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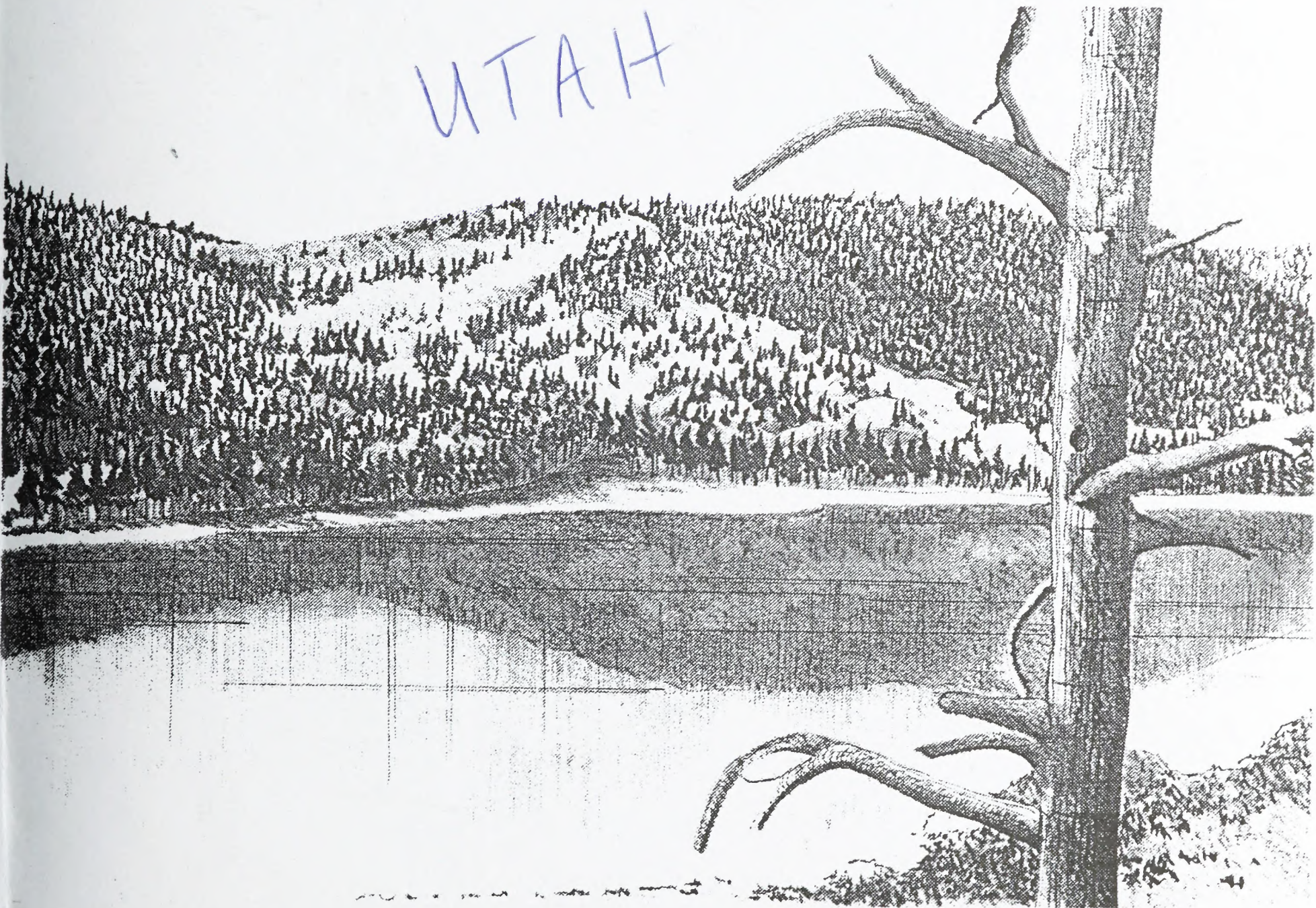


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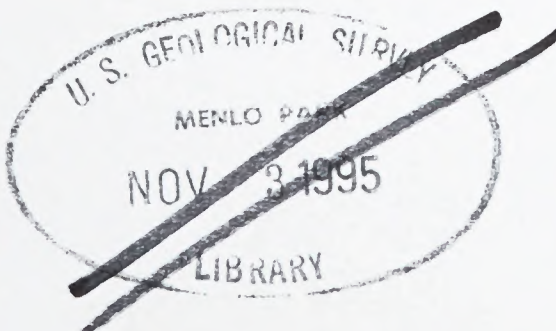
# Draft Environmental Impact Statement

## OIL AND GAS LEASING ON LANDS ADMINISTERED BY DIXIE NATIONAL FOREST

UTAH



In cooperation with the  
Bureau of Land Management



Dixie National Forest

June 1995

9/27







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**DRAFT  
ENVIRONMENTAL IMPACT STATEMENT**

**Oil and Gas Leasing on Lands Administered  
by the Dixie National Forest**

**Garfield, Kane, Iron, Washington,  
Piute, and Wayne Counties, Utah**

**Lead Agency:**

USDA Forest Service  
Dixie National Forest

**Cooperating Agency:**

USDI Bureau of Land Management  
Cedar City District

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**ABSTRACT**

This Environmental Impact Statement documents the analysis of the potential effects of implementing each of five alternatives for management of the Federal oil and gas estate on lands administered by the Dixie National Forest in Garfield, Kane, Iron, Washington, Piute, and Wayne Counties, Utah. The existing condition of the environmental resources in the project area is documented and potential impacts to those resources as a result of implementing the proposed action are addressed. The alternatives are Proposed Action - Forest Plan Intent, (1) No Action - No Lease, (2) Forest Plan Modification A, (3) Forest Plan Modification B, (4) Forest Plan Modification C.

Comments to this Draft EIS must be submitted to the Forest Supervisor by AUG 29 1995.

**NOTE TO REVIEWER**

Reviewers should provide the Forest Service with their comments during the review period of the draft environmental impact statement. This will enable the Forest Service to analyze and respond to the comments at one time and to use the information acquired in preparation of the final environmental impact statement, thus avoiding undue delay in the decision making process. Reviewers have an obligation to structure their participation in the National Environmental Policy Act process so that it is meaningful and alerts the agency to reviewers' position and contentions. **Vermont Yankee Power Corp. v. NRDC**, 435 U.S. 519, 533 (1978). Environmental objections that could have been raised at the draft stage may be waived if not raised until after completion of the final environmental impact statement. **City of Angoon v. Hodel (9th Circuit, 1986)** and **Wisconsin Heritages, Inc. v. Harris**, 490 F. Supp. 1334, 1338 (E.D. Wis. 1980). Comments on the draft environmental impact statement should be specific and should address the adequacy of the statement and the merits of the alternatives discussed (40 CFR 1503.3).







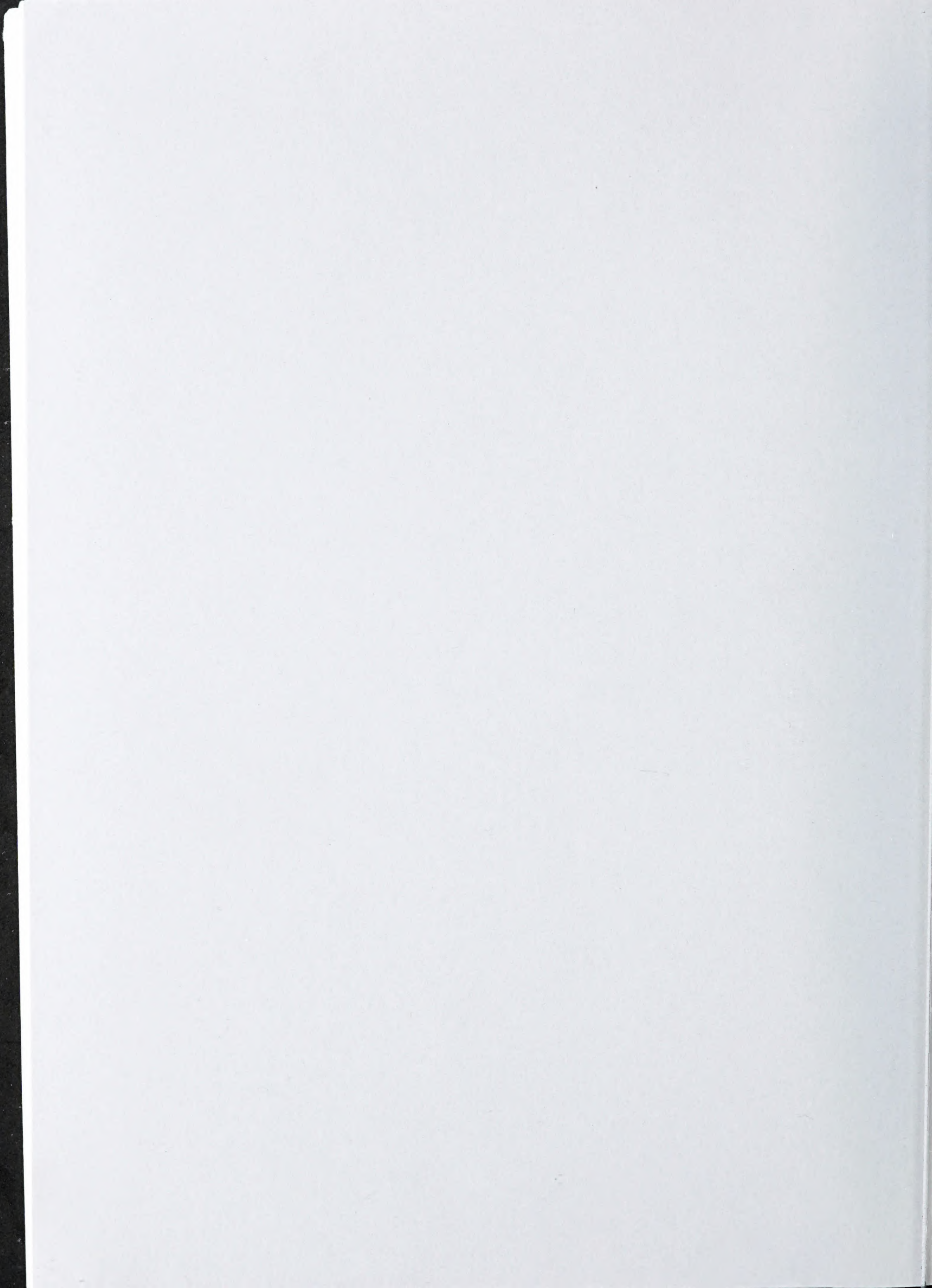
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## **SUMMARY**

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### INTRODUCTION

In many parts of the United States, National Forest System lands overlie geologic formations that contain oil or natural gas. "Leases" are offered under the mineral leasing laws for many of the lands for the purpose of drilling exploratory wells and extracting oil and/or gas. The mission of the Forest Service for minerals management is to support, facilitate, and administer the orderly exploration, development, and production of mineral and energy resources on National Forest System lands to help meet the present and future energy needs of the Nation.

The Forest Service and the Bureau of Land Management (BLM) are conducting an environmental analysis with the intent of identifying Federal lands with Federal mineral rights that should or should not be made available for oil and gas exploration, development, and production on the Dixie National Forest. In accordance with the National Environmental Policy Act of 1969 (NEPA), the Forest Service, as custodian of surface uses on National Forest System lands, in cooperation with the BLM, manager of subsurface minerals, is responsible for identifying and assessing potentially significant environmental impacts and addressing issues associated with oil and gas activities.

The environmental impact statement (EIS) describes and explains the leasing decisions the Forest Service and BLM will make, how the Forest Supervisor and the State Director of the BLM will implement the decisions, and how future decisions will be made to issue permits to drill and potentially develop oil and gas resources.

**Proposed Action** The Forest Service proposes to make most of the National Forest System lands on the Dixie National Forest available for oil and gas leasing and to authorize the BLM to offer certain lands for lease. The BLM proposes to offer for lease all lands that are authorized by the Forest Service. The Forest Service and BLM, Federal agencies with separate responsibilities for lands within the Dixie National Forest boundary, propose the following specific actions:

- 1) The Forest Supervisor of the Dixie National Forest will decide, within the Dixie National Forest study area, which National Forest System lands and non-Federal lands with Federal mineral ownership (split estate lands) are administratively available for oil and gas leasing and under what conditions (lease stipulations).
- 2) The Forest Supervisor will decide what specific National Forest System lands the BLM is authorized to offer for lease, subject to the Forest Service ensuring that correct stipulations will be attached to leases issued by the BLM.
- 3) The Forest Service proposes to amend the Dixie National Forest Land and Resource Management Plan (Forest Plan) to incorporate the leasing decision in place of the leasing matrix (in the Forest Plan) and other site-specific changes as indicated in the analysis.
- 4) The BLM will decide whether or not to offer for lease the specific lands authorized by the Forest Service.

The decisions made as a result of this analysis will not result directly in ground-disturbing activities. Ground-disturbing activities, such as exploration, drilling, and/or field development would require further environmental analysis and a separate site specific decision prior to approval.



## EXISTING LEASES AND DEVELOPMENT

**Relationship to the Forest Plan** Management of each administrative unit of the National Forest System, one or more National Forest(s) or National Grassland(s), is managed through a Land and Resource Management Plan (Forest Plan). Most of the existing Forest Plans include general decisions, as part of management prescriptions, to provide for oil and gas leasing, but do not include decisions for leasing specific lands. Prior to the passage of the Federal Onshore Oil and Gas Leasing Reform Act of 1987 (Leasing Reform Act) and except for acquired lands, the Forest Service had no authority to make decisions related to issuing or not issuing oil and gas leases on National Forest System lands. Forest Plan EISs that predate the Leasing Reform Act do not fully meet the intent of the regulations to make site-specific leasing decisions. Decisions the Forest Supervisor will make, including availability, will be used to develop an amendment to the Forest Plan.

**Reasonably Foreseeable Development Scenario** Activity that occurs after a lease is issued can create economic, environmental, and social impacts. A reasonably foreseeable development scenario (RFDS) was developed and used to estimate effects of exploration, development, and production activity. It was developed using historical oil and gas development information, other known geologic information, and interpretation of the information by Forest Service geologists. The purpose of the RFDS is to provide a basis for analysis and estimating environmental effects. It must be recognized that future exploration and development may not occur exactly where predicted in the RFDS presented in the EIS.

The projected level of activity by the oil and gas industry on the Dixie National Forest from 1994 through 2009 is 102 wells. It is predicted that eight of these will be exploration wells and would result in the discovery of three new fields, two fields (54 wells) of CO<sub>2</sub> and one field (40 wells) of oil and gas development (Kilbourne, Pete 1991). The new field developments for CO<sub>2</sub> are forecast to occur in the Escalante anticline and Aquarius Plateau, and the oil and gas field development location is not projected.

**Federal Management of Leases and Associated Development** The BLM is responsible for issuing oil and gas leases on Federal lands and on private lands for which the Federal government retains mineral rights. The BLM cannot issue leases for lands administered by the Forest Service without consent from the Secretary of Agriculture. In areas where exploration and development of oil and gas resources would conflict with the protection or management of other resources or public uses, the NEPA process identifies measures to mitigate impacts. Such mitigation measures may occur on oil and gas leases as either stipulations to uses or as restrictions on surface occupancy.

## SIGNIFICANT ISSUES AND ALTERNATIVE DEVELOPMENT

Development of alternatives was a two step process: 1) issues were identified through public and agency scoping and 2) leasing options were identified and analyzed.

**Public and Agency Scoping** Integral to the environmental analysis process was the solicitation of comments from the various federal, state, county, and local agencies, and interested organizations and individuals to obtain the most accurate and current environmental information and to provide public input into the planning and decision-making process. The initial opportunity to comment on the proposed project was "scoping" - an information gathering period involving the public early in the process. Through solicitation of comments, the responsible agency identifies the range, or scope, of issues and concerns to address during the environmental analysis and preparation of the environmental impact statement.

