. In 2006, total non-farm employment was 51,529. The largest sector is trade/transportation/utilities, which employed 11,785 people in 2006, about 23 percent of all non-farm jobs. Reflecting the strong housing market in the county, construction is the second largest sector in 2006 providing employment for 16 percent of all non-farm workers. Other important employment sectors in Washington County are education/health services (6,923 jobs), leisure/hospitality (6,566 jobs), and government (6,139 jobs). The largest employers in Washington County are the Washington County School District, Intermountain Health Care, Wal-Mart, Dixie State College of Utah, and St. George City.

Non-farm employment in Wayne County totaled 1,049 in 2006 and is concentrated in education/health services (primarily residential treatment facilities for troubled adolescents), government (education and local administration), and leisure/hospitality (tourism). In 2006, these three sectors accounted for 72 percent of all non-farm jobs in the county. From 2005 to 2006, the leisure/hospitality sector posted the strongest growth, increasing by 10 percent. In all other sectors but retail trade, job growth was flat or negative. In Wayne County, the largest employers are Aspen Ranch, Aspen Achievement Academy, Wayne County School District, the federal government, and Passages to Recovery (Utah Department of Workforce Services 2007).

Table 3.11-7 Employment by Industry, 2006

Industry	Garfield County	Iron County	Kane County	Piute County	Washington County	Wayne County
Total Nonagricultural Employment	2,260	16,806	3,092	333	51,529	1,049
Mining	12	58	0	7	246	0
Construction	83	1,839	181	15	8,289	109
Manufacturing	98	1,785	187	3	3,276	11
Trade, Transportation and Utilities	239	3,022	448	70	11,785	132
Information	126	123	31	0	869	2
Financial Activities	35	784	120	5	2,248	8
Professional and Business Services	17	1,272	51	2	3,786	4
Education and Health Services	207	1,591	83	25	6,923	303
Leisure and Hospitality	821	1,804	863	52	6,566	174

Other Services	27	334	407	7	1,402	24
Government	595	4,194	721	147	6,139	282

Source: Utah Department of Workforce Services, Annual Report of Labor Market Information, 2006. Energy Information Administration (2007b)

3.11.7 Wages and Income

Wage and income data for each of the six counties were obtained from the US Bureau of Labor Statistics (2008) and the US Bureau of Economic Analysis. Table 3.11-8 shows information on wages (annual and total), total personal income, and per capita personal income. Personal income is income received by persons from all sources. Per capita personal income is the mean income computed for every person living in a geographical area. Household income is the sum of money income received in a calendar year by all household members, including household members not related to the householder, people living alone, and other non-family members.

3.11.7.1 Wages

With the exception of Piute County, wages in the six-county area grew at a rate faster than the statewide rate. Wayne County posted the largest increase, increasing at an annual rate of 4.3 percent from 2000 to 2005. Washington County has the highest average annual wage ($26,046), followed by Wayne County ($23,886) and Iron County ($23,867).

From 2000 to 2005, all counties in the six-county area, except Piute, experienced an improvement in their average annual wage relative to the state. Wayne County fared the best, increasing to 71 percent of the state average in 2005, from 61 percent in 2000.

Despite strong wage growth in the region, the average annual wage in all counties stayed significantly below the 2005 state average of $33,328. Relative to the state average, Garfield, Kane, and Piute Counties fare the worst. In each of these counties, the average annual wage is at least 33 percent below the state average. Even though Washington County has the highest average annual wage of the six counties, it is about 78 percent of the state average.

Table 3.11-8 Wage Data, Selected Years

	2000	2002	2003	2004	2005
Average Annual Wage ($)					
State of Utah	29,229	30,585	31,106	32,171	33,328
Garfield County	18,769	19,935	20,208	21,498	21,819
Iron County	20,258	21,768	21,980	22,929	23,867
Kane County	18,524	19,204	19,630	19,735	21,885
Piute County	19,933	19,833	19,048	19,944	22,286
Washington County	22,089	23,101	23,716	24,518	26,046
Wayne County	17,821	19,677	20,918	22,368	23,886
Total Wages Paid ($1,000)					
State of Utah	30,518,822	31,861,030	32,410,184	34,483,093	37,173,461
Garfield County	39,813	40,683	41,120	46,183	47,996
Iron County	274,612	295,200	298,604	324,733	361,660
Kane County	51,239	49,437	53,040	55,374	61,932
Piute County	4,714	4,786	5,183	5,986	6,560
Washington County	731,935	846,355	908,536	1,034,660	1,212,755
Wayne County	20,078	21,410	20,820	22,683	24,180

Source: Bureau of Labor Statistics (2008), Quarterly Census of Employment and Wages.

3.11.7.2 Personal Income

From 2000 to 2005, total personal income in the study area increased at an annual rate of 8.2 percent, totaling $3.8 billion by the end of the period. Of the six counties, all but Garfield and Wayne saw personal income increase at an annual rate higher than the state average of 4.9 percent. Washington County posted the largest annual increase at 8.2 percent, followed by Iron County (7.5 percent) and Piute County (7.2 percent). Personal income grew at an annual rate of 3.7 percent in Garfield County and 3.2 percent in Wayne County.

Although growth in per capita personal income in each of the counties exceeded the statewide rate from 2000 to 2005, with the exception of Kane County, per capita incomes in the area remain below the state average. In 2005, per capita personal income in Kane County was about $200 higher than the statewide average, $27,456 compared to $27,231. Per capita income in the remaining counties was significantly below the state average. The largest differential was in Iron County, where per capita personal income was $6,442 lower than the state average, or about 76 percent of the statewide figure (Table 3.11-9).

COMPONENTS OF PERSONAL INCOME

Earnings by place of residence made up 63.3 percent of total personal income in the six counties in 2005, and dividends, interest, and rent (investment income) accounted for 18.1 percent. Personal current transfer receipts, largely social security and retirement income, accounted for 18.6 percent of personal income.

Government is the single largest source of earnings in each of the six counties. Garfield County's reliance on government is the highest of the six counties, accounting for almost 35 percent of earnings in 2005. Washington County received the smallest share of earnings (13.9 percent) from government.

Within the individual counties, Garfield County is the second most reliant on earnings (66 percent) and the most reliant on transfer payments of the six counties. Earnings from employment in the government sector accounted for more than one-third of all earnings in the county in 2005. Notably, farm earnings were negative in 2005 and have been declining for over a decade (Bureau of Economic and Business Research 2008).

Table 3.11-9 Personal Income, Selected Years

Total Personal Income ($1,000)					
	Year				
	2000	2002	2003	2004	2005
State of Utah	53,561,211	58,171,715	59,412,078	63,477,769	68,038,514
Garfield County	87,016	88,299	90,753	99,560	104,439
Iron County	556,689	649,634	670,452	733,041	799,104
Kane County	131,553	139,388	148,209	158,148	171,106
Piute County	22,321	24,619	26,436	29,284	31,410
Washington County	1,751,940	1,985,387	2,108,039	2,420,709	2,689,441
Wayne County	46,389	48,268	49,145	52,927	54,374
Per Capita Personal Income ($)					
State of Utah	23,874	25,010	25,220	26,214	27,231
Garfield County	18,319	19,170	20,012	22,378	23,506
Iron County	16,387	18,381	18,797	20,117	20,789
Kane County	21,641	23,100	24,413	25,867	27,456
Piute County	15,522	17,840	19,170	21,083	22,910

Washington County	19,201	19,932	20,171	21,912	22,565
Wayne County	18,292	19,011	19,889	21,445	22,157

Source: Bureau of Economic Analysis, State and Local Area Personal Income.

Iron County derives the largest share of its personal income from earnings (68 percent) of any county in the study area. The largest sources of earnings are government (27.7 percent), manufacturing (11.8 percent), and retail trade (6.8 percent). Notably, in 2005, farm earnings totaled $43 million, the largest amount among the six counties; however, Iron County's economy is well diversified and as a share of total earnings, the farm sector accounted for 7.2 percent.

About 60 percent of personal income in Kane County comes from earnings. The county's share of personal income from investment income was 21.1 percent, higher than the six-county average. Transfer receipts accounted for 18 percent of the county's personal income. Almost half of all earnings in Kane County come from two sectors: government (30 percent) and other services (17.2 percent). Farm income in the county has been steadily declining for several decades, a trend reflected in the negative amount listed for farm earnings.

Transfer receipts are a more important component of personal income in Piute County than in other counties. In 2005, transfer receipts accounted for more than one-quarter of the county's personal income. Dividends, interest, and rent accounted for 13.2 percent of the total and earnings 60 percent. Piute County is one of the few counties in Utah where farm earnings are a significant percentage of income. In 2005, the farm sector provided 35.3 percent of all earnings in the county, the highest share among the six counties. Government provided the second largest amount. When combined, farm and government accounted for 63.5 percent of earnings in Piute County during 2005.

Almost 70 percent of all personal income in the study area is in Washington County. Earnings contributed 62 percent of the total, followed by dividends, interest, and rent (19.5 percent) and transfer receipts (18.5 percent). Contrary to every other county in the area, Washington derives a comparatively small share of its earnings from government. In Washington County, the largest share of earnings comes from construction (17.3 percent), reflecting the construction boom that was underway in 2005, and health care (12.3 percent). Retail trade and transportation are also important sectors in the county. Farm earnings were negative in 2005 and have been persistently negative since 1995 (Bureau of Economic and Business Research 2008).

Personal income in Wayne County derives largely from earnings (65 percent). The remainder is evenly split between dividends, interest, and rent and transfer receipts. The two most important sectors, as measured by contributions to earnings, are government (30.5 percent) and construction (11.2 percent). Farm earnings are also important in Wayne County, representing 10 percent of all earnings in 2005, a share second only to Piute County. In Wayne County, 17.4 percent of personal income came from personal current transfer receipts in 2005, the lowest of the six counties. Because Wayne County is so small, one-third of the county's earnings data was suppressed in 2005 to avoid revealing individual company data.

Median Household Income

Based on information from the US Bureau of the Census, the median household income of the six counties has been, and continues to be, significantly lower than the statewide median (Table 3.11-10). Washington County had the highest median household income in 2005 ($43,566), but was 90 percent of the statewide equivalent. Piute County had the lowest 2005 median household income of the six counties at $32,862, or 68 percent of the statewide median.