A Notice of Intent (NOI) to prepare an EIS, initiating the 30-day scoping period, was published in the Federal Register on April 23, 1993. A scoping document in the form of a newsletter was sent to the 210



parties on the project mailing list on April 26, 1993. The purpose of the newsletter was to inform the public of the Forest Service's and BLM's intent to conduct an environmental analysis and solicit public comment to identify specific issues that should be addressed during the analysis and documented in the EIS. The newsletter also contained information about the purpose and need of the project, an overview of how oil and gas leases are developed on National Forests, a description of the project including a general map of the area, a description of ensuing environmental studies, and a request for public comments. At the request of the Southern Utah Wilderness Alliance an amendment to the NOI which extended the preliminary scoping period from June 1, 1993 to June 21, 1993 was published in the Federal Register on May 18, 1993. Postcards were sent to all names on the mailing list notifying them of the change in the scoping time period.

In addition to the NOI and newsletter, the Forest Service conducted a set of two public meetings to inform the public of the project and solicit comments. The meetings were held in: (1) Cedar City, Utah, on May 25, 1993, and (2) Salt Lake City, Utah, on May 27, 1993. Minutes and a list of attendees from the two meetings can be found in Appendix E of the "*Scoping Process Report*" (available from the Dixie National Forest).

**Key Issues** Forty-two individuals and groups provided comments. The comments were analyzed and summarized to represent the issues and concerns of the respondents. Based on this summary the Forest identified seven issues which were addressed in detail in the environmental analysis, they are:

- Issue 1** The effects of oil and gas leasing and possible subsequent exploration and development activities on wildlife and wildlife habitat.
- Issue 2** The effects of oil and gas leasing and possible subsequent exploration and development activities on the roadless resource and eligible Wild and Scenic Rivers.
- Issue 3** The effects of oil and gas leasing and possible subsequent exploration and development activities on water, soils, and riparian values.
- Issue 4** The effects of oil and gas leasing and possible subsequent exploration and development activities on the visual and recreation resources.
- Issue 5** The effects of oil and gas leasing and possible subsequent exploration and development activities on established National Parks, National Monuments, and Wildernesses.
- Issue 6** The effects of Federal leasing decisions on the opportunities to explore for and develop oil and gas resources within the analysis area.
- Issue 7** The effects of Federal leasing decisions and possible subsequent exploration and development activities on local communities and socioeconomic values.

**Leasing Options** An analysis of leasing options was conducted to determine the affects of various lease or no lease, and various lease stipulations on the site-specific resource components. This analysis was also used to evaluate alternatives that were not analyzed in detail in the EIS. The leasing options analyzed include:



**No Lease (NL)** All Federal minerals within the analysis area would not be available for leasing. Existing leases would remain in effect until they terminate or expire. This decision would not affect private minerals.

**No Surface Occupancy (NSO)** Under this leasing option, well sites, tank batteries, or other oil and gas exploration and development facilities would not be allowed to occupy the surface of specified lands.

**Timing Limitation (TL)** Under this leasing option, stipulations would restrict or prohibit oil and gas exploration and development activities during certain periods of time. For example, timing limitations or seasonal restrictions would be applied to protect the breeding of some sensitive wildlife species.

**Controlled Surface Use (CSU)** Under this leasing option, use or occupancy of the surface would be allowed but restricted to mitigate potential effects of oil and gas exploration and development activities on particular resource features or values. For example, stipulations could require oil and gas exploration and development operations (e.g., drill rigs, tank batteries, access roads) to meet a particular visual quality objective (VQO) in scenic areas.

**Standard Lease Terms (SLT)** Under this leasing option, there would be no special stipulations applied. Mitigation of impacts associated with oil and gas exploration and development activities on resources would be based on existing laws such as the Endangered Species Act, National Historic Preservation Act, Clean Water Act, and Clean Air Act. For resources that are not protected by law, mitigation would be based on the standard lease terms and 43 CFR 3101.1-2, which provides clarification of reasonable mitigation as used in Section 6 of the standard lease terms (e.g., delaying activities for up to 60 days or moving a well location up to 200 meters).

## **ALTERNATIVES CONSIDERED BUT ELIMINATED FROM DETAILED STUDY**

Alternatives that applied either the No Surface Occupancy or Standard Lease Terms to all areas were considered but not carried forward for detailed analysis. The leasing options analysis that evaluated each lease option for each specific resource area showed that NSO or SLT was not reasonable or justifiable for all areas. For those areas where it was reasonable, the NSO or SLT leasing options were included for consideration in one or more of the alternatives evaluated in detail.

Each of the leasing options is considered for each specific resource feature or value in one or more of the alternatives evaluated in detail. One of the alternatives was considered but eliminated from detailed study because it closely resembled Alternative 3. The few differences in some of the specific leasing options that this alternative would have applied to a few specific resources are considered in Alternatives 2 and 4, where the same stipulations would be applied.

## **ALTERNATIVES CONSIDERED IN DETAIL**

Based on the issues and the results of the Leasing Options analysis, the Forest Service developed a range of alternatives that meet the purpose of and the need for the project and respond to one or more of the issues. The alternatives propose specific actions that could be implemented: (1) to decide which lands would or would not be administratively available and if available, under what stipulations, and (2) decide which lands the BLM would be authorized to lease.



The alternatives were developed in response to the significant issues and to ensure that a full range of leasing alternatives were addressed for each specific resource area. Alternatives considered in detail include:

**Proposed Action: Forest Plan Intent** Under this alternative, all Federal minerals would be administratively available for oil and gas leasing and would be leased with protective lease stipulations. This alternative was designed to reflect the intent of the management direction contained in the Forest Plan. No Forest Plan amendments would be needed with this alternative.

**Alternative 1: No Action/No Lease** None of the Federal minerals within the Forest would be available for oil and gas leasing under this alternative (36 CFR 228.102(d)). Existing leases would remain in effect until they terminate or expire (this decision would not affect private minerals). Since all Federal minerals would not be available for leasing, there would be no site-specific decisions to be made (36 CFR 228.102(e)). This alternative would provide that greatest protection of sensitive resources on the Forest, but would preclude exploration and development of oil and gas resources. This alternative would require a Forest Plan amendment.

**Alternative 2: Forest Plan Modification A** Under this alternative, only 869,426 acres of Federal minerals would be administratively available. Areas of semi-primitive non-motorized recreation, roadless areas (RARE II), habitat areas of threatened and endangered (or proposed) species, sensitive aquifers, and rivers considered eligible for Wild and Scenic River designation would not be administratively available for oil and gas leasing. Areas available for oil and gas leasing would be lease with protective stipulations. This alternative would require a Forest Plan amendment.

**Alternative 3: Forest Plan Modification B** Under this alternative, all Federal minerals would be administratively available for oil and gas leasing and would be leased with protective lease stipulations. This alternative would apply NSO stipulations to developed recreation sites, high recreation areas and recreation residences, research natural areas, Brian Head Ski Area, areas with highly erosive soils, municipal watersheds, landslide and rockfall areas, slopes >40%, and streams and lakes. This alternative would require a Forest Plan amendment.

**Alternative 4: Forest Plan Modification C** Under this alternative, all Federal minerals would be administratively available for oil and gas leasing and would be leased with protective lease stipulations. This alternative would generally apply stipulations that would be the least restrictive to oil and gas exploration and development, while providing some protection to sensitive resources. This alternative would require a Forest Plan amendment.

The lease stipulations applied to specific resources features or values under each of these alternatives is described in detail in Chapter 2.

## AFFECTED ENVIRONMENT

The Dixie National Forest consists of four large areas of lands generally encompassing major plateaus or mountains in southwestern Utah. The analysis area includes all five ranger districts of the Dixie National Forest: Pine Valley, Cedar City, Powell, Escalante, and Teasdale. The Pine Valley Ranger District is bounded on the west by Nevada and extends east nearly to Zion National Park. Cedar Breaks National Monument is surrounded by the Cedar City Ranger District while Bryce Canyon National Park bounds that southeastern portion of the Powell Ranger District. The Escalante/Teasdale Ranger Districts extend east to bound with Capitol Reef National Park.



The Dixie National Forest consists of four large land areas separated by lands owned by private individuals and corporations or administered by the State of Utah, the Bureau of Land Management, and the National Park Service. Lands within the boundaries of these four large areas of the Forest total 1,967,296 acres. Of the total Forest area, there are 1,865,941 acres with Federal jurisdiction of both surface use and minerals. Some of the lands within the Forest boundary are privately-owned or administered by the State of Utah. There are 79,651 acres of land within the Forest boundary where both surface use and mineral rights are privately owned, and there are 18,006 acres with Forest Service-administered surface use and privately-owned mineral rights. Lands within the Dixie National Forest boundary with privately-owned minerals (i.e., not Federally-administered) are not included in the decision process for oil and gas leasing.

The Dixie National Forest 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 high-dissected sedimentary strata of the Colorado Plateau physiographic province in the east. Elevations range from below 3,000 feet in the west to above 11,000 feet in the east.

Air quality in the region is generally considered to be very good and current meets all National Ambient Air Quality Standards. Most National Parks and Monuments in the region are designated as Class I, pursuant to the Clean Air Act. The remainder of the National Forest is designated as Class II.

Generally summers are hot and relatively dry, while winters can be cold at times they are generally fairly mild. Rainfall ranges from 10 to 16 inches per year at elevations below 8,000 feet to averages as high as 28 inches per year at elevations above 8,000 feet. Over 60 percent of the rainfall occurs outside the growing season.

The Dixie National Forest straddles the major surface water divide between the Colorado River Basin and the Great Basin. Within the Upper Colorado River Basin, the analysis area includes a substantial portion of the headwaters of the Fremont River, Escalante River, and a small portion of the headwaters of the Paria River. In the Lower Colorado River Basin, the analysis area includes a substantial portion of the headwaters of the Santa Clara River, Ash Creek, and a small portion of the headwaters of the East Fork of the Virgin River. Within the Great Basin, the analysis area includes the headwaters of the main stem of the Sevier River, the East Fork of the Sevier River, and several creeks that drain north into the Escalante Desert.

Vegetation types are quite diverse on the Dixie National Forest ranging from sparse desert communities in the Great Basin portion of the Pine Valley Ranger District to mixed stands of conifers and open areas of sagebrush and grassland communities in the high plateaus of the Powell and Escalante/Teasdale Ranger Districts. The diverse vegetation communities support a great diversity of wildlife species. There are approximately 350 species of mammal, bird, amphibian and reptile, and fish known to occur on the Dixie National Forest. Of these species, twelve (12) have been identified as sensitive species, eight (8) of which are also Federally-listed threatened and endangered species and candidate species. Three mammals, seven birds, and two fish are sensitive species that are known to occur or are likely to occur in the Dixie National Forest.

Recreation opportunities are abundant on the Dixie National Forest evidenced by the over 5 million visitors to the Forest each year. Major recreational uses include: camping, picnicking, hiking, viewing scenery and wildlife, horseback riding, cross country and downhill skiing, hunting and fishing, and off-highway vehicle use. The majority of developed recreation sites (e.g., campgrounds, day-use areas, trailheads, overlooks) are located in the Pine Valley, Navajo Lake, and Duck Creek Recreation Areas. Other developed recreation sites are dispersed throughout the Dixie National Forest. Brian Head Ski Area provides downhill and cross country skiing facilities as well as a resort area. Dispersed recreation occurs throughout the Forest. Many of the eleven (11) scenic byways and backways provide visitors with primary access to



developed recreation sites, while a network of Forest Service roads provide access to semi-primitive recreation opportunities in more remote areas. Over 1,000 miles of trails, including the Great Western Trail and American Discovery Trail, provide additional access.

The Dixie National Forest contains 30 inventoried roadless areas (RARE II) of which this EIS evaluates the potential effects of oil and gas leasing and possible exploration and development in 21 of these roadless areas. There are three (3) designated Wilderness areas in the Dixie National Forest totaling approximately 83,000 acres: Pine Valley Mountain Wilderness, Ashdown Gorge Wilderness, and Box-Death Hollow Wilderness.

Visitors regard the landscapes of the Dixie National Forest as exceptionally scenic, with vistas and panoramic views of snow-capped mountains, colorful escarpments, broad rolling grasslands, stately stands of aspen and fir, and abundant fish and wildlife. The area is used for summer timber harvesting, outdoor recreation, and the area has the potential for yielding oil and gas. The visual character of the natural landscape has been somewhat modified in some areas by dispersed recreation residences and developed sites, livestock grazing, numerous roads and trails, timber harvesting, and previous and on-going oil and gas exploration and development.

National Forest resource management decisions can affect lifestyles, outlook, and career options of people living in or adjacent to a National Forest. Generally, changes in resource management practices are most important to Forest users and neighboring residents, but often other people who are not directly affected also are interested in, or affected by, changes in natural resource management. The Dixie National Forest covers 1,967,296 acres within portions of six counties: Garfield, Iron, Kane, Piute, Washington, and Wayne. Interstate Highway 15, U.S. Highway 89, and Utah State Highways 12, 14, 18, 22, 63 and 143 provide a high level of access to a large portion the Dixie National Forest. The nearest communities include: Cedar City, St. George, Hildale, Panguitch, Escalante, Boulder, Parowan, Tropic, Henrieville, Cannonville, and Torrey.

Cultural resources in the study area include prehistoric and historic sites. To date, over 1,600 archeological sites have been identified on the Dixie National Forest. Many of these were identified as a result of the 633 inventory surveys undertaken over the last 20 years, as well as formal investigations. These surveys, although well distributed throughout the project area, constitute less than eight percent of the land area. While the significance of many of these sites has not yet been evaluated, approximately 40 percent of the sites have been recommended as eligible for listing on the National Register of Historic Places. However, only two sites are currently listed: the location of the Mountain Meadow Massacre and the Long Flat archeological site.

**ENVIRONMENTAL CONSEQUENCES**

Impacts are defined as modifications to the environment, as it presently exists, that are brought about by an outside action. Impacts can be beneficial or adverse, short or long term, and either direct or indirect.

The authorization of a lease does not, in itself, create any impacts or effects, to the environment. However, lease issuance grants the right to conduct oil and gas activities (i.e., exploration, development, production) which may take place at a future time with identified restrictions. The regulations direct the Forest Service to consider the subsequent actions that would be authorized by a lease, and their potentially environmentally disturbing effects, as connected actions.

Successful oil and gas exploration and development generally progresses through five basic operational phases: (1) preliminary investigation (includes geophysical exploration), (2) exploratory drilling, (3)



development, (4) production, and (5) abandonment. Each of these phases may result in effects to the environment. During preliminary investigations, little surface disturbance typically results. Surface disturbance occurs during the second phase, exploratory drilling, when access road to the proposed well site would be upgraded and/or constructed, the well pad and associated features would be constructed, and drilling would occur. Surface uses associated with oil and gas field development wells include: access roads, well sites, flowlines, storage tank batteries, and facilities to separate water from oil and gas. Worker camps may be also be needed in remote locations. Access roads are typically planned, located, constructed for long-term use as opposed to roads built for short-term use to drill exploratory wells. Production is usually a combination of operations that would be less intensive than construction, but would require some activities that could result in effects to the environment, such as transportation to and from the wells, treating and separating fluids, disposing of produced water, and transporting oil and/or gas to market. All abandonments, whether they involve an exploratory well or an entire leasehold, would be required to (1) plug the wellbore and (2) reclaim the land surface to a productive use.

The potential environmental consequences that could result from oil and gas activities under each alternative are summarized and compared in terms of the seven major issues described previously. With proper implementation of Forest Plan standards and guidelines, and associated lease stipulations, none of the alternatives is expected to result in significant impacts the resources addressed in the seven major issues.

Known occurrences of threatened and endangered species or candidate species and their habitat would not be leased under any of the action alternatives and would therefore be protected. Controlled Surface Use stipulations under the Proposed Action and Alternatives 3 and 4 would minimize potential impacts in the habitats of sensitive species, while No Surface Occupancy stipulations under Alternative 2 would eliminate potential impacts to sensitive species. No Action/No Lease and Alternative 2 would result in no impacts to big game species. The Proposed Action and Alternative 3 would apply timing limitations on oil and gas activities during sensitive seasons. Alternative 4 would apply the least restrictive stipulations in big game habitat and would result in the greatest potential impacts.

None of the alternatives would directly effect any of three Wilderness areas in the Dixie National Forest. The Proposed Action, No Action/No Lease, and Alternative 2 would not directly effect roadless areas. Alternatives 3 and 4 would apply Controlled Surface Use Stipulations or Standard Lease Terms, respectively, which would allow road construction in roadless areas. Potential impacts associated with either of these alternatives on roadless characteristics would be significant and long term.