In recent years, household income has been rising faster in five of the six subject counties than in the state as a whole (Table 3.11-10). Only in Wayne County has the increase in household income failed to meet the state average. In 2001 and 2002, the median household income in the county actually declined. Washington County had the highest increase in household income from 2000 to 2005, gaining 15.1 percent.

Table 3.11-10 Median Household Income Estimates, 2000-2005

	Garfield County	Iron County	Kane County	Piute County	Washington County	Wayne County	State of Utah
2000	$35,079	$34,121	$34,937	$29,877	$37,854	$33,236	$45,934
2001	34,283	33,440	34,239	29,508	36,976	32,637	45,914
2002	33,964	34,096	34,455	28,399	37,850	31,545	46,165
2003	34,910	35,862	36,117	29,195	39,777	32,465	46,709
2004	37,454	37,495	37,613	32,225	42,726	34,129	47,224
2005	38,751	37,624	37,395	32,862	43,566	34,733	48,155
Percent Increase, 2000-2005	10.5	10.3	7.0	10.0	15.1	4.5	4.8

Source: US Bureau of the Census, Small Area Income and Poverty Estimates.

All counties in the study area have a larger share of low-income households than is the case statewide. Within the region, Piute County has largest share of households that reported making less than $10,000 in 1999 (14.9 percent). Almost 10 percent of the households in Wayne County and Iron County were in the lowest income brackets, while Washington County had the fewest low-income households.

At the other end of the scale, 13.8 percent of the households in Washington County had incomes greater than $75,000 in 1999, the highest of the six counties, but lower than the statewide rate of 22.5 percent. Piute County had the lowest share of high-income households in the study area.

3.11.8 Local Government Finances

Local government finances in 2002 for the six counties are summarized in Table 3.11-11. These data include all local governments—not only county governments, but also all municipalities, school districts, and special service districts within the counties.

Washington County has the highest population in the study area, and the highest revenue and expenditures. The highest per capita taxes are in Kane County ($1,213), followed by Garfield County (1,009). Per capita taxes in Piute County are the lowest at $611, followed by Wayne County at $678.

In each county, the largest share of general expenditures goes to education. The share spent in Piute County is 66 percent, the highest among the six counties. More than half of all general revenue in Garfield, Piute, Washington, and Wayne is spent on education. Iron and Kane are slightly less at 44.7 percent and 41.7 percent, respectively.

Of the six counties, Garfield County has the highest per capita public debt at $4,748, followed by Washington County ($3,335) and Iron County ($3,152). Piute County has the lowest per capita debt ($1,470) followed by Wayne County ($1,570).

Table 3.11-11 Local Government Finances, 2002

Description	Garfield County	Iron County	Kane County	Piute County	Washington County	Wayne County
General Revenue (millions)	$22.7	$90.6	$28.9	$5.3	$226.9	$7.6
Intergovernmental Transfers (millions)	$10.1	$39.3	$12.4	$3.9	$88.9	$5.1
Total Taxes (millions)	$4.6	$28.0	$7.4	$0.8	$83.6	$1.7
Per Capita Taxes	$1,009	$796	$1,213	$611	$840	$678
Per Capita Property Taxes	$655	$551	$900	$447	$536	$450
Direct General Expenditures (millions)	$23.4	$97.7	$27.0	$5.6	$210.3	$7.7
Per Capita Direct General Expenditures	$5,099	$2,776	$4,415	$4,079	$2,115	$3,012
Education	55.2%	44.7%	41.7%	66.0%	52.4%	55.9%
Health and Hospitals	1.6%	0.4%	24.8%	0.4%	0.4%	0.4%
Police	3.0%	5.0%	5.2%	4.8%	5.0%	5.4%
Public Welfare	0.0%	0.0%	0.0%	0.1%	0.0%	0.0%
Highways	9.6%	6.8%	5.4%	10.9%	6.9%	16.6%
Total Outstanding Debt (millions)	$21.8	$111.0	$16.8	$2.0	$331.7	$4.0
Per Capita Outstanding Debt	$4,748	$3,152	$2,745	$1,470	$3,335	$1,570

Source: Bureau of the Census, 2002 Census of Government, as cited in Gaquin and DeBrandt, 2007.

3.11.8.1 Property Taxes

Property tax data from the Utah State Tax Commission are shown in Table 3.11-12. Total 2006 property taxes paid range from $813,346 in Piute County to $102,116,227 in Washington County. Of the six counties, only Garfield County currently has property taxes levied against oil and gas properties. In 2006, this amounted to $167,041 and represented 3.6 percent of the county's total property tax payments (Utah State Tax Commission, 2006).

Table 3.11-12 Property Taxes Paid, 2001-2006

Year	Garfield County	Iron County	Kane County	Piute County	Washington County	Wayne County
2001	$3,242,290	$21,144,306	$4,947,813	$573,256	$55,666,192	$990,151
2002	3,566,835	21,425,718	5,591,662	585,330	64,822,974	976,752
2003	4,086,828	24,007,431	5,862,156	626,666	70,392,016	1,312,706
2004	4,166,925	24,889,692	5,645,788	748,422	74,992,373	1,298,548
2005	4,291,755	29,252,423	6,974,273	748,740	85,676,025	1,408,571
2006	4,689,272	36,079,871	10,448,643	813,346	102,116,227	1,423,295

Source: Utah State Tax Commission, Property Tax Division, Annual Statistical Reports, years as indicated (Utah State Tax Commission 2007)

3.11.8.2 Payments in Lieu of Taxes

The federal government makes payments in lieu of taxes to local governments to help offset losses in property taxes due to nontaxable federal land. During 2007, payments in lieu of taxes

for the six counties totaled $4,641,189 (Table 3.11-13). Payments in lieu of taxes are based on population, receipt-sharing payments, and the amount of federal land within a county.

Table 3.11-13 Payments in Lieu of Taxes, 2004-2007

Year	Garfield County	Iron County	Kane County	Piute County	Washington County	Wayne County
2004	$428,693	$1,525,195	$513,297	$113,302	$1,556,724	$240,126
2005	433,660	1,616,588	524,098	123,659	1,590,982	234,364
2006	433,510	1,643,542	535,585	127,275	1,618,587	240,198
2007	432,721	1,699,495	533,404	127,298	1,611,038	237,233

Source: US Department of the Interior.

3.11.8.3 Housing

Washington County has the highest housing occupancy rate of the six counties, followed by Iron and Piute Counties (Table 3.11-14). Many of the vacant housing units in the area are for seasonal, recreational, and occasional use. In Garfield and Kane Counties, over one-third of the housing units are for seasonal, recreation, and occasional use, reflecting the importance of tourism.

Washington County has the newest housing in the area, reflecting population growth that has occurred in the county over the past several decades. Washington County also has the highest median value of owner-occupied housing in the area. Piute County has the oldest housing in the area and the lowest value of owner-occupied housing. Iron, Kane, and Washington Counties have all experienced strong growth in new construction since 2000.

Table 3.11-14 Housing Occupancy, 2000

	Garfield County	Iron County	Kane County	Piute County	Washington County	Wayne County
Housing Units	2,767	13,618	3,767	745	36,478	1,329
Occupied	57.0%	78.0%	59.4%	68.3%	82.1%	67.0%
Vacant	43.0%	21.2%	40.6%	31.7%	17.9%	33.0%
For seasonal, recreational or occasional use	34.8%	15.0%	34.1%	25.5%	12.2%	24.5%

Source: Bureau of the Census, 2000 Decennial Census, Summary File 3, data elements H6 and H8.

Iron County has the highest rate of renter-occupied housing in the area as a result of Southern Utah University (Table 3.11-15). Washington County is second in the rate of renter-occupied housing.

Table 3.11-15 Occupied Housing, 2000

	Garfield County	Iron County	Kane County	Piute County	Washington County	Wayne County
Occupied Housing Units	1,576	10,627	2,237	509	29,939	890
Owner Occupied	79.0%	66.3%	78.1%	87.2%	74.0%	77.6%
Renter Occupied	21.0%	33.7%	21.9%	12.8%	26.0%	22.4%

Source: Bureau of the Census, 2000 Decennial Census, Summary File 3, data element H7.

Most housing units in the area are single-unit structures (Table 3.11-16). The highest percentage of single-unit structures is in Piute County. The lowest rate of single-unit structures is in Iron County, again reflecting the influence of student housing at Southern Utah University. In Kane County, nearly one-quarter of housing units are mobile homes or similar structures.

Table 3.11-16 Housing Units in Structure, 2000

	Garfield County	Iron County	Kane County	Piute County	Washington County	Wayne County
Housing Units	2,767	13,618	3,767	745	36,478	1,329
1 Unit	79.2%	65.9%	74.5%	86.3%	74.7%	81.2%
2-4 Units	1.4%	9.3%	2.4%	0.3%	5.2%	4.2%
5-9 Units	0.1%	3.7%	0.5%	0.0%	2.9%	0.0%
10 or More Units	0.0%	11.2%	0.2%	0.0%	5.1%	0.0%
Mobile Home/Other	19.4%	9.9%	22.3%	13.4%	12.2%	14.6%

Source: Bureau of the Census, 2000 Decennial Census, Summary File 3, data element H7.

Since 2000, 24,212 new housing units have been constructed in the six counties. The majority of these have been in Washington County, followed by Iron County. In Garfield and Kane Counties, a sizeable number of the new dwelling units are cabins and mobile homes. Since 2000, 49 percent of all new housing units in Garfield County have been cabins and mobile homes, while in Kane County 56 percent of new housing units have been cabins and mobile homes. Presumably, many of these are for seasonal or part-time use.

3.11.8.4 Agriculture

Since much of the six-county area is rural, agriculture and cattle ranching play a large part in the cultural identity of many of the residents. Iron County is the most significant of the six counties in agricultural production, accounting for over $77 million in agricultural products in 2002, 68 percent of the total for the six counties (Table 3.11-17).

Livestock, primarily cattle, accounts for more than one-half of the value of production in the area. In four of the counties, livestock was over 90 percent of the value of production. Although the breakout between crops and livestock is withheld for Kane County to prevent disclosure of individual data, the National Agricultural Statistics Service reported that $3.2 million worth of cattle and calves were sold by Kane County farmers in 2002. Hay accounts for most of the crop production in Iron and Washington Counties, although in Washington County, fruits and nursery production are sizeable.

Table 3.11-17 Value of Agricultural Production, 2002

	Garfield County	Iron County	Kane County	Piute County	Washington County	Wayne County
Value of Production (thousands)	$6,037	$77,402	$3,385	$9,028	$7,256	$10,523
Crops	8.1%	48.2%	D[1]	8.4%	41.6%	7.1%
Livestock	91.9%	51.8%	D[1]	91.6%	58.4%	92.9%

[1] Not disclosed.

Source: National Agricultural Statistics Service, 2002 Census of Agriculture.

The most profitable farms in the area are in Iron County, with average cash income of $57,920 in 2002 (Table 3.11-18). Farmers in Garfield and Washington Counties reported average net losses, on a cash basis, during 2002. Only in Wayne County did a majority of farms have sales

greater than $10,000, while in Washington County nearly three-fourths of the farmers (72.3 percent) had sales of less than $10,000.

Table 3.11-18 Agricultural Economics, 2002

	Garfield County	Iron County	Kane County	Piute County	Washington County	Wayne County
Number of Farms	225	438	131	108	481	173
Average Size (acres)	355	1,094	1,146	D[1]	451	245
Average Cash Income	-$6,926	$57,920	$1,711	$14,832	-$6,555	$14,420
Sales less than $10,000	60.0%	60.7%	62.6%	51.9%	72.3%	40.5%
Operators Principal Occupation in other than farming	43.6%	48.6%	45.8%	25.0%	53.4%	42.8%
Operators Work off the Farm	65.8%	63.5%	48.9%	45.4%	60.0%	61.8%
Operators Work more than 200 days off the Farm	47.1%	45.9%	32.1%	28.7%	42.6%	44.5%

[1] Not disclosed.
Source: National Agricultural Statistics Service, 2002 Census of Agriculture.

In most of the counties examined, most of the farmers have a principal occupation other than farming; however, in Piute County, a majority of the farmers consider farming to be their principal occupation. In Kane and Piute Counties, a majority of the farmers do not have outside employment. In the remaining four counties, the majority of the farmers have non-farm jobs in addition to their work on the farm. Although agriculture and ranching play a significant role in the culture and social makeup of the area, non-farm employment is necessary to augment farm earnings.

3.11.9 Utah Oil and Gas Industry

The Utah oil and gas industry began in 1891, when a water well being drilled in Farmington Bay near the Great Salt Lake encountered natural gas. Gas from several wells in this area was transported to Salt Lake City through wooden pipelines for several years until they were plugged by shifting sand in the lakebed. Oil was first discovered in the early 1900s near Rozel Point at the north end of the Great Salt Lake, near Mexican Hat in southeastern Utah, and near the town of Virgin in southwestern Utah. The first large-scale commercial oil well was drilled near Vernal in 1948. Since the early 1960s, Utah has consistently ranked in the top 15 oil-producing states and in recent years has experienced a dramatic rise in natural gas production. During 2005, Utah ranked 15th in crude oil production out of 31 states and two Federal Offshore Areas, and 11th in dry natural gas production out of 33 states and the Federal Offshore Area in the Gulf of Mexico.

The state's 2006 crude oil production of 17.9 million barrels was a 37 percent increase over the recent low of 13.1 million barrels produced in 2003. Although a substantial increase from the recent past, 2006's output was 44 percent of the all-time high of 41.1 million barrels produced in 1985. The distribution of oil production between the oil-producing counties (Carbon, Daggett, Duchesne, Emery, Garfield, Grand, San Juan, Sanpete, Sevier, Summit, and Uintah) changes over time as fields are initially developed, reach peak production, and then dwindle. In 2006

Duchesne County lead the state in oil production followed by Uintah, San Juan, and Sevier Counties. The other oil-producing counties trailed these four lead counties by a wide margin

There has been an even greater rise in natural gas production in Utah. In 2006, Utah's gross withdrawals of natural gas hit an all-time high of 357 billion cubic feet, up 69 percent from 211 billion cubic feet in 1985. In order of gas production, the gas-producing counties in 2006 were: Uintah, Carbon, Duchesne, Emery, San Juan, Summit, Grand, Daggett, Garfield, and San Pete. Not all gross withdrawals of natural gas are marketed to consumers. Low prices of natural gas during the late 1980s and early 1990s resulted in much of the gas produced in Utah at the time not being marketed. A large portion of the gas withdrawn from wells in Utah during this period was reinjected into the geologic formations to maintain pressure and oil production. The amount of gas used for repressuring in Utah reached a high in 1983, when 65 percent of gross withdrawals were reinjected to maintain pressure. Currently, approximately 95 percent of natural gas withdrawals in Utah are marketed.

During 2006, 129 different operating companies reported crude oil and natural gas production to the Utah Division of Oil, Gas, and Mining. Production occurred in 11 of Utah's 29 counties. Duchesne County had the highest oil production with 6,401,637 barrels, while Uintah County led natural gas production with gross withdrawals of 204 billion cubic feet.

A better gauge of oil and gas activity is the number of applications for permit to drill (APD) (Table 3.11-19). The number of APDs increased from 1,102 in 2004 to 2,061 in 2006 before dropping to 1,553 in 2007. While the majority of APDs were in the traditional oil and gas-producing counties, high prices are stimulating exploration in other areas. Four APDs were filed in the six-county area in 2007, two in Iron County and two in Piute County.

Table 3.11-19 Applications for Permit to Drill, by County (2004 – 2007)

County	2007	2006	2005	2004
Carbon	75	136	73	55
Daggett	0	0	0	1
Duchesne	371	447	254	211
Emery	34	36	21	7
Garfield	0	0	0	1
Grand	57	49	37	18
Iron	2	0	0	0
Juab	0	0	1	0
Piute	2	0	0	0
Rich	1	0	1	0
San Juan	24	18	7	5
Sanpete	2	5	3	0
Sevier	6	4	5	8
Summit	0	3	2	0
Tooele	1	0	0	0
Uintah	978	1,363	1,225	795
Utah	0	0	1	1
State Total	1,553	2,061	1,630	1,102

Source: Utah Division of Oil, Gas, and Mining.

Six different areas in Utah currently have significant production of oil and/or natural gas. These areas are defined by geology. Additionally, these areas are somewhat isolated from one another economically, especially in terms of the oil and gas exploration and production industry.

The major oil and gas producing area in Utah is the Uinta Basin in the northeastern part of the state. Vernal is the center of the oil and gas industry in the Uinta Basin and many of the production, drilling, and service companies maintain offices in the area. Other producing areas in Utah include both conventional and coalbed methane plays in Carbon and Emery Counties, the Paradox Basin in San Juan County, the Uncompahgre Uplift in Grand County, the Thrust Belt in Summit County, and the recently discovered Hingeline in the central part of the state. None of these plays are in the six-county area.

The Paradox Basin, Uncompahgre Uplift, and Thrust Belt all extend over state lines into adjacent states. Many of the workers involved in operating wells in these areas are actually employed in other states. Expanded gas operations in Carbon and Emery Counties and new oil production in the Hingeline are fairly recent discoveries. An oil service industry has not yet developed in these areas.

Despite the common perception of being vertically integrated, the oil and gas industry is highly fragmented, especially at the exploration and production stage. Many companies concentrate exclusively on oil and gas production and have no interest in downstream operations such as pipelines, refineries, and product distribution. Additionally, much of the work conducted in the producing fields is contracted to other companies that specialize in different aspects of drilling and maintaining the wells. Few of the operating companies operate their own drill rigs; instead they contract with companies that specialize in drilling. Other companies specialize in different operations such as grading well locations, well surveying, running and pulling well casings, cementing wells, perforating well casings, and reservoir treatment and stimulation. The operating, drilling, and service companies collectively constitute the oil and gas exploration and production industry. Other types of companies benefit from spending by the oil and gas industry. These include consulting geologists and engineering companies, environmental consultants, vendors of oil field equipment, and pipeline and trucking companies.

With numerous types of companies involved in the production of oil and natural gas, defining the oil and gas industry can be difficult. Economists use the numerical North American Industry Classification System (NAICS) developed by the Office of Management and Budget to classify industries for reporting employment and earnings. The two-digit NAICS codes are divided into 20 major industrial sectors. These major sectors are then further subdivided to reflect specialization within the primary industry.

The NAICS codes include three industrial subdivision classifications that apply directly to the oil and gas exploration and production industry. These are NAICS 211 - Oil and Gas Extraction, NAICS 213111 - Drilling Oil and Gas Wells, and NAICS 213112 - Support Activities for Oil and Gas Operations. Generally, these three industries are collectively considered the oil and gas exploration and production industry.

Total employment in Utah has been rising in these industries in response to increasing oil and gas prices (Table 3.11-20). Most of the employment is in the drilling and service companies, reflecting the fragmented nature of the industry. Total employment in the oil and gas industry in Utah increased 89 percent from 2001 to 2006, but still accounts for less than one-half of one percent of total employment in the state.

Table 3.11-20 Oil and Gas Industry Employment in Utah, 2001-2006

Year	NAICS 211 Oil and Gas	NAICS 213111 Drilling Oil	NAICS 213112 Support Activities	Total Oil and Gas Industry

	Extraction	and Gas Wells	for Oil and Gas Operations	Employment
2001	547	661	1,461	2,669
2002	563	492	1,506	2,561
2003	628	593	1,363	2,584
2004	730	691	1,581	3,002
2005	822	1,163	2,027	4,012
2006	1,096	1,427	2,532	5,055

Source: Bureau of Labor Statistics (2008), Quarterly Census of Employment and Wages

Although the oil and gas industry is small compared to other industries in Utah, it is very important in several areas of the state. In Duchesne and Uintah Counties, the oil and gas industry is directly responsible for approximately 20 percent of total employment and 35 percent of total wages. The oil and gas industry is also of noticeable size in Carbon, Emery, and San Juan Counties. Although there is significant natural gas production in Grand County, most of the workers involved live in Colorado. Similarly, the workers related to production in Summit County live in Wyoming.