The Proposed Action, No Action/No Lease, and Alternative 2 would protect rivers considered eligible for Wild and Scenic River designation with No Lease or No Surface Occupancy stipulations. Although Alternatives 3 and 4 would allow oil and gas exploration and development activities, Controlled Surface Use stipulations are expected to minimize potential impacts to levels that would not be expected to affect a river's potentially eligibility for designation.

All of the alternatives would protect watersheds through No Lease or No Surface Occupancy stipulations to protect riparian areas, wetlands, areas of highly erosive soils, streams and lakes, and municipal watersheds -- except Alternative 4 which could result in some impacts. Potential impacts to water, soils, and riparian values are expected to be minimized with Controlled Surface Use stipulations under Alternative 4.

None of the alternatives would directly impact high recreation areas or areas with recreation residences, except Alternative 4. This alternative could result in potentially significant impacts to recreation opportunities or uses in areas where oil and gas exploration and/or development would occur in high recreation areas or areas with recreation residences.



Alternative 3 and No Action/No Lease would not directly affect highly scenic areas with a visual quality objective (VQO) of Retention. The Proposed Action and Alternatives 3 and 4 would apply Controlled Surface Use stipulations in areas of VQO Retention. Oil and gas exploration activities in areas of VQO Retention would likely be evident in the landscape during active drilling operations and would result in short term, potentially significant visual impacts to viewers. Field development would result in long-term visual impacts where visible from sensitive viewpoints. Controlled Surface Use stipulations in areas of VQO Partial Retention under the Proposed Action and Alternatives 2 and 3, and Standard Lease Terms under Alternative 4, would result in largely moderate visual impacts to viewers. Although in most cases changes in the landscape would be evident, the stipulations would mitigate most of the impacts allowing oil and gas activities in these areas to meet the objectives of Partial Retention.

None of the alternatives would directly affect National Parks, National Monuments, or Wilderness areas; however, potential field developments under the Proposed Action and Alternatives 3 and 4 could result in some indirect effects to these areas (i.e., impacts to views, noise).

### **Cumulative Impacts**

Cumulative impacts are those impacts on the environment that result from the incremental impact of a reasonably foreseeable future actions when added to other past and present activities, regardless of what person or agency undertakes such other action. To determine cumulative effects, the effects of a potential oil and gas leasing development are added to those resulting from past and present activities, as well as other proposed future actions within the analysis area. At present, this includes other oil and gas developments and existing and proposed timber sales. Adherence to the Forest Plan objectives would reduce such impacts and opportunities for reclamation of deteriorated sites. As disturbed areas stabilize and revegetate, direct and indirect effects to land surfaces decrease with time.

Road construction or upgrading, in conjunction with oil and gas field development or timber harvest, could result in direct and indirect impacts by increasing accessibility. Any project that allows for more access into an area would generate increased recreational opportunities for the public. Cumulative impacts are likely to be more severe in the summer months rather than in the winter months as a result of any proposed oil and gas activity or timber sale. The current level of disturbance to big game would not increase or decrease. However, off-highway vehicle use is restricted to roadways in non-wilderness areas and the land itself, being rocky and vegetated, creates a natural deterrent.

### **Irreversible and Irretrievable Commitment of Resources**

An irreversible or irretrievable commitment of resources would occur when the current or potential productivity of those resources are consumed, committed, or lost and can never be regained. The majority of resources in the study area that would be affected by oil and gas activities would be affected short or long term, but they would not be consumed, committed, or lost to the extent that they could never be regained. One exception would be cultural resources. In this case, known surface resources would be avoided; however, subsurface resources could be damaged.

### **Unavoidable Adverse Effects**

With implementation of ground-disturbing activities, impacts to the environment would occur to a certain degree. It is the objective of the applicable regulations and Forest Plan standards and guidelines to avoid effects to resources and/or minimize effects to the extent possible; however, some impacts may be



unavoidable and some of those impacts may be significant. Significance exists if it is reasonable to anticipate a substantive impact on the environment and when controversy related to the effects on the quality of the human environment is likely to be high. Once a specific location has been proposed and prior to any ground-disturbing activities, potential site-specific impacts would be identified, addressed, and mitigated.

### **Relationship Between Short-term Use and Long-term Productivity**

The duration and severity of effects depend on the activity, life of the facility, and integrity of the resource. For example, a temporary road to an unsuccessful well may be reclaimed immediately after discontinued use or it may be used into the future for management purposes. If a well is successful, the road may be upgraded and used for the life of the well or longer. Following drilling, a well pad can be reclaimed if the well is unsuccessful or the area used for drilling equipment can be reduced and the area not needed for production equipment can be reclaimed.

Loss of productivity would occur when vegetation is cleared for roads, well pads, and ancillary facilities. Sedimentation, resulting from clearing and construction, in nearby waterbodies could deteriorate water quality affecting the aquatic habitat and long-term productivity of the waterbody. Removal of habitat would result in loss of community structure (strata) and species composition, which could reduce long-term productivity for biological diversity.

Roads constructed in roadless areas (RARE II, Owens 11/89), whether temporary and reclaimed or permanent, would potentially affect these areas' long-term eligibility for Wilderness.



# **CHAPTER 1**

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## ***PURPOSE AND NEED***







### INTRODUCTION

In many parts of the United States, National Forest System lands overlie geological formations that contain oil and/or natural gas. "Leases" are offered under the mineral leasing laws for many lands for the purpose of drilling exploratory wells and extracting oil and/or gas. The mission of the Forest Service in relation to minerals management is to support, facilitate, and administer the orderly exploration, development, and production of mineral and energy resources on National Forest System lands to help meet the present and future needs of the Nation (Mining and Minerals Policy Act [1970] and Forest Service Manual (FSM) 2802).

The United States Department of Agriculture, Forest Service, Dixie National Forest (Forest Service) and United States Department of the Interior, Bureau of Land Management, Cedar City District (BLM) are conducting an environmental analysis with the intent of identifying Federal lands with Federal mineral rights that should or should not be made available for oil and gas exploration, development, and production on the entire Dixie National Forest (Figure 1-1) in accordance with the Mineral Leasing Act of 1920. In accordance with the National Environmental Policy Act of 1969 (NEPA), the Forest Service, custodian of surface uses on National Forest System lands, in cooperation with BLM, manager of Federal subsurface minerals (including oil and gas lease operations), is responsible for identifying and assessing potentially significant environmental impacts and addressing issues associated with this proposed action.

The purpose this Environmental Impact Statement (EIS) is to implement the authority and responsibility granted to the Forest Service by the Federal Onshore Oil and Gas Leasing Reform Act of 1987 (P.L. 100-203) and to meet the regulatory requirements of 36 CFR 228 Subpart E.

This EIS describes and explains the leasing decisions the Forest Service and BLM will make. It explains how the Forest Supervisor and the District Manager (BLM) will implement the decisions and how future decisions will be made to issue permits to drill and potentially develop fields of oil and gas (refer to Appendix A). Also described are the environmental significance of each of these decisions and measures the Forest Service will use to assure protection of the quality of the environment.

### GENERAL BACKGROUND: LEGISLATION AND POLICY

Leasable public domain minerals (those which have never passed out of Federal ownership) are leased under authority of the Mineral Leasing Act of 1920, as amended. Acquired minerals (those which were re-acquired by the Federal government) are leased under the authority of the 1947 Mineral Leasing Act for Acquired Lands, as amended.

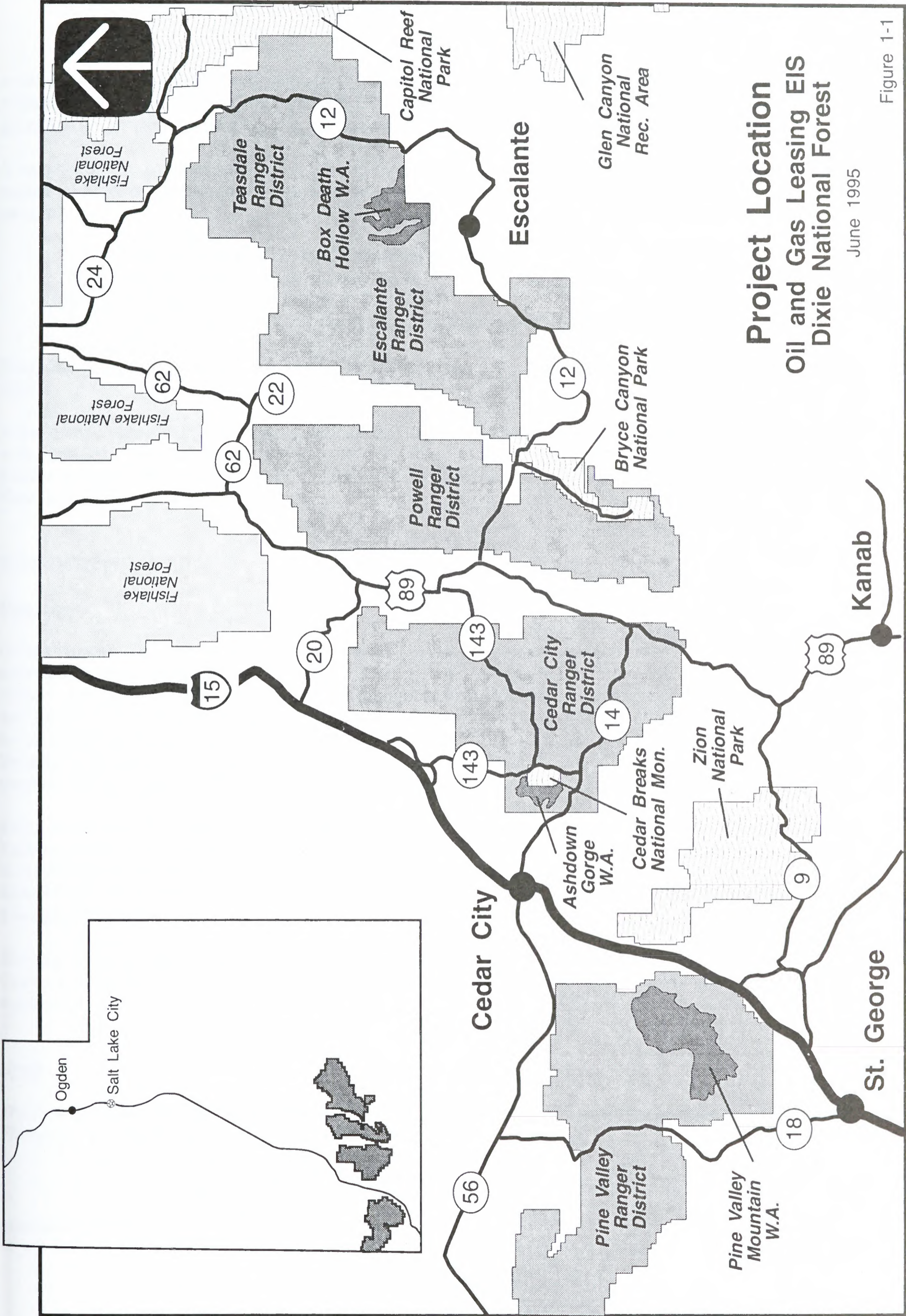
The Mineral Leasing Act of 1920 (as amended) provided that all public lands are open to oil and gas leasing, unless a specific land order has been issued to close an area. Prior to 1987, to lease a parcel of land administered by the Forest Service, a request was submitted to the BLM. The Forest Service was asked for a recommendation regarding the offering of a lease tract and appropriate stipulations to protect the resources; however, the primary authority and responsibility for determinations regarding leasing remained with the Secretary of the Interior and the BLM.

In 1987, Congress passed the Federal Onshore Oil and Gas Leasing Reform Act (Leasing Reform Act). This resulted in modifying the authorities of the Secretary of the Interior and Secretary of Agriculture by increasing the role of the Forest Service in the leasing process. In part, it required site-specific









# Project Location

## Oil and Gas Leasing EIS

### Dixie National Forest

June 1995

Figure 1-1







environmental analysis at the leasing stage. Consequently, the Forest Service developed new regulations in March of 1990 (36 CFR Parts 228 and 261) to be consistent with the Leasing Reform Act, and to provide guidance for oil and gas leasing and surface-use management on National Forest System Lands.

A result was the establishment of a "staged" decision process designed to accommodate the tentative nature of oil and gas exploration and development, which is very speculative and costly. The stages include:

- 1) the determination of lands available for leasing
- 2) the decision to lease specific lands
- 3) an Application for Permit to Drill (APD)
- 4) an application for field development if oil or gas is discovered.

Each decision is based on environmental analysis and disclosure of the probable effects in accordance with NEPA.

In the case of this environmental analysis and EIS, the Forest Service is exercising discretion in combining and addressing the first two of the four decision stages for National Forest System lands on the Dixie National Forest. This analysis and EIS tiers to the direction provided in the Dixie National Forest Land and Resource Management Plan (Forest Plan).

## **PURPOSE AND NEED**

### **Purpose**

Oil and natural gas are important resources for the people of the United States. They are the primary sources of energy for mechanical equipment, lighting, heat, transportation, communications, and production of food. Petroleum products are important components in agriculture, medicine, and manufacturing of fibers and plastics. The Federal government seeks to reduce its dependency on oil and gas from other nations by continuing to locate and develop its own reserves due to the uncertainty of these external sources and the effects on the economic trade balance. Companies in the oil and gas industry continually seek new deposits of oil or gas, or seek to profitably extract the resources from previously uneconomical deposits.

Since the Forest Plan was completed prior to the passage of the Federal Onshore Oil and Gas Leasing Reform Act of 1987, the current Forest Plan did not determine the availability of National Forest System lands for oil and gas leasing. It was determined further that the decision to lease, to not lease, or to lease with stipulations on specific lands was not made in the Forest Plan. Such a decision was to be based on site-specific analysis.

The purpose is to implement the authority and responsibility granted to the Forest Service by the Federal Onshore Oil and Gas Leasing Reform Act and to meet the Federal Regulatory requirements of 36 CFR 228 subpart E.

### **Need**

The Forest Supervisor and BLM State Director have several reasons to make these decisions at this time. These are described below.



### Outstanding Requests For Leases

During the two-year period between passage of the Leasing Reform Act and publication of the final implementing regulations, companies applied to the BLM for leases on the Dixie National Forest. Upon completion of this document these lease proposals will be acted upon. The Forest Service could not properly act upon these "Requests For Lease" prior to the regulations. The Forest needs to determine which lands should be available for leasing and which of the outstanding lease requests to authorize.

### Decisions For Lands Currently Leased

Currently, there are 87,527 acres of existing leases on the Dixie National Forest (refer to Figure 1-2). Approximately 75,455 acres of these existing leases are expected to expire by the year 2000 and thus become available for issuance as new leases (Table 1-1). Another 3,545 acres of leases are listed as suspended (time until expiration is stopped) and the expiration date cannot be determined until the suspension is lifted. Another 8,600 acres of leases are classified as producing oil or gas, have been extended, and are not expected to expire by the year 2009. Included in the analysis are those lands currently leased so that when the leases expire, the decision has been made whether or not to offer them for lease again and determine any needed stipulations. It is possible that currently leased lands would not be available for lease or would be available with stipulations applied that are not in the current lease.

**TABLE 1-1  
Acreage of Existing Leases Expected  
to Expire and Become Available**

Year	Acres
1994	800
1995	17,422
1996	1,912
1997	45,094
1998	7,974
1999	2,253
<b>TOTAL</b>	<b>75,455</b>

This analysis will have no direct effect on existing leases; however, there could be potential indirect effects.

### Anticipated Requests for Leases

Based on past experience and because the Dixie National Forest is considered an area of high potential for yielding CO<sub>2</sub> and moderate potential for producing oil and gas, the Forest Supervisor can expect to receive additional Requests for Leases each year. Under present circumstances, the Forest Supervisor must react to each request individually. When each lease request is studied on an individual basis, it is difficult for the Forest Supervisor and staff to study the aggregate and cumulative environmental effects of these operations. In order to plan for the orderly management of National Forest System lands, resolve potential conflicts in land or resource use in a meaningful way, and study the aggregate and cumulative effects of oil and gas leasing, the Forest is conducting this analysis leading to decisions related to the availability of lands for leasing and consent for the BLM to lease on an area-wide basis.

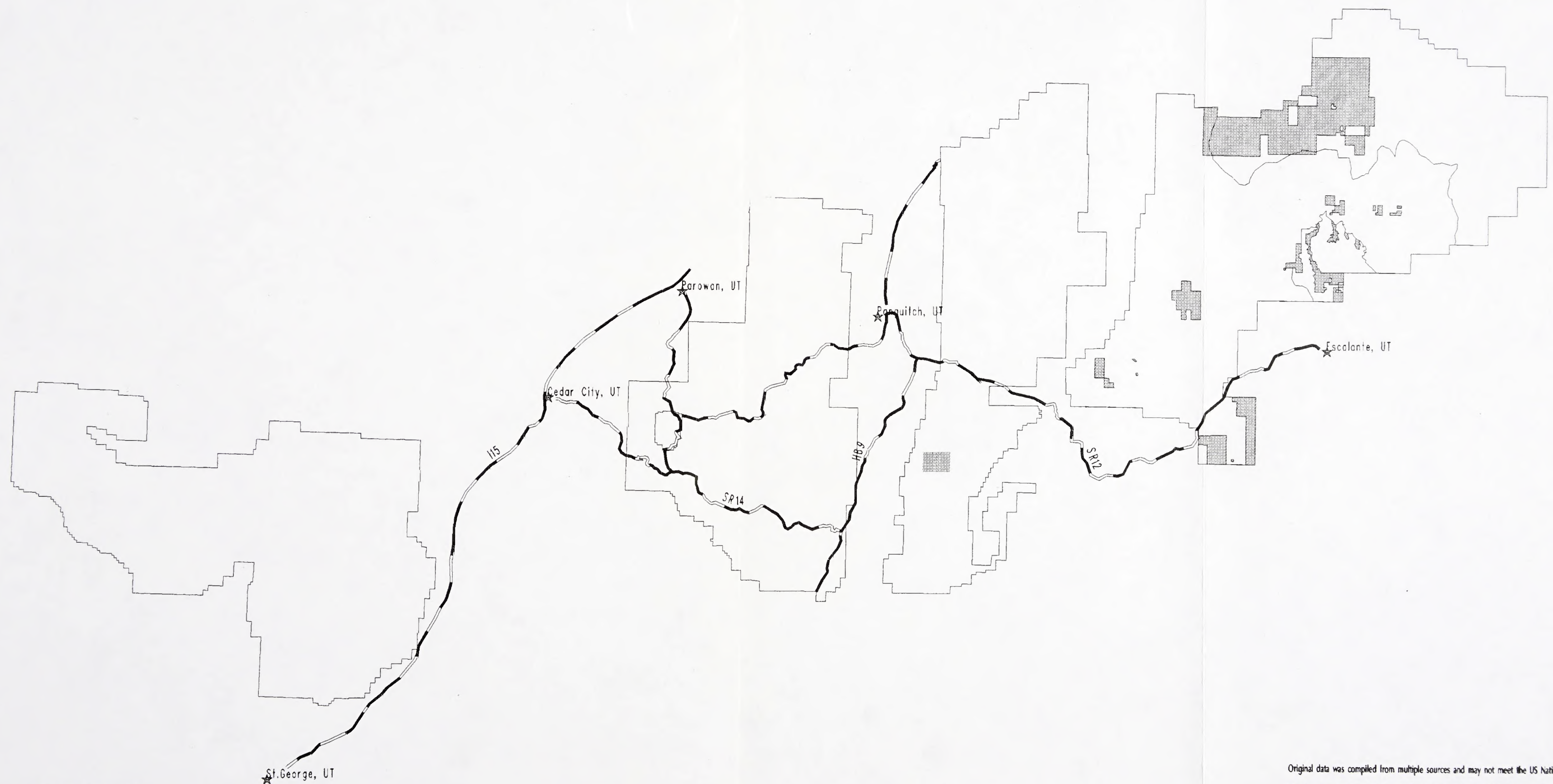
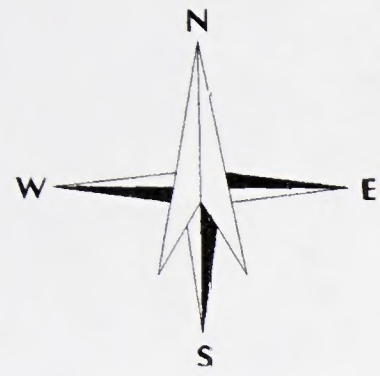
### Implement Regulations 36 CFR 228

Section 228.102 (b) of the Code of Federal Regulations (CFR), Title 36 requires the Forest Supervisor to develop a schedule for conducting leasing analysis and 36 CFR 228.102 (c) identifies the requirement of





# EXISTING OIL & GAS LEASES DIXIE NATIONAL FOREST



Prepared by USDA Forest Service  
Dixie National Forest GIS Staff  
Using ARCANFO GIS  
April 1995

Original data was compiled from multiple sources and may not meet the US National Mapping Accuracy Standard. For specific data source dates and/or additional digital info contact the Forest Supervisor, Dixie NF, Cedar City, Utah. This map has no warranties as to its contents or accuracy.







the analysis. The Dixie National Forest was identified as a high priority for completion of this leasing analysis.

A leasing decision was made on May 4, 1988 for the Escalante Known Geological Structure (KGS) located in Garfield County, southcentral Utah, near the town of Escalante. The KGS contains approximately 79,000 acres of which 64,200 acres are administered by the Dixie National Forest and 14,000 acres are administered by the Cedar City District of the BLM. There are 1,800 acres of State and private lands within the boundaries of the KGS. The decision for the KGS was in conformance with the Forest Plan. Since then, Forest Service officials decided to re-analyze that area in the larger context provided by this analysis. Since the KGS decision has been implemented, any new decision could not be implemented until existing leases within the area expire, terminate, or are relinquished.

Leases on Antone Bench and Areas 2, 3, 4, and 5 are not available for further oil and gas leasing as stated in the Utah Wilderness Act of 1984.

## **PROPOSED ACTION**

The Forest Service proposes to implement the management direction as reflected by the matrix for oil and gas leasing contained in the Forest Plan and the KGS Record Of Decision. This will make most of the National Forest System lands on the Dixie National Forest available for oil and gas leasing, and to authorize the BLM to offer certain lands for leasing. Although the Forest Plan did not make decisions related to leasing, the proposed action involves implementing the standards and guidelines of the Forest Plan. These standards and guidelines are reflected by the Matrix for Oil and Gas Leasing contained in the Forest Plan. This proposed action is described in detail in Chapter 2 of this document.

The BLM proposes to offer for lease all lands that are authorized by the Forest Service.

## **Decisions to be Made**

This EIS summarizes actions proposed concerning oil and gas leases on the Dixie National Forest. The Forest Service and BLM, Federal agencies that have separate responsibilities for lands within the Dixie National Forest, will make the following decisions:

- 1) The Forest Supervisor of the Dixie National Forest will decide, within the Dixie National Forest study area, which National Forest System lands and non-Federal lands with Federal mineral ownership (split estate lands) are administratively available for oil and gas leasing and under what conditions (lease stipulations - Appendix B) (36 CFR 228.102 (d)).
- 2) The Forest Supervisor will decide what specific National Forest System lands the BLM will be authorized to offer for lease, subject to the Forest Service ensuring that correct stipulations will be attached to leases issued by the BLM (36 CFR 228.102 (e)).
- 3) The Forest Service proposes to amend the Forest Plan to incorporate the leasing decision in place of the leasing matrix and other site-specific changes as indicated in the analysis.
- 4) Subsequently, the BLM will decide whether or not to offer for lease the specific lands authorized by the Forest Service.

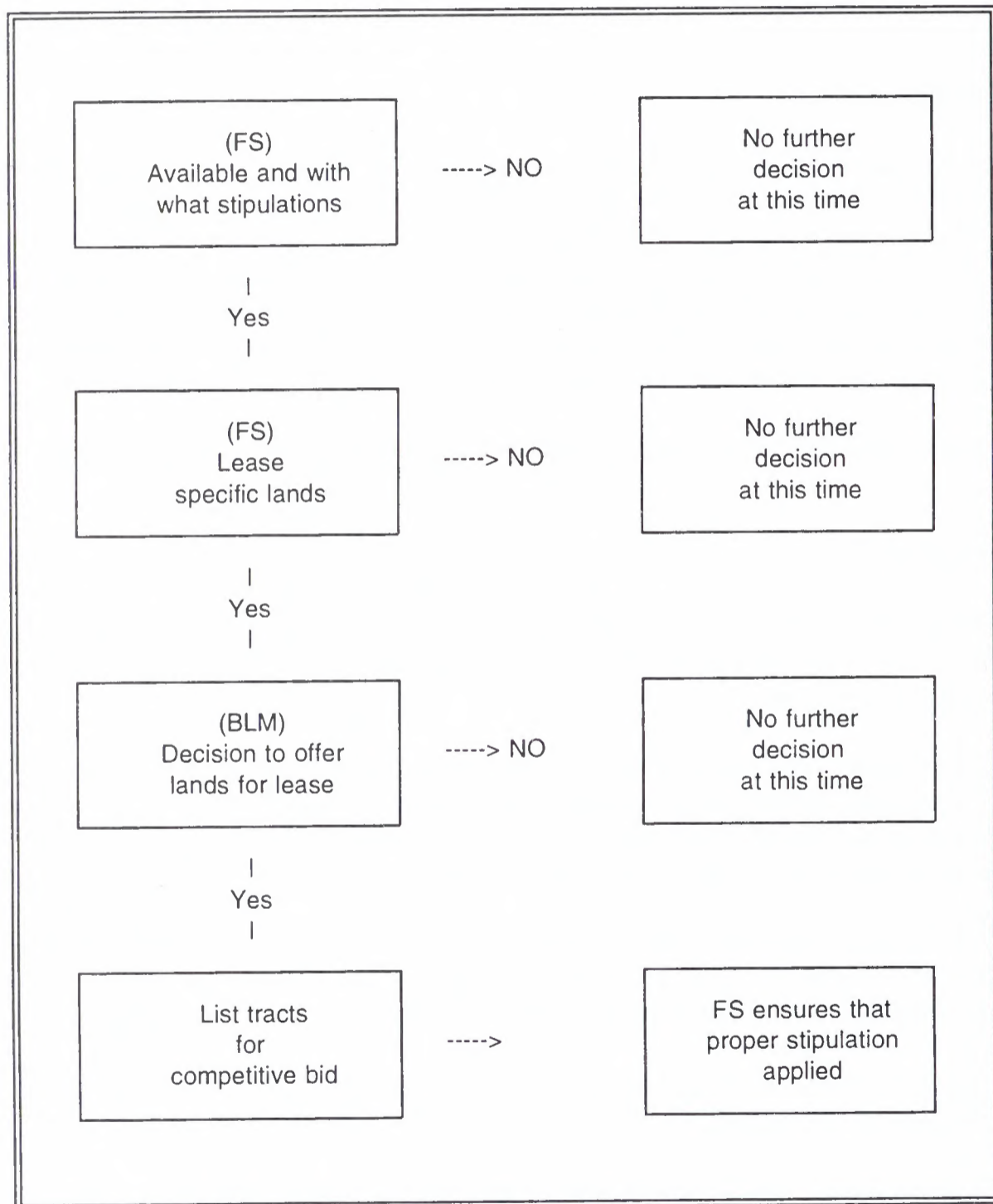
The project location and EIS study area are identified on Figure 1-1. Alternatives to the Proposed Action are described in detail in Chapter 2 and analyzed in Chapter 4.



## What The EIS Can and Cannot Do

The first decision will address whether lands are "available" or "not available" to lease, and if so with what stipulations. Once the decision is made regarding availability, then a decision is made whether to lease or not to lease those lands that were determined to be available. Graphically, the decisions look something like the process depicted in Figure 1-3. The application of these decisions is limited by the legal authority of the Forest Service and the BLM. These limits determine what the final decisions can and cannot do in several circumstances.

**FIGURE 1-3**  
**Decision to be Made Concerning Lands for Oil and Gas Leasing**





The decisions **CAN** determine the management of Federal lands. These decisions **CANNOT** be applied to non-Federal minerals owned by private, state, and/or local entities. The Dixie National Forest area considered in this document is a patchwork of ownership. The surface ownership is displayed on the Forest Service Visitors Map, which can be obtained from the District Rangers' or Forest Supervisors' Offices. Mineral ownership has a different intermingled pattern, displayed on Figure 3-15 (at the end of Chapter 3). Consequently, major oil and gas operations could continue on the Dixie National Forest even if the Federal government were to never issue another lease.

The decision **CAN** result in new limitations on the rights granted in future Federal leases. However, approximately 4 percent of the Federal minerals available for leasing (1,869,639 acres) are already leased (87,527 acres) and any new requirements **CANNOT** be imposed on the contractual terms of the existing leases, nor can existing leases be revoked if a decision is made not to lease. Although many operators are willing to voluntarily make changes, the lease they hold may not require them to do so.

The decision **CAN** provide surface resource protection on Federal lands. It **CANNOT** preserve Federal or non-Federal oil and gas deposits for the future. Regardless of any decision made in this document, oil and gas operators will be able to access non-Federal deposits. In doing so, they may drain Federal deposits. Preservation of oil and gas reserves on the Dixie National Forest is beyond the scope of this EIS.

The leasing decision for specific lands shall remain in effect until significant new information or circumstances cause the existing environmental analysis to be out of date, at which time the BLM will be notified and the lands will be scheduled for a new leasing analysis.

A series of statutes including the Leasing Reform Act establishes and defines the authority of the Forest Supervisor and District Manager (BLM) to make these decisions. These are more fully described in Appendix C.

Issuance of a lease has been determined to constitute the point of "irreversible and irretrievable commitment of resources" that requires NEPA analysis and disclosure. The EIS is intended to provide that analysis for the lands within the study area. Any stipulations intended to mitigate effects on surface resources beyond that required by the standard lease terms must be attached to the lease at the time it is issued. Consequently, the identification of stipulations in the determination of administratively available lands and their application in the decision by the Forest Service to authorize the BLM to lease specific lands, and the final decision of the BLM to offer the lands for lease, is of utmost importance in this EIS.

### **Summary of Events and Decisions Preceding this EIS**

**1920 - Mineral Leasing Act (as amended)** - This Act provided that all public lands are open to oil and gas leasing, unless a specific land order has been issued to close an area. The primary authority and responsibility for determinations regarding leasing remained with the Secretary of the Interior and the BLM.

**1969 - National Environmental Policy Act** - The National Environmental Policy Act establishes environmental policy for the Nation. Among other items, NEPA requires Federal agencies to consider environmental values in decision-making processes.

**1986 - Approval of The Forest Plan** - The Forest Plan for the Dixie National Forest was approved on September 2, 1986. This long-range, integrated land and resource management plan provide for integrated guidance for all natural resource management activities as required by the National Forest Management Act of 1976 (NFMA).



**1987 - Federal Onshore Oil and Gas Leasing Reform Act** - The authority to issue all leases for the production of Federally- owned oil and gas resides with the BLM. Prior to the Leasing Reform Act of 1987, the Forest Service's authority regarding oil and gas leases issued on National Forest System lands was varied, and in most cases the Forest Service only made nonbinding recommendations to the BLM. Under the Leasing Reform Act, the Forest Service's decision to lease with certain stipulations is binding on the BLM for all Federal minerals on National Forest System lands, if the BLM decision is to offer the leases for sale. The 36 CFR 228 regulations, issued in April, 1990, established the new process for making oil and gas leasing decisions in accordance with the Leasing Reform Act.

**April 20, 1990 - 36 CFR 228E Regulations** - The regulations prescribe methods by which the Forest Service will make decisions with regard to oil and gas leases and subsequent management of oil and gas operations on National Forest System lands. These regulations lay out the process for determining lands administratively available for leasing, including the designation of stipulations and the projection and analysis of post-leasing activity. (Refer to Appendix A, The Analysis Process.) The regulations describe the Forest Service process for authorizing the BLM to offer leases for sale.

**May 1990 - Forest Service Resource Planning Act Long Term Strategic Plan** - The Resource Planning Act (RPA) program provides general policy guidance at the National level based on a five-decade projection into the future. The Forest Service has defined nine roles in its basic National strategic plan. Multiple-use management, contributions to rural development, and management in situations of mixed ownership situations are three of those roles. The issue of minerals development is described in the 1990 RPA document as:

*The mineral resources within the National Forest System significantly affect the economic well-being of local communities and the strategic defense of the Nation. The public is concerned about the effects on minerals development on other resource values and on the environment.*

In the RPA document, the long-term strategy for minerals is to meet most demands for access to explore and develop mineral resources, except when doing so would pose unacceptably high risks to other resources.