Wages paid in Utah by the oil and gas industry have been rising along with employment in recent years (Table 3.11-21). The average wage paid by the industry in Utah during 2006 was $64,763, compared to a statewide average wage of $35,130 for all industries.

Table 3.11-21 Oil and Gas Industry Average Wages in Utah, 2001-2006

	NAICS 211 Oil and Gas Extraction	NAICS 213111 Drilling Oil and Gas Wells	NAICS 213112 Support Activities for Oil and Gas Operations	Total Oil and Gas Industry
2001	$63,157	$49,915	$43,216	$48,958
2002	55,448	48,327	39,921	44,938
2003	62,725	46,851	43,540	48,952
2004	67,828	53,296	50,254	55,219
2005	72,986	57,696	49,529	56,691
2006	79,518	67,481	56,849	64,763

Source: Bureau of Labor Statistics (2008), Quarterly Census of Employment and Wages.

3.12 Air Resources

3.12.1 Climate

Generally, the climate within the Dixie National Forest is dry with a high number of sunny days, but weather can change dramatically. Thunderstorms are common during the summer months and daytime temperatures are warm, with cool nighttime temperatures. With the Forest's mid-continent location including numerous canyons, plateaus, and mountainous terrain, it experiences wide temperature variations between seasons. Climates in the Dixie National Forest also vary greatly with elevation. During winter and spring, precipitation comes in the form of snow, with a moderate to heavy snowpack accumulating in many of the higher elevations. By late spring, temperatures warm up at the lower elevations, while the mountain snowpack begins to melt. Summer brings warm temperatures to most areas with hot temperatures in the more desert-like, lower elevation areas. Afternoon thunderstorms are common in June through September.

As discussed in Appendix SIR-2, warming of the climate system is unequivocal. The global warming observed over the past 50 years is due primarily to human-induced emissions of heat-trapping gases (i.e., greenhouse gases or GHG). These emissions come mainly from the burning of fossil fuels (coal, oil, and gas), with important contributions from the clearing of forests, agricultural practices, and other activities (USGCRP 2009). Through complex interactions on a regional and global scale, GHG emissions and net losses of biological carbon sinks cause a net warming effect of the atmosphere, primarily by decreasing the net amount of heat energy radiated by the earth back into space.

Global mean surface temperatures have increased nearly 1.8 degrees F in the last 100 years, and the rate of warming over the last 50 years is double that over the last 100 (IPCC 2007b). In their latest report, the Intergovernmental Panel on Climate Change (IPCC) found a widespread reduction in the number of frost days in mid-latitude regions, an increase in the number of warm extremes, and a reduction in the number of daily cold extremes in 70-75 percent of the land regions examined (IPCC 2007b). In Utah, the average temperature during the past decade was higher than observed during any comparable period of the past century, and roughly 2 degrees F higher than the 100-year average. Utah is projected to warm more than average for the entire globe and more than coastal regions of the contiguous United States (BRAC 2007: Appendix A).

3.12.2 General Air Quality

The climate and climatic conditions within the Dixie National Forest are one of the major reasons for its very good air quality and why it is currently meeting all National Ambient Air Quality Standards (NAAQS). Active mixing of air and average precipitation for Utah, along with an absence of major air pollution sources results in low pollutant background values for the Forest. According to EPA Air Quality Index (AQI) reports (see Section 3.12.7) the air quality within the Forest is considered good to excellent. In addition, the majority of land use within the Dixie National Forest results in little man-made air pollution. Recreational use, residential heating for support facilities, and limited vehicle traffic constitute the main emission sources. Prescribed burns and wildfires are a significant source of air pollution within these areas. The Utah Smoke Management Plan (SMP) requires certain climatic and pollution level criteria prior to initiating prescribed burns.

The NAAQS are defined in the Federal Clean Air Act as levels of pollutants above which detrimental effects on human health and welfare may occur. There are seven criteria pollutants designated with NAAQS: ozone (O_3), carbon monoxide (CO), nitrogen oxides (NO_x), sulfur dioxide (SO_2), particulate matter (PM) with aerodynamic diameter less than or equal to 10 microns and 2.5 microns (PM_{10} and $PM_{2.5}$), and lead (Pb). The NAAQS are shown in Table 3.12-1.

Table 3.12-1 National Primary and Secondary Standards

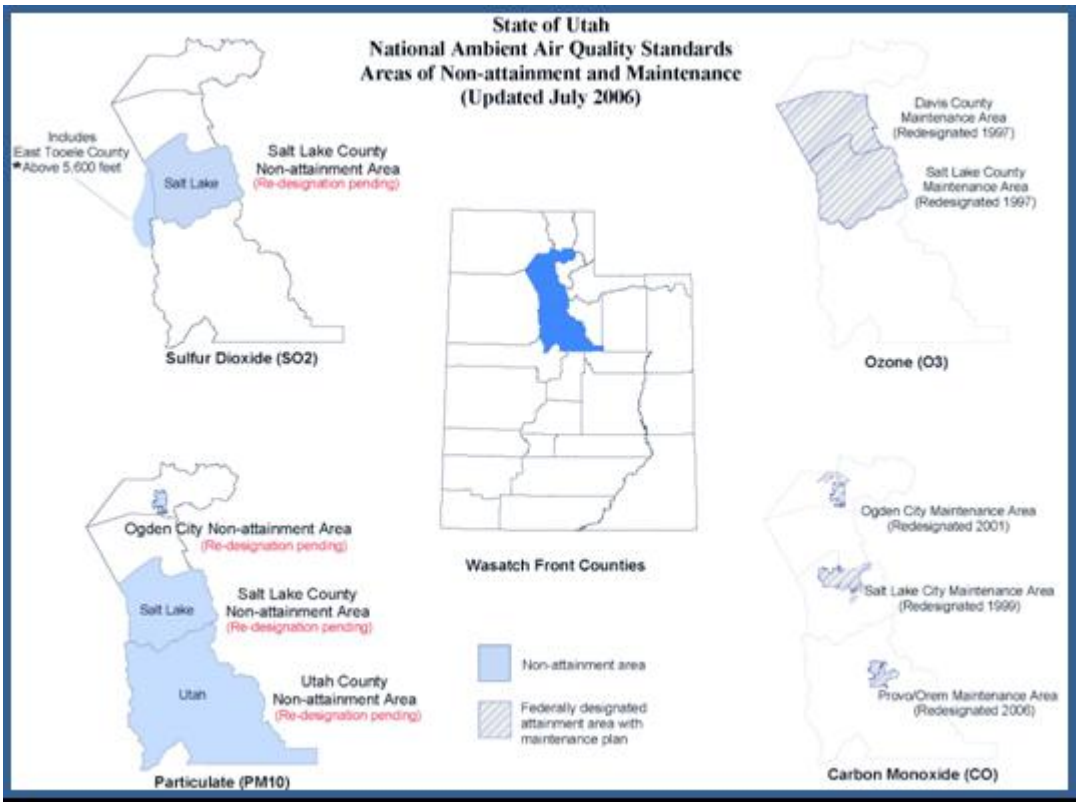
Pollutant	Averaging Time	Primary Concentration[1,2]	Secondary Concentration
Ozone	8 hours (5)	0.075 ppm 0.060-0.070ppm(6)	Same as primary
Carbon Monoxide (CO)	1 hour (1) 8 hours (1)	40,000 µg/m3 (35 ppm) 10,000 µg/m3 (9.0 ppm)	

Nitrogen Oxides (NO_x)	Annual Arithmetic Mean	100 µg/m3 (0.053 ppm)	Same as primary
	1 hour [2]	0.100ppm	None
Sulfur Dioxide (SO_2)	3 hours [1]		1,300 µg/m3 (0.5 ppm)
	24 hours [1]	(0.14 ppm)	
	Annual Arithmetic Mean	(0.03 ppm)	
Particulate Matter as PM_{10} (Aerodynamic diameter < 10 microns)	24 hours [2]	150 µg/m3	Same as primary
Particulate Matter as $PM_{2.5}$ (Aerodynamic diameter < 2.5 microns)	24 hours [3]	35 µg/m3	Same as primary
	Annual Arithmetic Mean [4]	15 µg/m3	
Lead (Pb)	Quarterly Arithmetic Mean	1.5 µg/m3	Same as primary

[1] µg/m3 = micrograms per cubic meter
[2] ppm = parts per million
Source: Code of Federal Regulations, 40 CFR Part 50, National
(1) Not to be exceeded more than once per year
(2) Not to be exceeded more than once per year on three year average
(3) The 3-year average of the weighted annual mean PM2.5 concentrations from single or multiple community-oriented monitors
(4) The 3-year average of the 98th percentile of 24-hour concentrations at each population-oriented monitor within an area
(5) The 3-year average of the fourth-highest daily maximum 8-hour average ozone concentrations measured at each monitor within an area over each year
(6) Proposed range for promulgation of new ozone NAAQS.

Regulations state that ambient air quality standards for NO_x, SO_2, and PM_{10} must not be exceeded at any time during the year in areas with general public access. Short-term standards for CO, NO_x, and SO_2 can be exceeded only once annually. Compliance with the 24-hour PM_{10} and $PM_{2.5}$ standards are based on the 98th percentile of 24-hour concentrations averaged over three years. Compliance with the new ozone standard is attained if the 3-year average of the annual 4th highest daily maximum 8-hour average at every ozone monitor does not exceed 0.075 ppm. Based on these federal regulations, Utah has several non-attainment areas within the State. Non-attainment areas, and the pollutant for which an area became non-attainment, are shown in **Figure 3.12-1**.