**May 4, 1988 - Leasing Decision** - A leasing decision was made as the result of the Escalante Known Geological Structure (KGS) Environmental Impact Statement. Subsequently 34,544 acres of National Forest system land were authorized for lease. Since then Forest Service officials have decided to relook at the KGS decision in the bigger context provided by this document. Antone Bench and Areas 2, 3, 4 and 5 are not available for leasing after the existing leases expire, and therefore are not included within this decision. The KGS leasing decision is most accurately portrayed in Alternative 2 (Chapter 2), but some minor changes have been made for consistency reasons.

## **SCOPE OF THE PROPOSED ACTION**

### **Geographic Scope**

**Lands Involved in the Analysis** - The area involved in this decision process is the Dixie National Forest, which stretches about 170 miles across southern Utah. The largest National Forest in Utah it straddles the divide between the Great Basin and the Colorado River. Elevations vary from 2,800 feet near St. George, Utah to 11,322 feet at Blue Bell Knoll on the Boulder Mountain (Figure 1-1). (The Box-Death Hollow, Ashdown Gorge, and Pine Valley Mountains Wildernesses have been withdrawn from leasing; therefore, there is no leasing-related decision to be made within the Wilderness boundary, although potential indirect effects are considered.)



The Dixie National Forest is characterized by a large area of intermingled ownership with adjacent landowners including private individuals, corporations, the State of Utah, and the National Park Service. Nearby rural communities include Teasdale, Boulder Town, Escalante, Tropic, Antimony, Junction, Circleville, Panguitch, Hatch, Alton, Paragonah, Parawan, Cedar City, Newcastle, Enterprise, and St. George in Utah. Salt Lake City is approximately 250 miles north and Las Vegas, Nevada is about 150 miles southwest along Interstate Highway 15.

Within the Forest boundary, there are 1,865,941 acres with both Federal jurisdiction of surface use and mineral rights and 3,698 acres with private-owned surface rights and Federally-administered mineral rights.

**Lands Excluded From Decisions** - Table 1-2 displays the acres that are not included in this decision process, but are included in the cumulative effects analysis. The existing oil fields are included in the analysis process; however, the decisions cannot be implemented until production ends and the leases expire, terminate, or are relinquished.

**Administrative Scope**

The decisions to be made in this EIS are the four actions described (earlier in this chapter) under the heading *Proposed Action*. Once these decisions are made, no further NEPA analysis on these decisions will be needed as long as conditions remain basically as described and analyzed in this EIS. The analysis of specific Federal minerals in the EIS includes all unleased and leased lands in the study area. The decision will include all land with Federal minerals, although the decision cannot be implemented on some lands until current leases expire, terminate, or are relinquished. It is anticipated that up to 45 leases not held by production representing about 75,455 acres (Table 1-1), will become available between the years 1994 and 2000 as previously noted.

It is not anticipated that any lands currently leased and held by production will become available for leasing by the year 2009. Some of the wells forecast in the reasonably foreseeable development scenario (RFDS), discussed later in this chapter, will occur on lands currently leased or leases held by production. Producing wells will continue to hold these leases in place until production ceases. Administrative changes, such as Forest Plan amendments needed to implement an alternative, are within the scope of this document.

**Actions**

The scope of this EIS includes, in addition to the proposed action, the effects of connected actions and cumulative actions. Connected actions are those actions that are (1) closely related to the proposed action and automatically triggered by the proposed action, (2) cannot or will not proceed unless other actions are taken previously or simultaneously, or (3) are interdependent parts of a larger action and depend on the larger action for their justification (40 CFR 1508.25). Cumulative actions are actions that, when viewed with

**TABLE 1-2  
Acreage Excluded From Decisions**

Designation	Acres
National Forest System lands with non-federal minerals	18,006
Private surface rights with non-federal minerals	79,651
Lands and minerals within Antone Bench and Areas 2, 3, 4, and 5	3,220
Lands and minerals within the National Wilderness Preservation System	83,000
<b>Total Acres</b>	<b>183,877</b>



other proposed actions, such as timber sales, wildlife improvements, etc., may have cumulatively significant impacts and should be discussed in the same EIS (40 CFR 1508.25)

The authorization of a lease grants rights to explore for and develop oil and gas within the terms and stipulations of the lease. The exercise of these rights results in implementation of connected actions. However, authorization implies that oil and gas development may take place at a future time with identified restrictions. The regulations, 36 CFR 228.102 (c)(4), direct the Forest Service to consider the subsequent actions that would be authorized by a lease as connected actions, associated with review and approval of the APD and other associated plans of operation. These actions also meet the definition of connected actions in the procedural requirements for the NEPA (40 CFR 1502).

These expected actions are the basis of the environmental analysis from which the leasing decisions will be made. The decision on the lands that will be administratively available, and the subsequent decision authorizing leases, are based upon analysis of the likely environmental effects of the connected actions.

Connected actions are being considered under each alternative in this EIS. In this context, connected actions include the post-leasing approval of Surface Use Plans of Operation, and issuance of Rights-of-Way authorizations for off-lease activities needed to support oil and gas exploration, development, and production on lease. These actions may authorize or result in other activities such as drilling, construction of production facilities, roads and pipelines as discussed in the RFDS (refer to Appendix E).

As discussed in the section on the Federal management of oil and gas activities at the end of this chapter, there are three stages in the process that require additional permitting for actions related to oil and gas leasing. These include the issuance of permits for exploratory drilling and field development. The process for issuance of these site-specific permits will implement and require completion of an additional NEPA analysis. The NEPA analysis that may be required would complement the analysis completed in this document. The analysis summarized in this EIS is key to determining which lands would be administratively available and under which stipulations, including determining those specific parcels that would be designated with a stipulation for No Surface Occupancy (NSO).

### **Forest Plan Context**

Management of each administrative unit of the National Forest System (one or more National Forest(s) or National Grassland(s)) is governed by a Land and Resource Management Plan (Forest Plan). Most of the existing Forest Plans include general decisions, as part of management prescriptions, to provide for oil and gas leasing, but do not include decisions for leasing specific lands. Prior to the passage of the Leasing Reform Act and except for acquired lands, the Forest Service had no authority to make decisions related to issuing or not issuing oil and gas leases on National Forest System lands. Most of the Forest Plan EISs, which predate the Leasing Reform Act, do not fully meet the intent of the regulations to make site-specific leasing decisions. This analysis process is discussed in more detail in Appendix A. Decisions the Forest Supervisor will make, including availability, will be used to develop an amendment to the Forest Plan (refer to Forest Manuals and Handbooks for Plan Amendment Process).

### **REASONABLE FORESEEABLE DEVELOPMENT SCENARIO**

In order to analyze the environmental effects that could occur as a result of a leasing decision, a projection of the kind and amount of activity that could be reasonably anticipated was made. The RFDS for this analysis was developed using historical oil and gas development information, geologic information and interpretation, and projected market trends. It must be recognized that future exploration and development



may not occur as predicted in the RFDS presented and only provides a reasonable basis for analyzing potential subsequent activities and their effects (refer to Appendix E for a detailed discussion and presentation of the RFDSs).

Generally, any development of oil and gas resources will progress through five basic phases: (1) preliminary investigations, (2) exploratory drilling, (3) development, (4) production, and (5) abandonment (refer to Appendix D for a more detailed discussion).

Activity that occurs after the lease is issued can create economic, environmental, and social impacts. A site-specific RFDS was developed and used to estimate site-specific effects of exploration, development, and production activity. The site-specific RFDS forecast can serve as the basis for leasing decisions for "specific lands" throughout the study area analyzed regardless of whether a specific area was, or was not, forecast to be impacted in the RFDS. It must be recognized that future exploration and development may not occur exactly where predicted in the RFDS presented, in Appendix E.

The projected level of activity of the oil and gas industry on the Dixie National Forest from 1994 through 2009 is 102 wells. It is predicted that eight (8) of these will be exploration wells and would result in the discovery of three new fields, two field developments for CO<sub>2</sub> (54 wells) and one field development for oil (40 wells) (Kilbourne, Pete. 1991). The new field developments for CO<sub>2</sub> are forecast to occur in the Escalante Anticline Aquarius Plateau, and the oil and gas field development location is not projected.

## **FEDERAL MANAGEMENT OF LEASES AND ASSOCIATED DEVELOPMENT**

### **Federal Leasing Process**

The BLM is responsible for issuing oil and gas leases on Federal lands and on private lands for which the Federal government retains mineral rights. The BLM cannot issue leases for lands administered by the Forest Service without consent from the Secretary of Agriculture. The Mineral Leasing Act of 1920, as amended, and the Mineral Leasing Act of 1947 for acquired lands provide the legislative authority for Federal oil and gas leasing. Title 43 CFR 3100 provides the regulatory basis for administering Federal oil and gas leasing.

In areas where exploration and development of oil and gas resources would conflict with the protection or management of other resources or public land uses, the NEPA process identifies measures to mitigate impacts. Such mitigation measures may be applied as lease stipulations, which restrict how operations are conducted or where they can be located.

Competitive and noncompetitive leases may be obtained for oil and gas exploration and development on lands owned or controlled by the Federal government. The Leasing Reform Act of 1987 requires that all public lands available for oil and gas leasing be offered first by competitive leasing at an oral auction. Noncompetitive oil and gas leases may be issued only after no competitive bids have been received for public lands. Competitive and noncompetitive leases are issued for a period of ten years. Both types of leases continue for the period oil and gas are produced in paying quantities. The maximum competitive lease sizes are 2,560 acres in the lower 48 states and 5,760 acres in Alaska. The maximum noncompetitive lease size is 10,240 acres in all states. Refer to Appendix A for a more detailed discussion of the competitive and noncompetitive leasing process.



## **Standard Lease Terms and Conditions**

The standard lease terms are contained in BLM Lease Form 3100-11, *Offer to Lease and Lease for Oil and Gas* (Appendix B). As a minimum, all leases must contain standard lease terms. Under the standard lease terms, the lessee has the right to use as much of the leased lands as is necessary to explore or drill for, extract, remove, and dispose of oil and gas deposits that may be in the leased lands, together with the right to build and maintain necessary improvements thereon. Section 6 of the standard lease form requires the operator to conduct operations in a manner that minimizes adverse impacts to surface resources and other land uses and users. The lessee also is required by regulation to comply with the minimum operation standards of Onshore Orders and Notices to Lessees (refer to Appendix A).

## **Mitigation Measures**

Forest Plan standards and guides will be adhered to during implementation of all of the alternatives. Mitigation is employed in three major areas. First, standard terms of BLM Lease Form 3100-11 (Appendix B), 43 CFR 3100, and 36 CFR 228E, contain basic mitigation measures to protect the environment. Second, at the lease-issuance stage, special stipulations may be added to protect specific resource values. Examples are NSO on slopes over 40 percent, or Timing Limitation (TL) for big game calving and lambing areas. Finally, at the APD stage, additional site-specific mitigation measures may be required or incorporated through negotiations with the applicant to protect site-specific resources identified. Additional mitigation measures may be required or negotiated at the APD stage as a result of on-the-ground examination and NEPA analysis. Conditions of Approval (COA) can be required if they are within the terms of the lease and negotiated if they are outside the terms of the lease. These are determined on a site-specific, case-by-case basis. Any post-lease mitigation applied must be approved and may not change the intent of the lease or impose undue constraint upon the operator.

## **Bonding**

The lessee, or the lessee's operator, must furnish a lease bond of at least \$10,000 before beginning any surface-disturbing activities related to drilling. In lieu of individual lease bonds, lessees, owners of operating rights (sublessee), or operators may furnish a bond in an amount of not less than \$25,000 covering all leases and operations in any one State; or a bond in the amount not less than \$150,000 covering all leases and operations nationwide.

The bond is intended to ensure compliance with all lease terms, including protection of the environment. The BLM may increase the bond amount any time conditions warrant such an increase, or the Forest Service can require additional bonding under 36 CFR 228.109.

## **Rentals and Royalties**

In the first five years of the lease, annual rental rates for competitive and noncompetitive leases are \$1.50 per acre or fraction of the acre. After the first five years, annual rental rates increase to \$2.00 per acre. The royalty rate on production is 12.5 percent for competitive and noncompetitive leases.

## **Expiration or Termination of a Lease**

Oil and gas leases expire at the end of their term. A term is ten years for competitive and noncompetitive leases, but leases may be extended (not to exceed two years) beyond their primary term for diligent drilling



operations or be eliminated from an approved Unit Agreement. Leases that produce paying quantities of oil or gas do not expire until production ends.

Leases without producing wells automatically terminate if the lessee fails to make full and timely payment of the annual rental. The rental must be received by the Federal government on or before the anniversary date of the lease.

The owner of a lease also may relinquish the lease in whole or in part by filing a written relinquishment with the BLM State Office having jurisdiction over the leased Federal lands. A relinquishment takes effect on the date it is filed. The lessee is responsible for plugging any abandoned wells. The lessee also is responsible for other work required by the BLM to place the leasehold in proper condition for abandonment and bring the lease account into good standing. If the lessee fails to perform the required abandonment work, the bond will be used to pay for the costs of abandonment, and the lessee will be prohibited from leasing any additional Federal lands.

A more detailed description of oil and gas activity is included in Appendix D.







**CHAPTER 2**

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*ALTERNATIVES*







### INTRODUCTION

Early in the project, a scoping process was initiated to solicit comments from relevant agencies and the general public. Comments received were analyzed and summarized to represent the issues and concerns of the respondents. Based on and in response to the issues, the Forest Service developed a range of alternatives that meet the purpose and need for the project (as identified in Chapter 1). The alternatives propose specific actions that could be implemented to: (1) decide which lands would and would not be administratively available for leasing, and (2) decide which leasing option would be applied to those lands that would be leased.

This chapter describes the scoping process, the seven key issues identified during scoping, the development of alternatives, and each alternative and the reasonably foreseeable development anticipated for each. It also provides a comparison of the alternatives, including the no-action alternative.

### SCOPING PROCESS

Soliciting comments from various federal, state, county, and local agencies as well as interested organizations and individuals is the first step in the EIS preparation process. The comments are used to obtain the most accurate and current environmental information and to incorporate public opinion into planning and decision making. Scoping is an information gathering process open to the public and agencies early in the course of the EIS preparation process, and is required by NEPA in CEQ regulation 40 CFR 1501.7, 1501.6 and 1508.25. The purpose of the scoping process is not only to characterize significant environmental issues that warrant study or evaluation, but also to identify issues that are not significant so that the environmental analysis and EIS will remain focused. Scoping is not a single, isolated activity, but instead is an ongoing process throughout the preparation of the EIS.

The scoping process for this project consisted of early consultation, two public scoping meetings and public notification to interested parties.

A Notice of Intent (NOI) to prepare an EIS, initiating the 30-day scoping period, was published in the Federal Register on April 23, 1993. A scoping document in the form of a newsletter was sent to the 210 parties on the project mailing list on April 26, 1993. The purpose of the newsletter was to inform the public of the Forest Service's and BLM's intent to conduct an environmental analysis and solicit public comment to identify specific issues that should be addressed during the analysis and documented in the EIS. The newsletter also contained information about the purpose and need of the project, an overview of how oil and gas leases are developed on National Forests, a description of the project including a general map of the area, a description of ensuing environmental studies, and a request for public comments (to be submitted by June 1, 1993). At the request of the Southern Utah Wilderness Alliance an amendment to the NOI which extended the preliminary scoping period from June 1, 1993 to June 21, 1993 was published in the Federal Register on May 18, 1993. Postcards were sent to all names on the mailing list notifying them of the change in the scoping time period.

In addition to the NOI and newsletter, the Forest Service conducted two public scoping meetings to inform the public of the project and solicit comments. The meetings were held in: (1) Cedar City, Utah, on May 25, 1993, and (2) Salt Lake City, Utah, on May 27, 1993. Meeting minutes and a list of attendees from the two meetings are on file in the Forest Supervisors Office in Cedar City, Utah.



## SUMMARY OF SCOPING PROCESS

A total of 42 groups and individuals provided comments. These comments were reviewed, analyzed and summarized. From this summary, seven key issues were identified which will be addressed in detail in the environmental analysis. While future comments are also being considered, these key issues were used to guide the analysis and develop alternatives. These seven issues are summarized below:

### Issue 1

*The effects of oil and gas leasing and possible subsequent exploration and development activities on wildlife, and wildlife habitat.*

Concerns were expressed about the potential effects on wildlife, and wildlife habitat. There was concern about the potential effects on big game as well as non-game species. Potential effects on wildlife could result from seismic exploration, reserve pits. Further, big game could be displaced by oil and gas activity (e.g., noise, use of roads). Protection of old growth was requested because of its importance to the northern goshawk and spotted owl. One comment requested leasing of critical habitat with protective stipulations (Timing Limitation and No Surface Occupancy was mentioned). Other comments suggested that critical habitat should be considered unsuitable (for oil and gas leasing). A forest-wide restriction on activities in critical wildlife habitats (i.e., calving, fawning, and critical winter range areas, and sage grouse leks) was also requested.

Concern was expressed about the protection of threatened, endangered, and proposed wildlife and plant species, as well as sensitive species, including: peregrine falcon, Mexican spotted owl, black bear, cougar, and Bonneville and Colorado cutthroat trout. The requirement for a Biological Assessment/Biological Evaluation (BA/BE) was of concern.

### Issue 2

*The effects of oil and gas leasing and possible subsequent exploration and development activities on the roadless resource and eligible Wild and Scenic Rivers.*

Concerns were expressed about the potential impacts to roadless areas. It was suggested that as much consideration should be given to the "wilderness" values and characteristics within these areas as would be given to Congressionally-established Wilderness Areas. Comments ranged from closing all roadless areas to leasing to allowing all roadless areas to be leased. Some suggested that leases be issued only where roads currently exist. There was concern expressed that if the decision to lease roadless areas was made during this analysis process, it would preclude the opportunity to consider these roadless areas for future recommendation as Wilderness in the Forest Plan revision process, as provided for in the Utah Wilderness Act. Concern was also expressed that potentially eligible Wild and Scenic rivers should be protected from oil and gas exploration and development.

### Issue 3

*The effects of oil and gas leasing and possible subsequent exploration and development activities on water, soils, and riparian values.*



Concerns were expressed that oil and gas exploration and development activities would disturb soils and cause impacts on soils, water, and riparian areas. Potential impacts include erosion of unstable soils, steep slopes, and erodible soils which could cause damage to watersheds and potentially degrade water quality. Some expressed concern that there may be an accident and hazardous materials could be released contaminating water. Concern was also expressed that riparian areas were important not only for the maintenance of water quality but for wildlife and plant life, as well as scenery. There is also a concern that aquifers and stream flows could be altered which would have a negative impact on wildlife.

#### **Issue 4**

*The effects of oil and gas leasing and possible subsequent exploration and development activities on the visual and recreation resources.*

Concerns were expressed that the effects of activities subsequent to leasing, such as construction of roads and well pads and the presence of drill rigs would impact important views, especially those from viewpoints within Bryce Canyon National Park and established Wilderness Areas. There was a concern expressed that all areas that have a visual quality objective (VQO) of Retention be protected by a stipulation of No Surface Occupancy.

Concerns were expressed for potential impacts to recreation opportunities and high use areas, and that they should be leased only with substantially restrictive stipulations. Concerns were also expressed that oil and gas exploration and development activities could have an impact on big game hunting experiences and opportunities. It was suggested that hunting seasons be protected by timing limitations, including limiting activity: 1) from five days before to five days after the general elk hunt, 2) from one day before to three days after the general deer hunt, and 3) from two days before through the entire season for the once in a lifetime hunt.

#### **Issue 5**

*The effects of oil and gas leasing and possible subsequent exploration and development activities on established National Parks, National Monuments, and Wilderness.*

Concern was expressed about the potential effects of oil and gas exploration and development on existing established National Parks, National Monuments, and Wilderness Areas and that these areas would be degraded by the sights, sounds, and smells caused by oil and gas activities. Some wanted a protective buffer around these areas. There was a concern expressed about the protection of the Class I airsheds which exist over most National Parks and Monuments. Concern was also expressed that potential park lands (adjacent to existing parks) should be protected from oil and gas exploration and development.

#### **Issue 6**

*The effects of Federal leasing decisions on the opportunities to explore for and develop oil and gas resources within the analysis area.*

Concerns were expressed that overly restrictive stipulations imposed to protect the surface resources, could limit opportunities or even preclude potential oil and gas exploration and development.



## Issue 7

*The effects of Federal leasing decisions and possible subsequent exploration and development activities on local communities and socioeconomic values.*

Concern was expressed that leasing decisions could effect the local economic base of rural communities limiting their potential development. One comment wanted careful consideration of economic impacts on all levels of government (i.e., local, county, state, and federal). Concern was expressed that local government plans were not considered in leasing decisions.

### **DEVELOPMENT OF ALTERNATIVES**

The alternatives were developed in response to the issues (described previously) and to insure that a full range of leasing options were addressed for each specific resource value or feature. These specific resource values were identified using the leasing matrices in the Forest Plan and through the issues raised during the scoping process.

The possible leasing options, listed in order from most restrictive to list restrictive, are:

- **No Lease (NL)** - no new leases would be authorized
- **No Surface Occupancy (NSO)** - well sites, tank batteries, or similar facilities would not be allowed to occupy the surface of specified lands
- **Timing Limitations (TL)** - oil and gas exploration and development activities would be restricted or prohibited during certain time periods
- **Controlled Surface Use (CSU)** - surface use and occupancy would be allowed but would be limited in some cases to mitigate the potential effects of oil and gas exploration and development on a particular resource(s) (e.g., requiring operations to meet a visual quality objective)
- **Standard Lease Terms (SLT)** - no special stipulations would be applied but oil and gas exploration and development activities would be required to comply with current laws, regulations, and Onshore Orders

A full range of these leasing options were incorporated into the development of alternatives so that the comparison of alternatives would disclose what specific lease stipulations would be necessary and justifiable in accordance with 36 CFR 228.102(c).

Leasing options were assigned to resource features and values of major concern, identified during scoping:

- threatened, endangered, proposed and sensitive species
- critical wildlife habitats
- riparian and wetland areas (including streams and lakes)
- recreation (developed sites, semi-primitive non-motorized areas, high recreation areas)
- sensitive aquifers and municipal watersheds
- sensitive visual resource areas (VQOs of Retention and Partial Retention)
- special interest areas (Research Natural Areas, roadless areas, "#" management areas)
- steep slopes and unstable or highly erosive soils
- geologic hazards (rockfall and landslide areas)

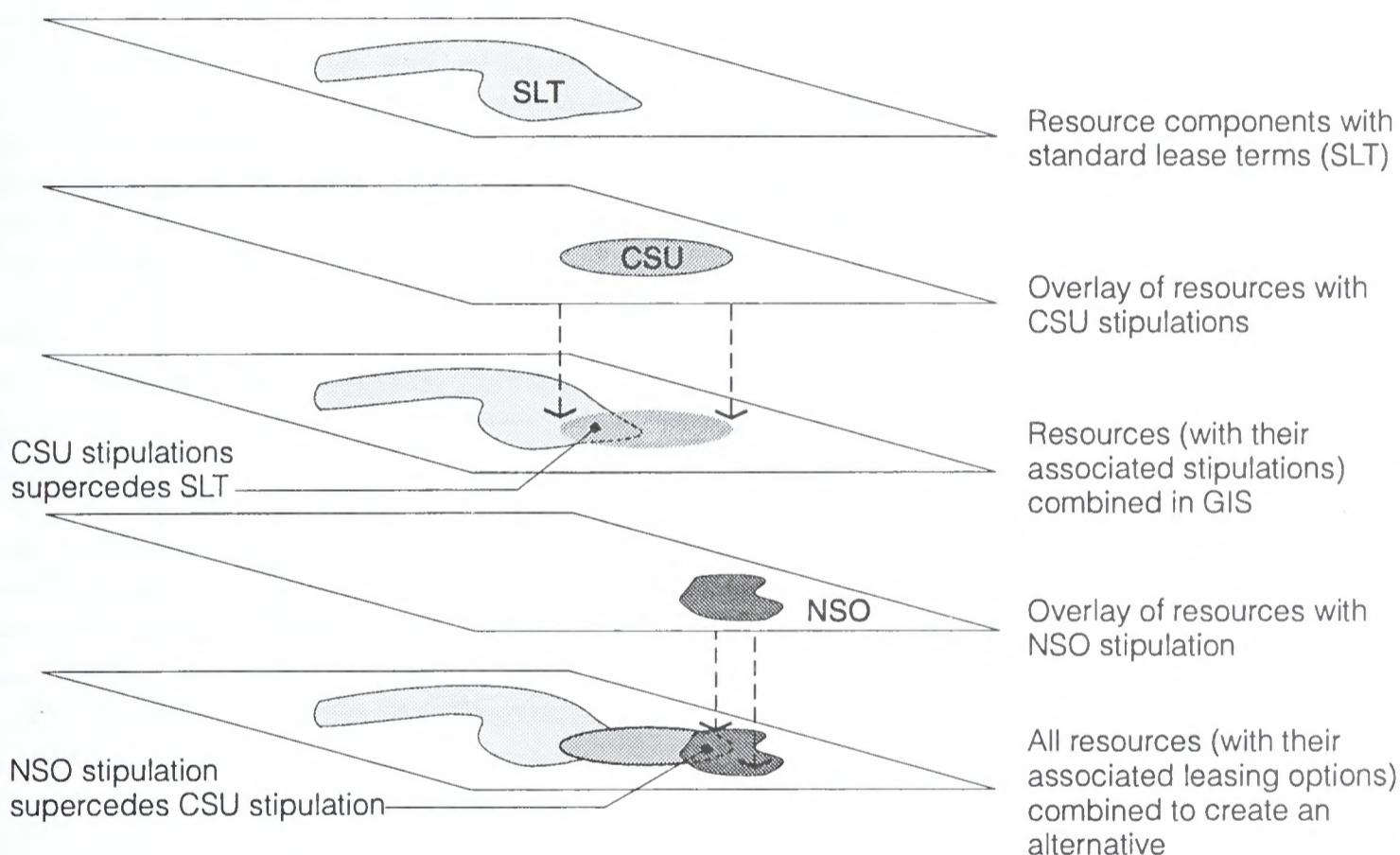


A reasonable range of alternatives as developed by assigning the leasing options to site-specific areas and occurrences of these resource features or values as mapped in the Dixie National Forest's geographic information system (GIS). Using the GIS, mapping of these resources and their associated leasing options was combined resulting in the alternatives evaluated in this EIS. In developing the alternatives, the most restrictive leasing option (i.e., NL or NSO) assigned to a particular resource superseded any less restrictive options (i.e., CSU or SLT) assigned to other resources that occur in the same area or site-specific location. For example, where NSO was assigned to an area of high erosion potential that coincides with the habitat of a sensitive wildlife species assigned CSU, the NSO option would be applied to the area common to both of these resources. Another example would be an area of key wildlife habitat assigned the TL option that has some acres of NSO due to the presence of steep slopes within the wildlife habitat.

Figure 2-1 illustrates this process of overlaying mapping of each of the key resource features and values considered in developing the alternatives.

**FIGURE 2-1**

**Combining the Resources and Leasing Options to Develop the Alternatives**



The leasing options represented by one alternative were found to be addressed in one or more of the other alternatives, and was eliminated from consideration and detailed analysis (refer to *Alternatives Considered But Not Evaluated in Detail*, below). Table 2-1 shows the leasing options, assigned to each of the five alternatives.

Two resource elements not addressed specifically by the alternatives are old growth and rivers eligible for Wild & Scenic River designation. Because the issue associated with old growth is centered on its relationship with the northern goshawk, old growth is addressed with threatened, endangered, proposed and sensitive species (refer to Chapters 3 and 4). To date, no rivers or river segments on the Dixie National Forest have been identified as eligible for potential designation as Wild and Scenic rivers. If a leasing decision is not consistent or conflicts with future determinations on potential Wild and Scenic River eligibility, additional analysis may be required.



**TABLE 2-1**  
**Leasing Options by Alternative by Resource**

RESOURCE COMPONENT	ALTERNATIVES				
	Proposed Action	1*	2	3	4
<b>Threatened, Endangered, Proposed, and Sensitive Species</b>					
Threatened, Endangered, & Proposed Species	LN	NL	NL	LN	LN
Sensitive Species	CSU	NL	NSO	CSU	SLT
<b>Wildlife</b>					
Critical Deer Fawning	TL	NL	NSO	TL	SLT
Critical Deer Winter	TL	NL	NSO	TL	SLT
Critical Elk Calving	TL	NL	NSO	TL	SLT
Critical Elk Winter	TL	NL	NSO	TL	SLT
Sage Grouse Leks	TL	NL	NSO	TL	SLT
<b>Roadless</b>					
RARE II Areas (Owens 11/89)	NSO	NL	NL	CSU	SLT
<b>Vegetation</b>					
Riparian & Wetlands	NSO	NL	NSO	NSO	CSU
<b>Watersheds &amp; Soils/Geologic Hazards</b>					
Aquifers (sensitive)	SLT	NL	NL	LN	SLT
Streams & Lakes	NSO	NL	NSO	NSO	CSU
Municipal Watersheds	NSO	NL	NSO	NSO	CSU
Rockfall & Landslide Areas	NSO	NL	NSO	NSO	NSO
Slopes >40%	NSO	NL	NSO	NSO	CSU
Areas of High Erosion Potential	NSO	NL	NSO	NSO	CSU
Marginally Unstable Slopes	SLT	NL	CSU	SLT	SLT
<b>Recreation</b>					
Developed Sites	NSO	NL	NSO	NSO	NSO>40 Acres CSU<40 acres
Semi-Primitive Non-Motorized	NSO	NL	NL	CSU	SLT
Hunting Season	SLT	NL	TL	SLT	SLT
High Recreation	NSO	NL	NSO	NSO	SLT
<b>Visual Resources</b>					
VQO Retention	CSU	NL	NSO	CSU	CSU
VQO Partial Retention	CSU	NL	CSU	CSU	SLT
<b>Special Areas</b>					
Recreation Residences	NSO	NL	NSO	NSO	SLT
Research Natural Areas	NSO	NL	NSO	NSO	NSO
Ski Area	NSO	NL	NSO	NSO	CSU
# Management Areas	NSO	NL	NSO	CSU	SLT
<b>All Other Areas</b>	SLT	NL	SLT	SLT	SLT

\* No Action Alternative

NL = No Lease

NSO = No Surface Occupancy

TL = Timing Limitation

CSU = Controlled Surface Use

SLT = Standard Lease Terms

LN = Lease Notice



The range of five alternatives evaluated in detail respond to the issues identified for the entire analysis area. The **Proposed Action** represents the intent of management direction contained in the Forest Plan, as described in the standards and guidelines (Forest Plan). The **Alternative 1: No Action/No Lease Alternative** and **Alternative 4: Forest Plan Modification C** define the limits of the possible range of alternatives. Once these three alternatives were identified, additional alternatives were developed to respond specifically to the two categories of issues 1) protection of resources, and 2) minimal restrictions on exploration and development.

**Alternative 2: Forest Plan Modification A** was developed in response to issues and comments related to special resource values, other than oil and gas, and the need to insure their protection.

**Alternative 3: Forest Plan Modification B** was developed in response to issues and comments related to the need for oil and gas development, and associated economic benefits, and the effects of restrictive stipulations and mitigation on oil and gas exploration and development.

### **ALTERNATIVES CONSIDERED BUT NOT EVALUATED IN DETAIL**

Alternatives that applied either NSO or SLT to all areas were considered but not carried forward in detail in this analysis. The leasing option analysis that evaluated each lease option for each specific resource area showed that NSO or SLT was not reasonable and justifiable for all areas (refer to Leasing Option Analysis in the Resource Background Reports available at the Dixie National Forest offices). For those areas where it was reasonable, the NSO or SLT leasing options were included for consideration in one of the other alternatives.

### **ALTERNATIVES CONSIDERED IN DETAIL**

The five alternatives considered in detail are:

- Proposed Action: Forest Plan Intent
- Alternative 1: No Action/No Lease
- Alternative 2: Forest Plan Modification A
- Alternative 3: Forest Plan Modification B
- Alternative 4: Forest Plan Modification C

Under the Proposed Action and Alternatives 2, 3, and 4, the NSO stipulation would apply to well sites and production facilities such as tank batteries and compressor stations. Forest Plan standards and guidelines would be used to determine the acceptability of access proposals as well as govern the design, placement, and other decisions related to any proposed roads or other linear facilities (e.g., pipelines and power lines) that typically extend beyond the lease boundaries. This would allow for consistent standards to be applied, whether facilities are located on or off lease.