Figure 3.12-1 Non-Attainment Air Quality Areas in Utah



Source: Utah Department of Environmental Quality – subject to change in near future

None of these non-attainment areas affect the Dixie National Forest. Utah County, which is non-attainment for PM_{10}, is approximately 120 miles from the northernmost portion of the Dixie National Forest. Although the overall air quality in the Forest is rated good to excellent, there are portions of the Forest that lie near areas that have been closely reviewed and compared to the NAAQS. The UDAQ, EPA, and the SMP have designated the Forest area as Airsheds 2, 3, 4, 12, and 13, within the State of Utah. Utah Air Quality Control Rule 307-204 of the Air Quality Rules regulates the management of wildfires and prescribed burns. The SMP states that prescribed burns will not cause or significantly contribute to daily $PM_{2.5}$ or PM_{10} impacts or violate NAAQS. The purpose of the rules is to mitigate the impact on public health and visibility of prescribed fire and wildland fire. In some cases, air pollution generated in nearby urban Washington County has limited the ability of the Forest Service to implement prescribed burning.

3.12.3 Sensitive Areas

All areas of the state have been designated as either Class I or Class II for air quality. Pursuant to the Federal Clean Air Act, Class 1 areas include all National Parks greater than 6,000 acres and national wildernesses greater than 5,000 acres that were established as of 7 August 1977. Class I provides the most protection to these lands by severely limiting the amount of additional man-made pollution that can occur. Class II areas include all other areas of the country. Class II "Sensitive Areas" have been identified by the Forest Service, predominately as wilderness areas not considered Class I, although air quality regulators only distinguish between Class I and Class II. The regulations allow a specific increase or "increment" in pollution over and above the existing air quality "baseline" pollution levels. Facilities that may impact Class I areas

may be allowed to produce small increases in pollution, while facilities that impact only Class II areas are allowed somewhat larger increases. However, any facility that may increase pollution concentrations in these areas may not cause a violation of the NAAQS. The impact from a source is determined by using EPA-approved air dispersion models. Table 3.12-2 shows the allowable increases of pollution to the ambient air environment of Class I and II areas.

Table 3.12-2 Allowable Pollutant Increases in Class I and Class II Areas

Pollutant	Period	Class I	Class II
		Increment	Increment
SO_2	3-hour	25 ug/m3	512 ug/m3
	24-hour	5 ug/m3	91 ug/m3
	Annual	2 ug/m3	20 ug/m3
NO_x	Annual	2.5 ug/m3	25 ug/m3
PM_{10}	24-hour	8 ug/m3	30 ug/m3
	Annual	4 ug/m3	17 ug/m3
$PM_{2.5}$	24-hour	Undefined	Undefined
	Annual	Undefined	Undefined

µg/m3 = micrograms per cubic meter

These allowable criteria pollutants (SO_2, NO_x, and PM_{10}) are also the precursors to secondary pollutants that can contribute to acid rain, visibility, and regional haze. Based on the designation status from the State of Utah and several federal agencies, there are three Class I areas and six "sensitive" Class II areas that could be impacted by connected actions to leasing. The identified Class I areas are located within 100 kilometers (62 miles) of the Dixie National Forest. They include Bryce, Zion, and Capitol Reef National Parks. Table 3.12-3 presents selected Class I and Class II areas that are sensitive areas that may be considered when addressing impacts. EPA and state regulators have no authority to regulate sensitive Class II Areas any differently than other Class II Areas, but land managers can request consideration of their sensitivities. See Figure 5.12-1 in this report for Class I areas located within the Cumulative Effects Area (CEA).

Table 3.12-3 Sensitive Areas near the Dixie National Forest

Federal Class I & II Areas (unless otherwise specified)[1]	Managing Agency[2]	Class Category	State	Distance from Dixie National Forest (miles)
Bryce NP	NPS	Class I	UT	0
Zion NP	NPS	Class I	UT	0
Capital Reef NP	NPS	Class I	UT	9
Grand Canyon NP[3]	NP	Class I	AZ	68
Glen Canyon NRA[3]	NPS	Class II	UT	15
Cedar Breaks NM[3]	NPS	Class II	UT	0
Ashdown Gorge WA[3]	USFS	Class II	UT	0
Paria Canyon Vermillion Cliffs WA[3]	USFS	Class II	UT	25
Pine Valley Mountain WA[3]	USFS	Class II	UT	0
Box Death Hollow WA[3]	USFS	Class II	UT	0
Beaver Mountain WA[3]	USFS	Class II	UT/AZ	40
Moapa Valley NWR[4]	USFWS	Class II	NV	70

Federal Class I & II Areas (unless otherwise specified)[1]	Managing Agency[2]	Class Category	State	Distance from Dixie National Forest (miles)
Grosvenor Arch, Markaguat Plateau, Santa Clara, Bald Knoll[3]	Various	Class II	UT	0-20
Natural Bridges NM[3]	NP	Class II	UT	68
Grand Staircase-Escalante NM[3]	BLM	Class II	UT	0

[1] NP = National Park, NRA = National Recreation Area, NM = National Monument, WA = Wilderness Area, NWR = National Wildlife Refuge.
[2] NPS = US Department of the Interior, National Park Service, USFS = US Department of Agriculture, Forest Service, USFWS = US Department of the Interior, Fish and Wildlife Service.
[3] Sensitive Class II areas included in the analysis.
[4] Sensitive Class II areas not included in the analysis.

3.12.4 Air Quality Regulatory Considerations

The Land and Resource Management Plan for the Dixie National Forest (USFS 1986) requires compliance with all state and federal Air Quality Standards. The potentially applicable Air Quality Standards identified in the plan include:

- Utah Air Conservation Rules (Utah Administrative Code R307)
- Utah State Implementation Plan (SIP)
- National Ambient Air Quality Standards (NAAQS)
- National Standards of Performance for New Stationary Sources (New Source Performance Standards or NSPS)
- National Prevention of Significant Deterioration Standards (PSD)
- National Emissions Standards for Hazardous Air Pollutants (NESHAP)

The State of Utah's policy is to "maintain levels of air quality that will protect human health and safety, prevent injury to plant and animal life, and facilitate the enjoyment of natural attractions of the State" (Utah Air Conservation Act, pp 19-2-101.2). To enforce this policy, the State of Utah has promulgated a comprehensive set of rules, regulations, standards, and policies that are implemented by the UDAQ. Regulatory authority of the UDAQ is derived from the Utah Administrative Code Chapter 19-2 and the rules adopted by the Utah Air Quality Control Board. The state has been granted Administrative Authority to implement the provisions of the Federal Clean Air Act by the EPA. The UDAQ requires owners and operators of pollution generating facilities to obtain permits, install pollution control equipment and procedures, monitor emissions, maintain records, and implement other air quality protective activities. The Air Conservation Rules (R307-401) apply to any person intending to:

- construct a new installation which will or might reasonably be expected to become a source or an indirect source of air pollution, or
- make modifications or relocate an existing installation which will or might reasonably be expected to increase the amount or change the effect of, or the character of, air contaminants discharged, so that such installation may be expected to become a source or indirect source of air pollution, or
- install a control apparatus or other equipment intended to control emissions of air contaminants.

- operate a qualified air emission source; person must submit a Notice of Intent (NOI) and receive an Approval Order (AO) prior to initiation of construction. The NOI must include plans, specifications, and other information as is necessary to determine whether the proposed installation will be in accordance with all applicable requirements.
- Adhere to Best Management Practices (BMPs; see Appendix C of the FEIS, Conditions(s) 40)

Prior to issuing the AO, the state must provide an opportunity for public review and comment. A copy of the proposed AO is also sent to the applicant, the EPA, and to officials having cognizance over potentially impacted locations, including other states, city and county executives, regional land use planning agencies, state and federal land managers, and Indian Governmental bodies. The comments and concerns of the general public and government entities must be considered before the AO is issued.

Several of the New Source Performance Standards (NSPS) and National Emission Standards for Hazardous Air Pollutants (NESHAPs) would apply to the equipment and process of oil & gas production. These promulgated standards require that certain thresholds, based on a mass emission rate, are not exceeded. Applicable NSPS requirements could include Subpart Kb: Storage Vessels for Volatile Organic Liquids (including petroleum liquids), Subpart GG or KKKK: Stationary Gas Turbines, Subpart KKK: Equipment Leaks of Volatile Organic Compounds (VOC) from Onshore Natural Gas Processing Plants, Subpart LLL: Onshore Natural Gas Processing; SO_2 Emissions; NESHAPs, Subparts HH (oil and natural gas production), HHH (natural gas transmission and storage), and other more recently promulgated standards. Compliance with these applicable regulations is implicit and required for development of production oil well fields. Some of these requirements are expressed in the BMPs listed in Appendix C of the FEIS. Adherence to and compliance with these regulations that limit air pollutant emissions are addressed in the permitting phase of an oil and gas project.

3.12.5 Criteria Pollutants

Statewide emission inventories are updated every three years, with the latest published inventory in 2005 (Annual Report, Utah Division of Air Quality, UDEQ 2005, 2007, and 2009). The Dixie National Forest is located in Garfield, Iron, Kane, Piute, Washington, and Wayne Counties. The tabulated emissions from state inventory surveys of all documented sources in these counties are shown in Table 3.12-4.

Table 3.12-4 Emissions Totals by County (tons per day)

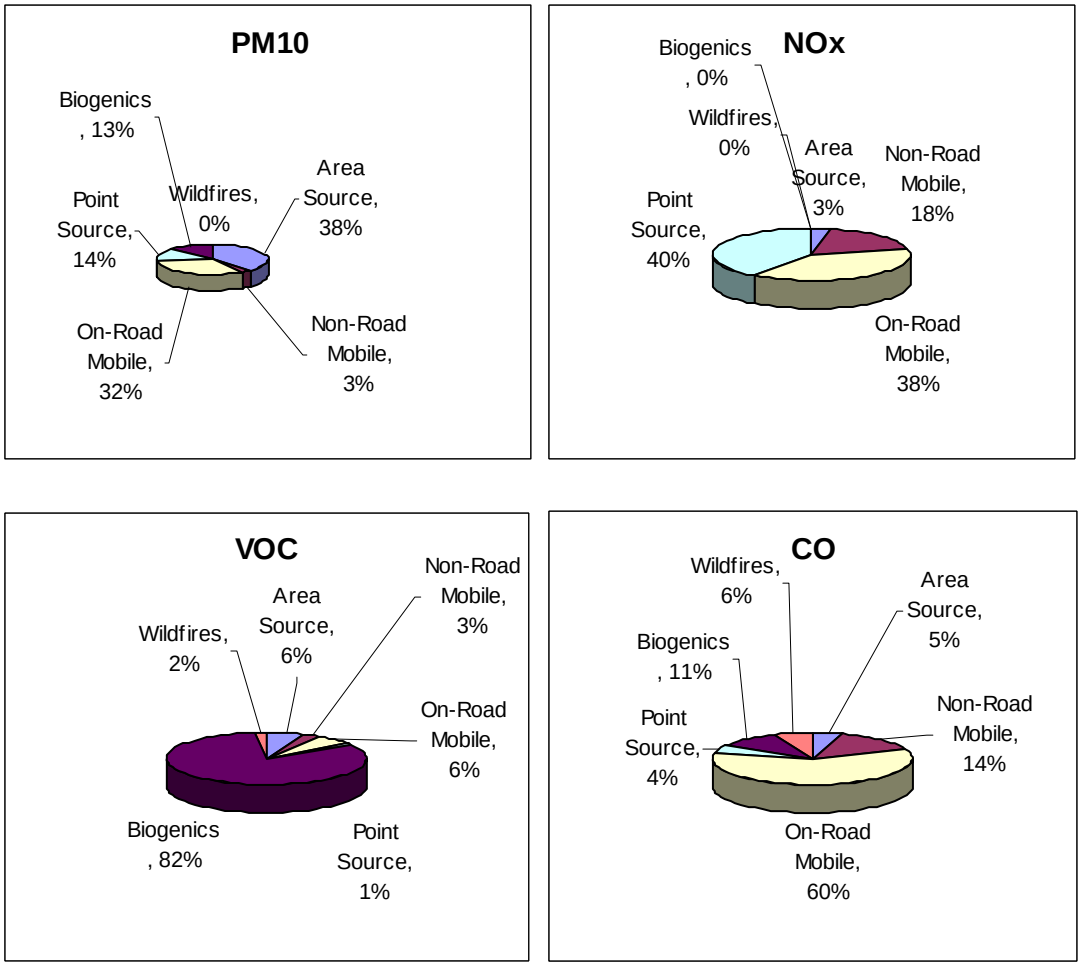
Year[1]	2002	2005	2002	2005	2002	2005	2002	2005	2002	2005
County	NO_x	NO_x	PM_{10}	PM_{10}	SO_x	SO_x	VOC	VOC	CO	CO
Garfield	4.5	1.78	13.80	4.70	0.26	0.16	140.6	125.0	139.6	44.30
Iron	11.00	8.98	5.60	5.83	1.50	0.82	112.3	111.0	101.5	79.16
Kane	1.50	1.79	2.00	2.45	0.20	0.15	134.0	135.4	44.9	45.44
Piute	0.50	0.38	0.90	0.70	0.10	0.05	35.7	32.07	11.3	8.25
Wash	12.70	17.26	2.10	17.40	0.80	0.75	160.9	171.7	155.4	21.30
Wayne	0.71	0.62	1.30	1.44	0.40	0.22	67.4	67.6	21.9	18.89

[1] The 2005 Annual Report listed 2002 emissions; the 2007 and 2009 Annual Reports listed 2005 emissions.

The different source-types are divided into six separate categories as seen in Figure 3.12-2. Point sources reference larger, stationary industry including manufacturing and power plants. Area sources are usually smaller stationary sources that, because of their greater number, are

accounted for by classes of sources operations, such as home heating units. Although biogenics and wildfires are area sources, they are separated in the following pie charts because they are non-anthropogenic (not produced by human activity). The following pie charts depict sources for all of Utah, but are representative of percentages of source-type emissions throughout the State of Utah.

Figure 3.12-2 Emission Source Type (2005 Data)



3.12.6 Existing Surrounding Sources

Industrial sources located to the southwest of the Forest are the most likely to impact the Forest due to prevailing winds. Prevailing winds are mainly from the south-southwest. Figure 3.12-3 shows the annual prevailing winds from the Cedar City meteorological station (National Climatic Data Center 2008). The major sources located in the urban areas of the state are associated with typical industrial operations such as peaking power plants, sand and gravel operations, mining, and general industrial manufacturing. Other upwind sources of pollutants can include emissions from wildfires in Arizona, Nevada, or California. Table 3.12-5 lists the major and significant sources that are located within the six county area of the Forest. "Significant" meaning the source is not major, but is in close proximity to the Forest boundary and emits measurable amounts of air pollutants. Major coal-fired power plants located outside the six-county area (west and south of the Pine Valley Ranger District and 125 miles to the northeast of the Escalante Ranger District) may also affect the air quality of the Forest. Coal mining

operations border the perimeter of the Forest but are not designated as major sources. These include the proposed Alton Coal Hollow operation located 10 miles south of the Cedar City Ranger District in Kane County, and the SUFCO and Emery Deep Mine (underground mines), which are located 35 miles northeast of the Escalante Ranger District.

Figure 3.12-3 Cedar City Windrose

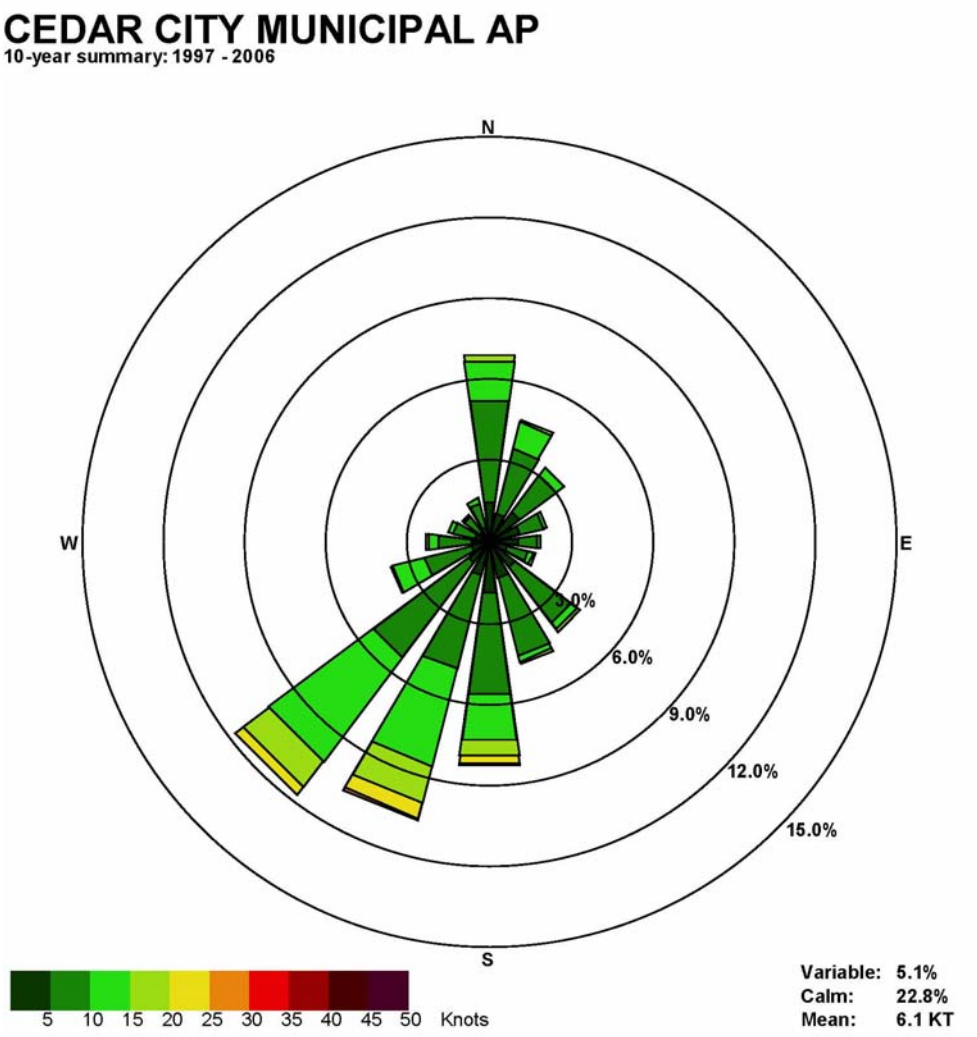


Table 3.12-5 Permitted Significant Sources in the Six County Area

Source	County, State
St. George Steel Fabrication	Washington, UT
Bear River Contractors	Washington, UT
Sorenson Pit	Washington, UT
Western Rock Products	Washington, UT
Washington County Landfill	Washington, UT
O'Sullivan Furniture	Iron, UT
OMG APEX	Washington, UT
Hilldale City Cogeneration	Washington, UT
Cedar City Yard	Iron, UT
City of St. George Power Plants Redrock, Millcreek & Bloomington	Washington, UT
Agrinautics	Iron, UT
Nuclear Fuel Service	Garfield, UT
USMX	Washington, UT
Bulldog Crushing/Hot Mix	Iron, UT
Cedar City Pit	Iron, UT
Panguitch Pit	Garfield, UT
St. George Pit	Washington, UT
GenPak Corporation	Iron, UT
Furniture Manufacturer	Iron, UT
Ft. Pearce Aggregate Plant	Washington, UT
NEVCO Energy 270 MW Coal-Fired Plant	Sevier, UT
Anderson Junction Aggregate Plant	Washington, UT
Reid Gardner Power Plant	Clark County, NV

In addition to permitted facilities located near the Forest, there are recreational activities within the Forest that are also sources of air pollution. These include motorized recreational vehicles such as powered watercraft, motorcycles, ATVs, and snowmobiles. While there is a national effort to improve emissions from these types of motors, the typical 2-stroke engine emits significantly more pollutants than those of more regulated highway vehicles. The criteria pollutants of concern from such recreational vehicles are NO_x, CO, and PM, and, to a lesser extent, VOCs and SO_2.

Minor stationary air emission sources within the Forest include residential heating sources (i.e., boilers and heaters) and propane-combustion electrical generators for remote cell towers. These sources are considered either minor or insignificant.