Also under the Proposed Action and Alternatives 2, 3 and 4, no buffer zone around developed recreation sites would be specified or included in the stipulation applied to the developed site. The rationale or intent such a stipulation would be to protect the visual resources the around these sites; however, visual quality objectives (VQO) of Retention or Partial Retention typically associated with recreation sites would define and protect the areas adjacent to these sites. Without buffers, more site specific application of stipulations can be implemented than would be possible when assuming a quarter- or half-mile radius from these sites.



Alternatives 2, 3, and 4 would, additionally, allow exploration on all arterial and collector roads within 200 meters either side of the road centerline. Within this corridor, Timing Limitations (TL) would not apply. However, compliance with all other stipulations would be required. One exception to this is where arterial and collector roads would pass through or near "high recreation" areas (areas most frequently used by forest visitors) on the Cedar City and Powell Ranger Districts. In this case, TL stipulations would apply (as indicated in Table 2-1).

Descriptions of the alternatives considered in detail and the reasonably foreseeable exploration and development activities that could be anticipated for each alternative are presented in the *Alternatives Descriptions* section below. The reasonable foreseeable development scenario (RFDS) described in Appendix E is based on the potential for oil and gas occurrence, historical exploration and development activity, and projected oil prices (economics).

The RFDS changes for each alternative depending on the restrictions imposed by the leasing options proposed under each alternative and the oil and gas potential areas (Figure 2-2). In some areas, the leasing options proposed under some alternative would likely restrict oil and gas activity to the point where it would no longer be considered of feasible, economically or technically. Table 2-2 lists the oil and gas potential areas by Ranger District and presents the ratings that describe the relative likelihood for oil and gas discovery (e.g., high, moderate, low) within each potential area.

Many of the resource areas discussed under each alternative overlap each other and may be protected in some areas by more restrictive stipulations than those described for that particular resource. The reason for this, as previously described, is that the most restrictive leasing options (i.e., NL or NSO) superseded less restrictive leasing options (i.e., CSU or SLT) in areas where different resources coincide. The maps of the alternatives (Figures 2-3 through 2-6 in the map pockets at the end of this chapter) display the most restrictive leasing options identified for a specific area when the resource layers were combined to form an alternative.

Based on the analysis contained in this Draft EIS, these alternatives may be implemented in whole or used in part to develop other alternatives with respect to one or more of the specific resources or resource areas in the final decision.

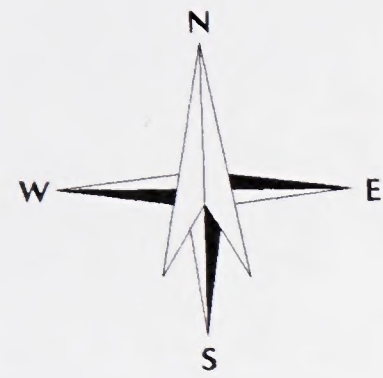
### **Features Common To All Alternatives**

All alternatives would honor existing leases and lease stipulations. There would be some exploration and development activities associated with any of the alternatives. The RFDS assumes that two (2) exploratory wells and development of a CO<sub>2</sub> field would occur in the No Action/No Lease alternative. These exploration and development assumptions are the "base-case" and are included in all alternatives (refer to Appendix E). With the exploration and development activities there would be associated ground disturbance.

### **Exploration Activities**

Lease stipulations identified in each of the alternatives do not apply to geophysical operations on a lease (refer to Appendix D for a discussion of geophysical operations) with the exception of the stipulations for TL that may be applied to elk calving and deer fawning areas and to elk and deer winter range, and the stipulations for NSO applied to administrative sites, campgrounds, and summer home areas. This assumes that portable or heliportable methods would be used where needed for access. Geophysical operations not on a lease require a geophysical prospecting permit from the Authorized Officer.








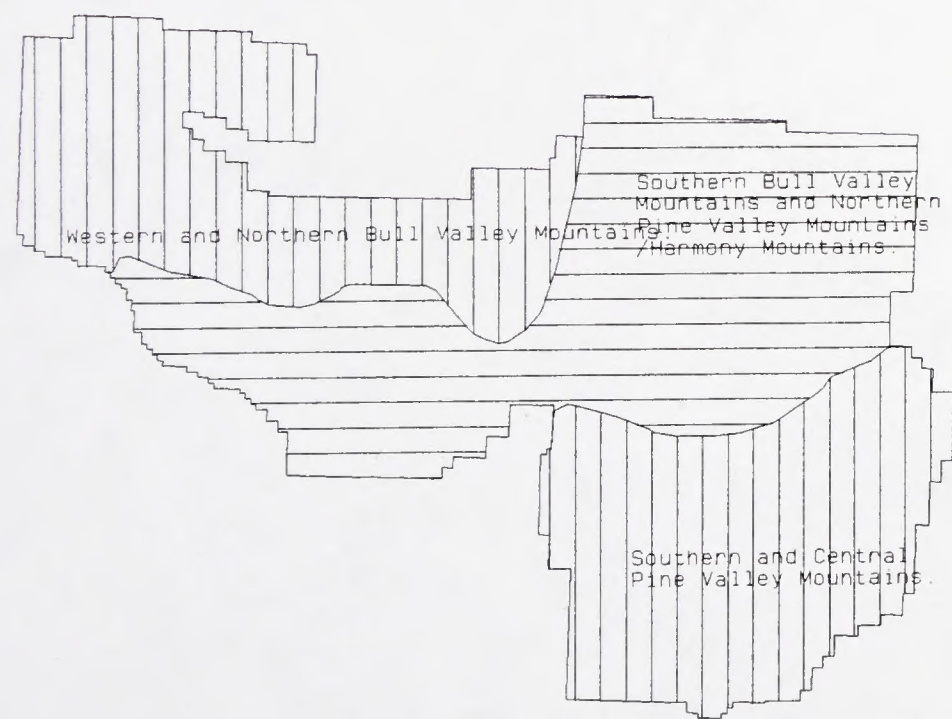
# Oil and Gas Potential

## DIXIE NATIONAL FOREST

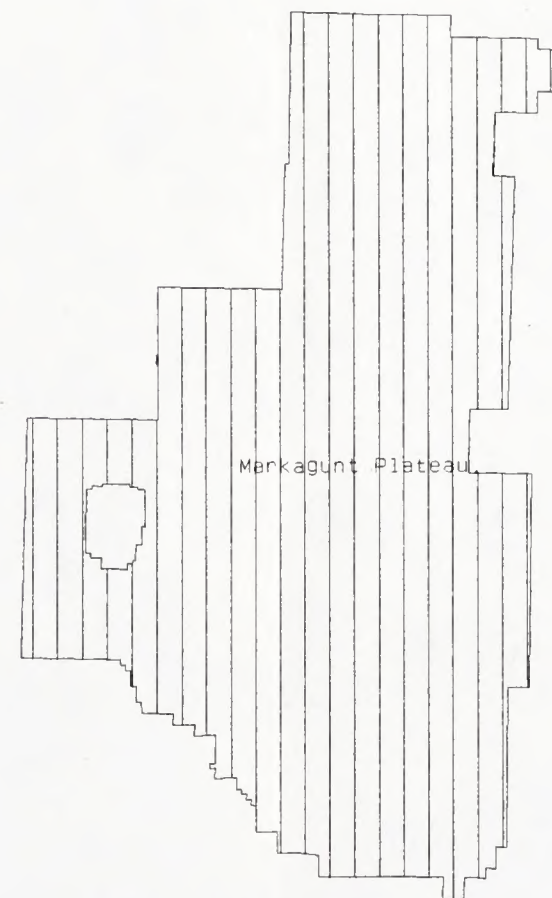


### Legend

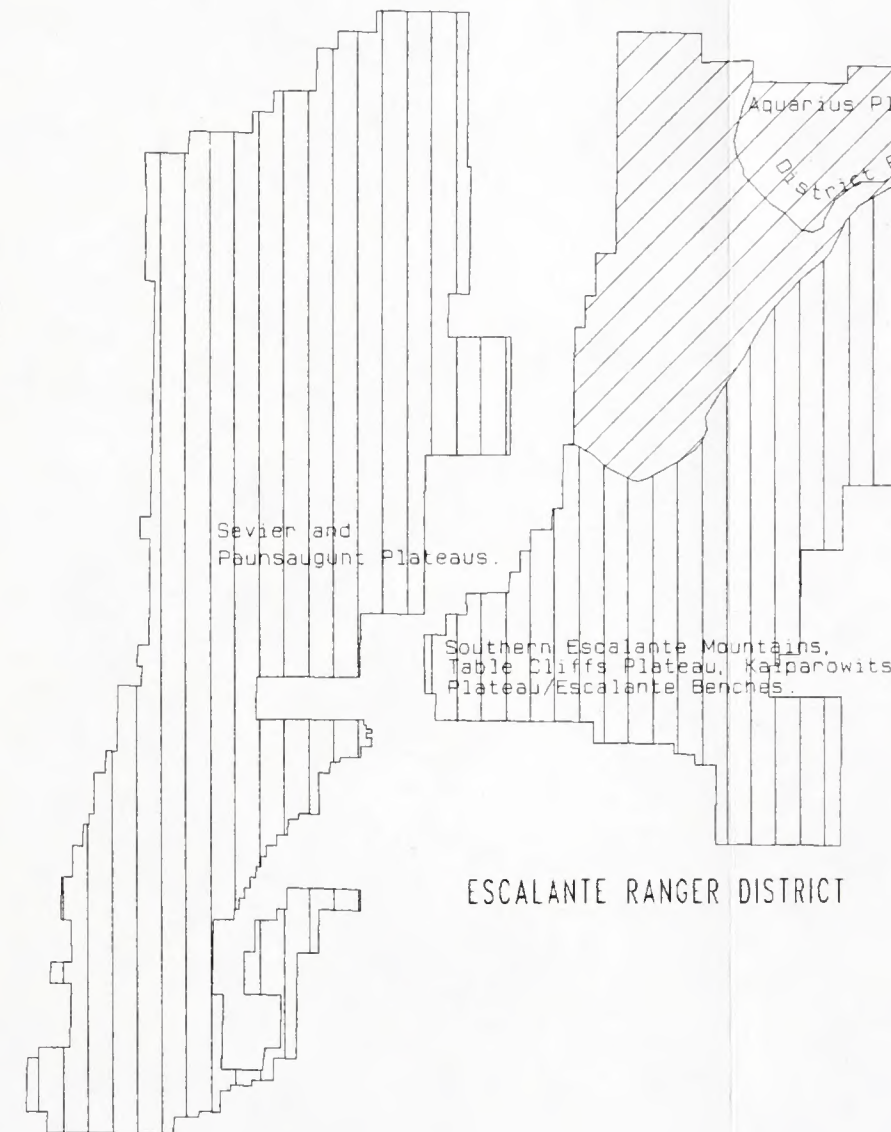
-  High CO2 Moderate Oil & Gas
-  Low Oil & Gas
-  Moderate Oil & Gas



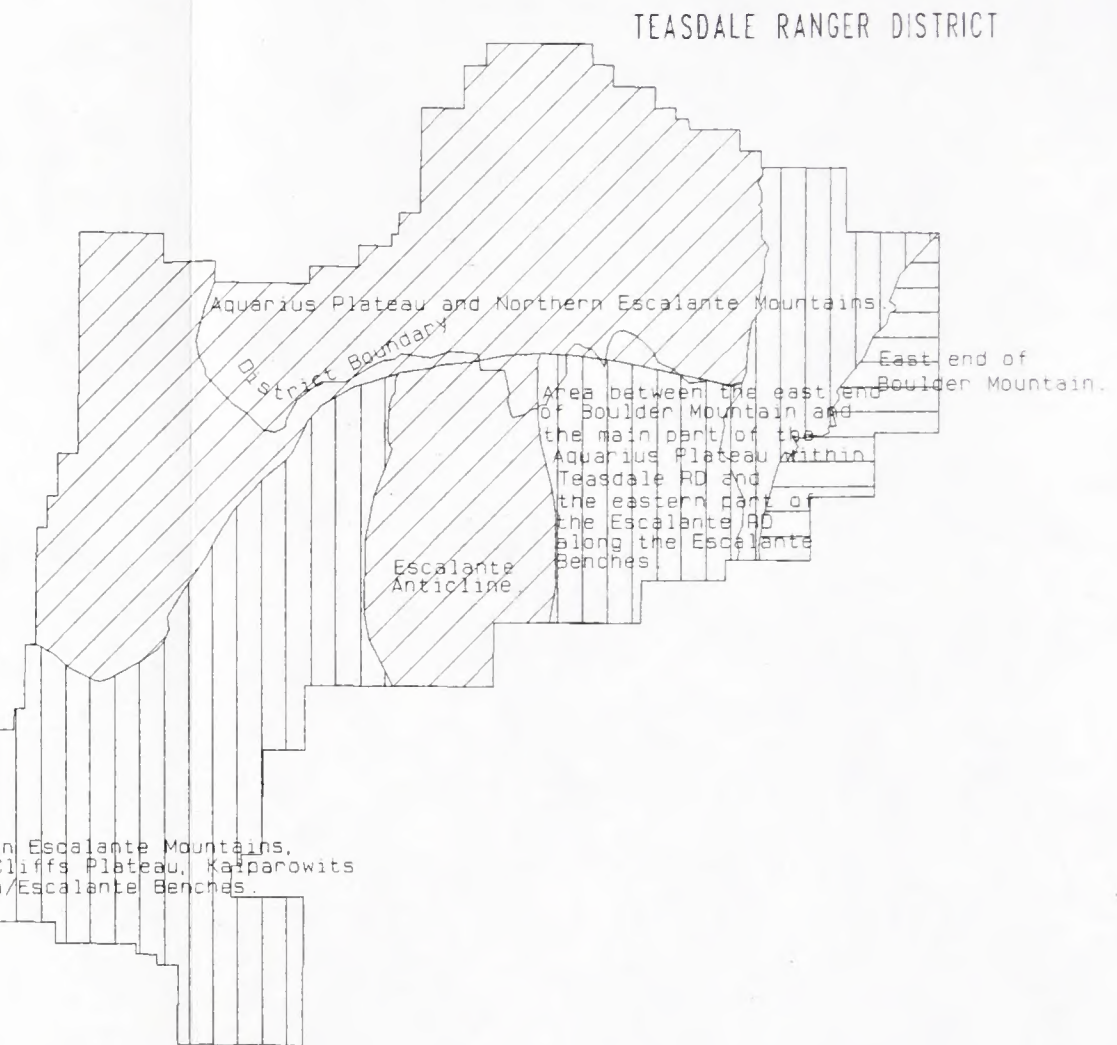
PINE VALLEY RANGER DISTRICT



CEDAR CITY RANGER DISTRICT



POWELL RANGER DISTRICT



TEASDALE RANGER DISTRICT

ESCALANTE RANGER DISTRICT







**TABLE 2-2**  
**Oil and Gas Potential Areas and Ratings**

Ranger District	Oil & Gas Potential Area	Oil & Gas Potential			CO <sub>2</sub> Potential		
		High	Moderate	Low	High	Moderate	Low
Pine Valley	Southern Bull & Northern Pine Valley Mountains			X			X
Pine Valley	South Central Pine valley Mountains		X			X	
Pine Valley	Western & Northern Bull Valley		X			X	
Cedar City	Markagunt Plateau		X			X	
Powell	Sevier & Paunsagant Plateau		X			X	
Escalante & Teasdale	Escalante Anticline		X		X		
Escalante	South Escalante Mountains		X			X	
Escalante & Teasdale	Area East of Boulder Mountain		X			X	
Teasdale & Escalante	Aquarius Plateau		X		X		
Teasdale	East End of Boulder Mountain			X			X

The number of acres of ground disturbance resulting from projected oil and gas exploration activities was extrapolated from past activities (Appendix E).

- Each exploratory well pad would require an average of 2.25 acres.
- Each exploratory well pad would require 1.8 miles of light reconstruction of existing roads and 2.3 miles of new road construction.
- Each mile of road reconstruction or new construction would disturb 3.13 gross acres with a net disturbance of 2.67 acres per mile after cut and fill slope reclamation.