The Forest allows timber harvest activities in order to achieve management goals and provide opportunities for the local timber industry. Harvesting includes timber cutting, 2-stroke chainsaw engine emissions, miles of logging road reconstruction, and transportation of the timber. These activities result in particulate emissions from construction, timber harvesting activities, and haul road usage in addition to NO_x, CO, VOCs, and PM from logging truck exhaust.

Utah submitted its 2003 State Implementation Plan (SIP) and is in the process of developing an update to the current SIP. The current SIP addressed many issues including emissions from a wide variety of sources, including vehicles and anthropogenic fire. Smoke emissions are controlled with an Enhanced Smoke Management Plan. The updated SIP will address a backstop trading program for SO_2 from large industrial sources. The backstop trading program is essentially a "cap & trade" program, which would set a cap on the maximum amount of SO_2 emissions and allocate emission allowances to the affected sources. If the cap is not exceeded,

various emission controls and trading of emissions between sources may take place. The updated SIP will assess the impact of Utah sources of emissions on protected areas (Class I areas) in adjacent states, and the impact of emission sources in adjacent states on Utah's protected areas, and will set forth appropriate control measures as needed. The SIP update will address the effects of nitrogen oxide and PM emissions from Utah's large industrial sources on protected areas in Utah and adjacent states (UDEQ 2008).

3.12.7 Air Monitoring

The Forest area is designated as attainment/unclassifiable for all criteria pollutants. As can be seen in Figure 3.12-1, Garfield, Iron, Kane, Piute, Washington, and Wayne Counties are classified as attainment or unclassified for all criteria pollutants.

The UDAQ runs 27 monitoring stations within the state. Only one of these stations is located near the Forest, in an urban setting within Washington County (City of Santa Clara). The Dixie National Forest also has cooperated with the National Park Service in operating Interagency Monitoring of Protected Visual Environments (IMPROVE) air quality monitoring sites. Three monitors have been set up in Bryce Canyon; 1) Bryce Point records visibility, 2) Repeater Hill monitors deposition, and 3) Yovimpa Point takes pictures for visibility monitoring. An IMPROVE monitor for visibility has also recently been established near the entrance to Zion National Park. Short-term ambient air monitors have also been placed near the Dixie National Forest for specific projects.

The Air Quality Index (AQI) is a daily EPA rating system that accounts for all measured criteria air pollutants in a geographic area and assigns the rating a qualitative description. The AQI focuses on health effects that may be experienced within a few hours or days after breathing polluted air. EPA calculates the AQI for five major air pollutants regulated by the Clean Air Act: ground-level ozone, PM, CO, SO_2, and NO_x. For each of these pollutants, EPA has established national air quality standards to protect public health. For example, if an area has an AQI rating of 0 to 50 it is classified as good air quality; if the rating is 101 to 150, it is classified as "unhealthy for sensitive groups". Table 3.12-6 displays the AQI over the last three years for the monitoring location in the St. George area.

Table 3.12-6 Air Quality Index Ratings

Condition	2006[1]	2005[1]	2004[2]
Good (0-50)	324	325	309
Moderate (51-100)	38	34	39
Unhealthy (101-150)	0	3	0
Very Unhealthy (201-300)	1	1	0
Hazardous (>300)	1	0	0

[1] Washington County 363 days with AQI
[2] Washington County 348 days with AQI
Source: EPA AQI Reports

Table 3.12-6 shows that the number of good days increased between 2004 and 2006. The total number of moderate to hazardous days shows little trend. Since the prevailing winds are westerly, the pollutants indicated for the Washington County monitoring location can enter the Dixie National Forest, but at lower concentrations than recorded at the monitoring location due to the effects of air mixing and pollutant dispersion. Note that the total numbers of days

recorded per year in the table may not sum to 365 due to monitoring equipment malfunction, recording, or data validation errors.

3.12.8 Regional Haze and Visibility

Regional haze is caused by fine particles in the air that settle out very slowly. Because of the impact that haze has on visibility in National Park Service units and Class I designated wilderness areas, many efforts to control and reduce man-made haze, and the air pollutants that cause it, are underway through national laws and regional collaboration. Such a collaboration, involving states, Indian tribes, industry, and environmental advocates, is being coordinated by the Western Regional Air Partnership (WRAP). The State of Utah along with United States Department of Agriculture (USDA) are members of WRAP and have been involved with developing visibility protection programs. Federal and state laws provide visibility protection for the 156 mandatory Class I areas in the U.S., five of which are located in Utah. Visibility protection programs are being developed for Class I areas in the western U.S. (WRAP 2010); these programs should also result in some visibility protection and improvement in the Class II wilderness areas on the Forest.

The Regional Haze Rule (RHR) requires that reasonable progress be demonstrated toward natural visibility conditions on the monitored "Worst 20 percent" of sample days, and no worsening of visibility for the monitored "Best 20 percent" of sample days be allowed at each mandatory federal Class I area. Baselines have been developed for Class I areas, although the data is still being checked for quality control. Glide rates or uniform rates of progress have been developed for each mandatory Class I area to measure the progress of the RHR. Figure 3.12-4 shows the mean visual range measured by the IMPROVE monitoring system at the Grand Canyon, Bryce Canyon, Zion, and Capitol Reef National Parks from 1993 to 2003, the most recent year for which data is available. Mean visual ranges generally trended upward over this period.

Figure 3.12-4 Trends in Mean Standard Visual Range in Nearby National Parks

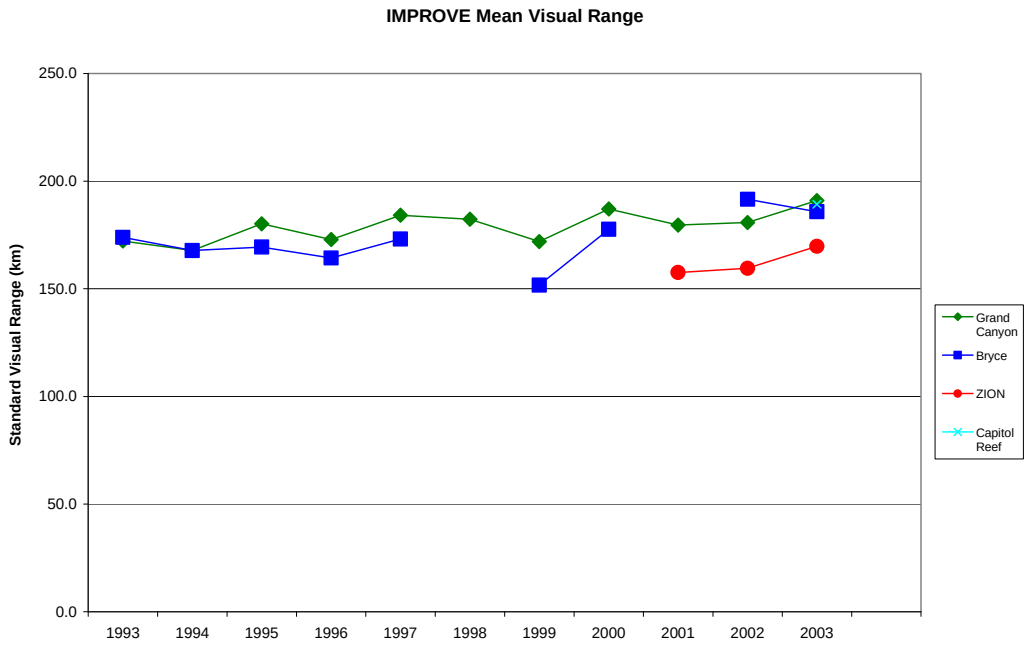
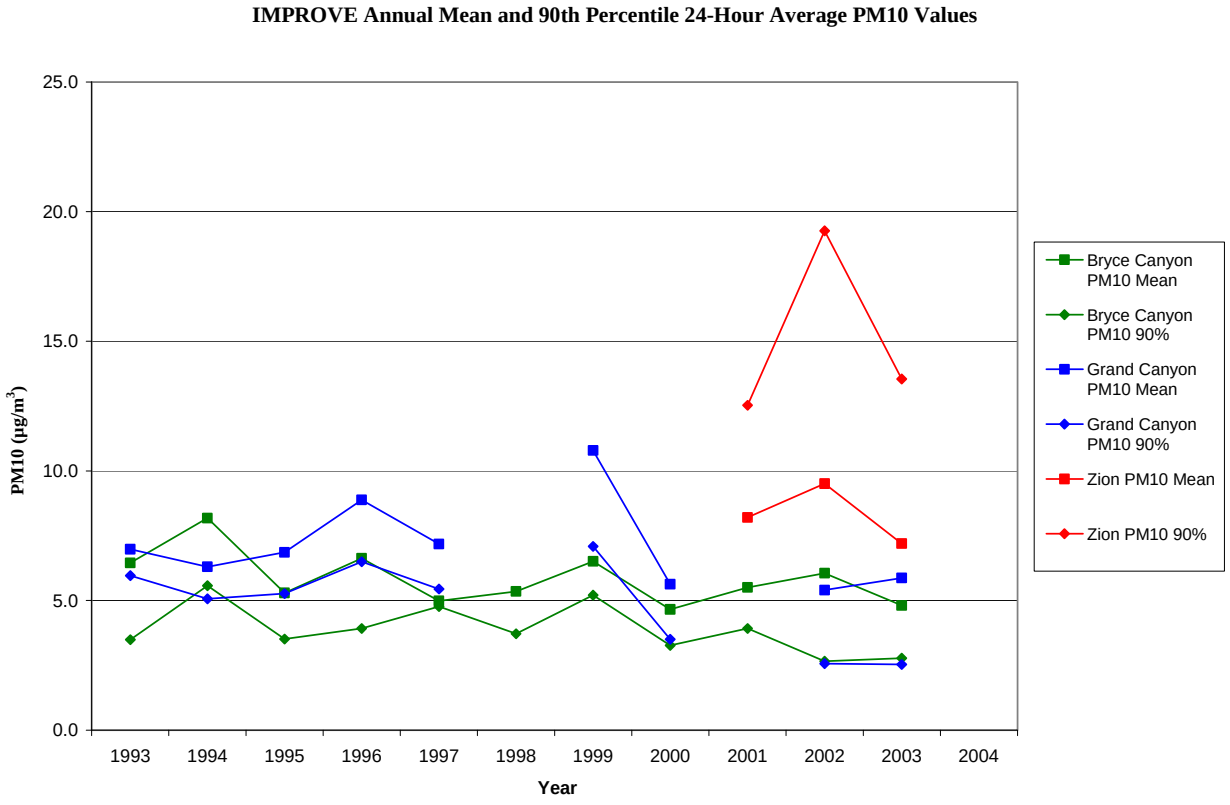


Figure 3.12-5 shows trends in particulate concentrations at nearby National park IMPROVE monitoring sites. The values show PM_{10} concentrations an order of magnitude or more below NAAQS standards. Trends over the decade from 1993 to 2003 have been flat to downward.

Figure 3.12-5 Trends in PM_{10} Concentrations in Nearby National Parks



The primary location in the vicinity of the Forest where ozone is routinely monitored is at Zion National Park, which has complete data since 2003. Table 3.12-7 shows that ozone levels have been flat and below the historic NAAQS of 0.08 ppm, and a little below the current NAAQS of 0.075 ppm in place since May 2008, with the exception of a spike above the NAAQS in 2005.

Table 3.12-7 Ozone Monitoring Data from Zion National Park

MONITORING SITE	AVERAGING PERIOD	CASTNET OZONE CONC. (PPB)
		8 HR AVERAGE
Zion National Park	2008	72
	2007	71
	2006	72
	2005	91
	2004	74
NAAQS		71 [1]

[1] Based upon a three year (2006-2008) average of the fourth highest daily maximum eight hour average, revised down in 2009 from 78.

The Air Quality Trends in National Parks 1994-2003 report assessed trends in Bryce Canyon NP. Pollutants that affect visibility, such as sulfate ion, nitrate ion, and ammonium ions were compared over this 9-year period. For Bryce Canyon National Park, overall visibility showed an improvement (i.e., a decrease in concentration), as did sulfate ion concentration. Nitrate and ammonium ion concentrations increased.

The Preliminary 2018 Reasonable Progress Visibility Target Values of the federal RHR report prescribes visibility for Bryce National Park as requiring 3-5 deciviews (dv) improvement for the "Best 20 percent" Days and 0-0.5 dv decrease in Haze Index to meet the 2018 glide rate. A deciview is a linear measurement of visibility impairment derived from calculated light extinction. Zion National Park will require a 5-7 dv improvement for the "Best 20 percent" Days and 0.5-1.0 dv decrease in "Worst 20 percent" Days Haze Index to meet the 2018 glide rate.

3.12.8.1 FLAG and Air Quality-Related Values

The Federal Land Managers' Air Quality-Related Values Work Group (FLAG) is a cooperative working group consisting of National Park Service, USDA Forest Service and the U.S. Fish and Wildlife Service. The FLAG was formed (1) to provide consistent policies and processes for identifying air quality-related values (AQRVs) and for evaluating the effects of air pollution on AQRVs, primarily in Federal Class I air quality areas and (2) to provide State permitting authorities and potential permit applicants consistency on how to assess the impacts of new and existing sources on AQRVs. AQRVs include Visibility, Deposition, and Ozone. FLAG guidance uses EPA's estimates of natural visibility conditions under its Regional Haze Rule as reference levels for Class I visibility analyses. For deposition, FLAG assesses sulfur and nitrogen deposition impacts using concern thresholds, pollutant exposures, and deposition analysis thresholds. Visibility and Deposition with regard to FLAG are evaluated in Sections 4.12.2.1 and 4.12.2.2. Ozone is discussed in Section 5.12.3.1.

3.12.9 Greenhouse Gas Emissions and Sinks

Appendix SIR-2 contains a detailed discussion of climate change, including greenhouse gas (GHG) emissions and sinks and is incorporated by reference into this EIS. The reader may refer to this document for a complete discussion of greenhouse gases. The following discussion is a summary of climate change, and specifically greenhouse gas emissions and sinks, as it relates to the baseline condition of air resources on the Dixie National Forest.

In 2005, activities in Utah accounted for approximately 68.8 million metric tons (MMt) of gross carbon dioxide equivalents (CO_{2e}) emissions, an amount equal to 1 percent of total U.S. gross GHG emissions. Utah's gross GHG emissions are rising at a faster rate than those of the nation as a whole (gross emissions exclude carbon sinks, such as forests). Utah's gross GHG emissions increased by about 40 percent from 1990 to 2005; national emissions rose by 16 percent during the same period. On a per capita basis, Utahns emitted about 27 metric tons (Mt) of CO_{2e} in 2005, slightly higher than the national average of 25 $MtCO_{2e}$ /yr.

The principal source of Utah's GHG emissions is electricity generation in power plants fueled by coal or natural gas, accounting for 37 percent of total State gross GHG emissions in 2005. The next largest contributors to total gross GHG emissions are the transportation sector (25 percent) and the residential, commercial, and industrial fossil fuel combustion sector (18 percent; CCS 2007).

Estimates of carbon sequestration have been prepared by the EPA for forest ecosystems in the U.S. (EPA 2008a; NRS 2009), which include the overall carbon stock balance of carbon sequestered in forest media, wood products in use, and wood in solid waste disposal facilities. These estimates predict that U.S. forests contained approximately 43,000 MMt of "sequestered" carbon in 2007. The Dixie National Forest has not conducted a Forest-specific estimate of GHG emissions from normal forest management activities. However, based on estimates from other western forests published in 2009 (and not including carbon sequestration; USFS 2009d), the Dixie National Forest probably emits between 400 and 2,000 Mt of carbon dioxide per year. Taken together with carbon sequestration, it is assumed that the overall carbon stock balance for the Dixie National Forest follows the national trend described by the EPA (see Appendix SIR-2), in that carbon is being sequestered in both the Forest ecosystem and harvested wood obtained from the Forest, and that this is resulting in a net sequestration of carbon dioxide (CO_2) on an annual basis.

In addition to forest management activities, a significant amount of GHG is emitted from forest fires (i.e., wildfires). GHG emission estimates that have been made nationally and in other states have shown that forest fires are significant sources of GHG emissions, and forest fires on the Dixie National Forest would also produce large quantities of GHG emissions. EPA (2008b) estimated that across the U.S., GHG emissions from forest fires in 2006 were 268 MMt of carbon dioxide, 25 MMt of methane, and 2.5 Mt of nitrous oxide (see Appendix SIR-2).

3.12.10 Pine Valley Ranger District

The Pine Valley Ranger District is the western section of the Forest. The air quality in the southern portion of this ranger district can be influenced by Washington County's area, mobile, and point sources. Washington County is currently in a rapid population growth mode and produces significant amounts of pollutants associated with a growing urban population. Fugitive and stack particulates are the main pollutant of concern being emitted from these activities. PM pollutants are mainly from aggregate producers, land clearing, and unpaved roads. Prevailing winds are from the west and can influence the existing air quality of this ranger district. Wind events form the south would impact this ranger district even more due to the juxtaposition of sources and receptors. Recreational activities such as vehicle sight-seeing, off-road vehicles, and campfires also impact the air quality.

Existing major air emission sources located near the Pine Valley Ranger District include the City of St. George's peaking power plants and the Reid Power Plant located near Moapa, Nevada. St George's diesel and gas-fired turbines and boilers, when considered as one facility, constitute a major source for NO_x emissions. Significant emissions of SO_2, CO, and PM_{10} also are released from these facilities when operating. The Reid Gardner Power Plant is a coal-fired electric generating facility located west of the Pine Valley Ranger District. Historically, this facility has emitted over 1,000 tons of NO_x, SO_2, and CO_2 emissions annually. NV Energy Company, in a joint settlement plan with the State of Nevada, has agreed to reduce NO_x emissions by 30 percent and to close the oldest units (1 – 3) when a new 1,500 Megawatt (MW) coal-fired power plant, the Ely Energy Center, begins operations. Construction of the Ely Energy Center power plant was placed on hold by NV Energy in 2009. Emissions of NO_x and SO_2 are of concern for both ozone-forming and acid rain potential in the cumulative effects area.

3.12.11 Cedar City Ranger District

The Cedar City Ranger District also has influences from urban growth, mobile sources, and associated industry. With prevailing winds from the west, air resources in this ranger district are currently impacted by emission sources located to the west including: Cedar City, Interstate-15, and a variety of light industrial sources. Light industrial sources include a polystyrene foam and industrial chemical manufacturer, which emits significant amounts of VOCs. Alton Coal Company, located southeast of this ranger district, may be restarting coal surface mining in the near future. Recreational activities such as vehicle sight-seeing, off-road vehicles, and campfires to some extent impact the air quality. Three wells on private lands near the southern tip of the Cedar City and Powell Ranger Districts were drilled to test coals in the Dakota Sandstone; all three wells have been plugged. There are no major air emission sources located in the Cedar City Ranger District.

3.12.12 Powell Ranger District

The Powell Ranger District has similar air resources issues as Cedar City Ranger District, but without the impacts from mobile sources from Interstate-15 and nearby population growth. The town of Panguitch has a population about one percent of St. George and seven percent of Cedar City. Other very small towns are located on the borders of this ranger district, and some mining activities are located directly south. With Bryce Canyon National Park located along the southeast border, the general air quality is considered excellent. There are no major air emission sources bordering the Powell Ranger District. However, there are several coal mines, and the NEVCO and Hunter Power Plants, all located within 70 miles of the borders of the Powell Ranger District. The proposed Alton Coal Hollow project is near the southern end of the ranger district.

3.12.13 Escalante Ranger District

The Escalante Ranger District has no nearby emission sources such as major urban areas, highways, or significant area sources. The Upper Valley Oil Field, located along the southeastern boundary of this ranger district, was discovered in 1964. The field has produced over 27 million barrels of oil and more than 61.6 million cubic feet of gas (likely vented) and is still producing. The Upper Valley Oil Field has been electrified, thus reducing emissions to a very low level. The air quality of the Escalante Ranger District is typically excellent. Air emission sources bordering the Escalante Ranger District are similar to the sources in the Powell Ranger District. Recreational activities such as vehicle sight-seeing, off-road vehicles, and campfires to some extent impact the air quality.