The total area of ground disturbance would average 15.09 gross acres and 10.95 net acres for each exploratory well.



## Development Activities

### CO<sub>2</sub> Field Development Surface Disturbance

- Each well would require 0.7 miles of road.
- Each well would be connected by pipeline to a central gas processing plant.
- When possible, pipelines would be installed within road rights-of-way; otherwise, they are constructed within their own right-of-way.
- Pipeline rights-of-way would be completely rehabilitated after the pipeline is installed. The average field would contain 3.2 miles of pipeline outside of road rights-of-way.
- Pump stations would be installed between wells and the central plant to maintain pressure and flow. These areas would be accounted for in the pipeline rights-of-way.
- Electric and phone lines would generally be constructed within road or pipeline rights-of-way.
- Check dams would be constructed in drainage bottoms to contain sediment.
- Each mile of access road would disturb 3.13 gross acres and 2.67 net acres after rehabilitation of cuts and fills.
- Each well pad would disturb 2.25 gross acres.
- After drilling, the pad would be rehabilitated except for a 50 x 50 foot area (0.06 acres).
- Each mile of pipeline outside the road rights-of-way would disturb 3.03 gross acres would be completely rehabilitated (0 net acres disturbed).
- An average gas processing plant occupies 5 acres.
- Each check dam disturbs 0.25 acres.

The total land area that could be disturbed by development of a CO<sub>2</sub> field would be about 128 gross acres and 56 net acres. If a second CO<sub>2</sub> field was developed, total land area that could be disturbed would be 265 gross acres and 114 net acres.

### Oil Field Development Surface Disturbance (Proposed Action and Alternatives 3 and 4)

The geologic, development, and production characteristics of a newly discovered oil field would be similar to the existing Upper Valley field, which occurs primarily on the Escalante Ranger District and is partially located on BLM-administered lands. Any new oil fields are likely to be smaller than the Upper Valley field, thus disturbances shown below are relatively conservative.



The Upper Valley field contains:

- 40 miles of access roads
- 40 wells (13 injection, 23 producing, 2 outpost, and 2 wildcat wells)
- 40 miles of pipeline which are mostly separate from the roads
- Power lines and phone lines
- 4 tank batteries
- Maintenance facility
- 10 check dams

Important surface disturbance characteristics are listed below:

- Each mile of access road would disturb 3.13 gross acres and 2.67 net acres after rehabilitation of cuts and fills.
- Each well initially would disturb 2.25 gross acres and 0.06 net acres during its production life.
- Each mile of pipeline outside the road rights-of-way would impact 3.03 gross acres and 0 net acres after rehabilitation.
- Each tank battery would disturb 1 to 2 acres.
- The maintenance facility and each check dam would disturb 0.25 gross and net acres.

The total land area that could be disturbed for a oil field similar to Upper Valley would be 340 gross acres and 118 net acres.

### **Alternative Descriptions**

This section describes for each of the alternatives how the stipulations would be applied to each of the key resources components (refer to Table 2-1). As described above, the RFDS changes somewhat for each alternative depending on the lease stipulations or restrictions that would be applied to oil and gas activities. The potential exploration and development activity considered to be reasonably foreseeable under the stipulations that would be imposed each alternative are also described below.

Figures 2-3 through 2-6, in the map pockets (at the end of this chapter), illustrate the Proposed Action and the action alternatives (Alternatives 2, 3, and 4). These maps show the leasing options that would be applied to each key resource (Table 2-1) within the Forest boundaries associated with each of the alternatives described below.

The acres listed in Tables 2-3 through 2-6 for each resource component indicate the number of acres of each resource that could be leased with the associated stipulation. However, note that the numbers do not add up to the total acres for each stipulation listed at the bottom of these tables. The total acres shown at the bottoms of these tables represent the total area that would be leased with a particular leasing option under that particular alternative. The total acres listed in the right most columns of these tables represent the total acres of each resource component within the Forest boundary (which is the same in all these tables).



## Proposed Action: Forest Plan Intent

Under this alternative, a total of approximately 1,783,500 acres of Federal minerals would be administratively available for oil and gas leasing and would be leased with protective lease stipulations. This alternative was designed to reflect the intent of the management direction contained in the Forest Plan. No Forest Plan amendments would be needed with this alternative.

Table 2-3 displays the number of acres that would be leased under each leasing option by resource component (as listed in Table 2-1) for the Proposed Action. The acres listed for each resource component indicate the number of acres of that resource that could be leased with the associated leasing option.

The leasing options that would apply to the key resources under the Proposed Action and the rationale for their application are described below:

### Threatened, Endangered, Proposed and Sensitive Species

Threatened, Endangered, & Proposed Species      A Lease Notice would be attached to the lease to inform the lessee of the presence of T&E and proposed species and/or their habitat within the lease boundary. Protection of the species and habitat would be insured through the Endangered Species Act (ESA) and regulation (36 CFR 228.108(f)) rather than with a lease stipulation.

Sensitive Species      A CSU stipulation would be applied to protect areas with known locations of sensitive species and/or their habitats. This stipulation would be applied to sensitive species that are not protected under the ESA, and would state that proposed activities within a lease would have to be located or conducted in a manner that would minimize potential impacts.

**Wildlife**      Lease stipulations would be applied to specific wildlife habitats as indicated below. A Timing Limitation (TL) stipulation would preclude commencement of activities during the key period of use by wildlife.

- Critical Deer Fawning Range      May 16 to July 1
- Critical Deer Winter Range      November 1 to April 15
- Critical Elk Calving Range      May 1 to July 1
- Critical Elk Winter Range      November 1 to April 15
- Sage Grouse Leks      March 15 to June 1

### Roadless

RARE II      A NSO stipulation would be applied to the remaining roadless areas that were identified on the RARE II (Owens 11/89) map.

### Watersheds

Sensitive Aquifers      Standard Lease Terms



**TABLE 2-3  
Acres of Resource under each Leasing Option -- Proposed Action**

RESOURCE COMPONENT	LEASING OPTION					
	NL	NSO	TL	CSU	SLT	Total Acres
<b>Threatened, Endangered, Proposed and Sensitive Species</b>						
T,E,&P Wildlife Species <sup>1</sup>	0	0	0	0	238,500	238,500
T,E,&P Plant Species <sup>1</sup>	0	0	0	0	610,800	610,800
Sensitive Wildlife Species	70,200	322,100	128,600	344,600	0	865,500
Sensitive Plant Species	77,200	220,900	125,900	187,500	0	611,500
<b>Wildlife</b>						
Critical Deer Fawning	17,000	98,900	64,900	0	0	180,800
Critical Deer Winter	700	67,600	75,100	0	0	143,400
Critical Elk Calving	3,900	67,400	83,200	0	0	154,500
Critical Elk Winter	1,700	115,200	112,200	0	0	229,100
Sage Grouse Leks	0	0	3,800	0	0	3,800
<b>Roadless Areas</b>						
RARE II Areas (Owens 11/89)	86,000	307,250	0	0	0	393,200
<b>Vegetation</b>						
Riparian & Wetlands	1,100	32,100	0	0	0	32,100
<b>Watersheds &amp; Soils/Geologic Hazards</b>						
Aquifers (sensitive)	8,500	131,400	81,800	103,300	25,500	350,400
Streams & Lakes	1,100	32,100	0	0	0	33,200
Municipal Watersheds	3,800	39,600	0	0	0	43,400
Rockfall & Landslide Areas	0	16,400	0	0	0	16,400
Slopes >40%	38,000	230,200	0	0	0	268,200
Areas of High Erosion Potential	9,700	97,900	0	0	0	97,600
Marginally Unstable Slopes	0	46,200	1,500	8,200	600	56,600
<b>Recreation</b>						
Developed Sites	0	13,500	0	0	0	13,500
Semi-Primitive Non-Motorized	0	508,100	0	0	0	508,100
Hunting Season	-- <sup>2</sup>	-- <sup>2</sup>	-- <sup>2</sup>	-- <sup>2</sup>	-- <sup>2</sup>	-- <sup>2</sup>
High Recreation Areas	0	29,100	0	0	0	29,100
<b>Visual Resources</b>						
VQO Retention	600	194,500	60,900	137,300	0	393,300
VQO Partial Retention	2,600	374,200	150,500	407,900	0	935,200
<b>Special Areas</b>						
Recreation Residences	0	100	0	0	0	100
Research Natural Areas	0	2,300	0	0	0	2,300
Ski Area	0	1,400	0	0	0	
# Management Areas	0	261,200	0	0	0	261,200
<b>Total Acres<sup>3</sup></b>	<b>86,000</b>	<b>881,400</b>	<b>279,600</b>	<b>571,500</b>	<b>145,800</b>	<b>1,964,300</b>

NL = No Lease                      TL = Timing Limitation                      SLT = Standard Lease Terms  
 NSO = No Surface Occupancy      CSU = Controlled Surface Use              LN = Lease Notice

<sup>1</sup> Protection of all threatened, endangered, and proposed species would be stipulated in a Lease Notice attached to leases.  
<sup>2</sup> Leasing options applied to hunting season would be based on affected big game units.  
<sup>3</sup> The Total Acres shown represent the total area that would be leased under each leasing option for this alternative.



Streams & Lakes

A NSO stipulation would be applied to streams and lakes that are 40 acres or larger in size to meet State water quality standards by maintaining and improving surface and ground water quality, to provide habitats to maintain viable populations of fish and riparian dependent wildlife, maintain long term soil productivity, minimize man-caused soil erosion, and to maintain the integrity of associated ecosystems. The intent is to protect areas less than 40 acres to the same degree but they would be protected under existing regulations (43 CFR 3101.1-2 and 36 CFR 228.108(j)) and not require a specific lease stipulation.

Municipal Watershed

A NSO stipulation would be applied to areas designated as municipal watersheds to prevent disruption or degradation of water developed for or managed as municipal water supplies.

Rockfalls & Landslides

A NSO stipulation would be applied to rockfalls and landslides to maintain or improve water quality to meet State water quality standards, maintain long term soil productivity, minimize man-caused soil erosion, maintain the integrity of associated ecosystems, and to maintain habitat to provide viable fish populations.

Slopes >40%

A NSO stipulation would be applied to slopes of 40 percent or greater to meet State water quality standards by maintaining and improving surface and ground water quality, to maintain long term soil productivity, to minimize man-caused soil erosion, to maintain the integrity of associated ecosystems, to provide habitats to maintain viable populations of fish, and to enable or insure reclamation of the site.

Areas of High Erosion Potential

A NSO stipulations would be applied to soils with high erosion hazard to maintain or improve water quality to Soils meet State water quality standards, maintain long term soil productivity, minimize man-caused soil erosion, maintain the integrity of associated ecosystems, and to maintain habitat to provide viable fish populations.

Marginally Unstable Slopes

Standard Lease Terms

**Vegetation**

Riparian & Wetlands

A NSO stipulation would be applied to riparian and wetland areas that are 40 acres or larger in size to meet State water quality standards by maintaining and improving surface and ground water quality, to provide habitats to maintain viable populations of fish and riparian dependent wildlife, maintain long term soil productivity, minimize man-caused soil erosion, and to maintain the integrity of associated ecosystems. The intent is to protect areas less than 40 acres to the same degree but they would be protected under existing regulations (43 CFR 3101.1-2 and 36 CFR 228.108(j)) and not require a specific lease stipulation.

**Recreation**

Developed Sites

A NSO stipulation would be applied to developed campgrounds and trailheads to preclude surface disturbing activities that would impact the site, facilities, and the recreational experience.

Semi-Primitive

A NSO stipulation would be applied to the SPNM areas that are identified on the



Non-Motorized Forest Plan Management Area map to preclude surface disturbing (SPNM) activities which would change the recreation opportunities afforded by these areas.

Hunting Season Standard Lease Terms

High Recreation Areas A NSO stipulation would be applied to these important recreation lands.

### Visual Resources

VQO Retention A CSU stipulation would be applied to areas with a VQO of Retention. Proposed activities within this area must be designed or located in such a manner as to meet this objective within one year.

VQO Partial Retention A CSU stipulation would be applied to areas with a VQO of Partial Retention. Proposed activities within these areas must be designed or located in such a manner as to meet this objective within one year.

### Special Areas

Recreation Residence Areas A NSO stipulation would be applied to the two recreation residence areas to preclude impact to the facilities and recreational experience.

Research Natural Areas A NSO stipulation would be applied to the Research Natural Areas to insure they are maintained for the purposes they were designated.

Ski Area A NSO stipulation would be applied to the Brian Head Ski Area to preclude surface disturbing activities that would impact the site, facilities, and recreational experience.

# Management Areas A NSO stipulation would be applied to these areas to preclude occupancy for any mineral activity.

### Reasonable Foreseeable Development Scenario - Proposed Action

Under the Proposed Action alternative, 8 of the 9 exploratory wells would be reasonably foreseeable. One exploratory well on the Pine Valley District would likely not be drilled due to the limited acreage available for surface occupancy. The management restrictions would extremely limit or preclude field development in this area, and therefore, the exploratory well could not be economically justified. All existing leases would be honored. Each exploratory well would impact approximately 15 acres.

The following is a summary description of the reasonably foreseeable development scenario (RFDS) in each Ranger District. Refer the RFDS in Appendix E for additional information.

**Pine Valley Ranger District** - No exploratory wells are foreseeable.

**Cedar City Ranger District** - One exploratory well is reasonably foreseeable that would directly disturb approximately 15 acres on the Markagunt Plateau.

**Escalante and Teasdale Ranger Districts** - Six exploratory wells are reasonably foreseeable and would disturb 90 acres. Three wells could occur in the Aquarius Plateau and Northern Escalante



Mountains, two wells could occur in the Escalante Anticline, and one well could occur in the Southern Escalante Mountains, Table Cliffs Plateau, or Kaiparowits Plateau/Escalante Benches.

There is a reasonable potential for two (2) field developments within the Escalante and Teasdale Ranger Districts. One field development would be located in the Escalante Anticline, two (2) wells plus 25 future carbon dioxide (CO<sub>2</sub>) wells are reasonably foreseeable. Development of the Escalante Anticline field would disturb a total of approximately 129 acres. The other field development would occur in another high CO<sub>2</sub> potential area located on the Aquarius Plateau were another 27 CO<sub>2</sub> wells for the additional field would also be reasonably foreseeable. The total number of wells foreseeable between the two fields would be 54 wells, which would result in a total disturbance of approximately 265 acres.

### **Alternative 1: No Action/No Lease**

The No Action Alternative is required by NEPA and is intended to reflect a situation where no leases would be issued. Forest Service direction for implementing the requirements of NEPA identifies two options for defining the No Action Alternative: 1) no change from current management direction or from the level of intensity, and 2) no action or activity would take place (e.g., proposals for projects are denied). Since the Forest Plan made no decisions related to oil and gas leasing and 36 CFR 228.102 requires the completion of a leasing analysis prior to making decisions, continuing current management would not enable the Forest Service to authorize the BLM to issue leases, and as such, would essentially be a no lease alternative.

The No Action/No Lease Alternative is needed to define one end of the possible range of alternatives and reflect the effects of no leasing on the Federal minerals. The Forest Plan would have to be amended to reflect that no leases would be issued for oil and gas activities on the Federal minerals. The leasing matrices would need to be removed from the Forest Plan. All Federal minerals within the analysis area would not be available for leasing (36 CFR 228.102(d)). Existing leases would remain in effect until they are terminated or expire. The decision would not involve private minerals. Since all Federal minerals would not be available for leasing, there would be no site-specific decision to be made (36 CFR 228.102 (e)).

#### Reasonable Foreseeable Development Scenario - Alternative 1

Under this alternative, two (2) exploratory wells would be reasonably foreseeable and would likely occur on one of the existing leases in the area of the Escalante anticline.

With the limited acreage available for leasing and few exploratory wells in this area, field development for hydrocarbons would not be foreseeable. However, a field development for CO<sub>2</sub> would be foreseeable as it is a known resource in the Escalante anticline. Refer the RFDS in Appendix E for additional information.

### **Alternative 2: Forest Plan Modification A**

Under this alternative, approximately 869,426 acres of Federal minerals within the analysis area would be administratively available for leasing. Those areas not administratively available for leasing include semi-primitive non-motorized areas (SPNM), roadless area (RARE II), habitat areas of threatened, endangered, and proposed candidate wildlife or plant species, sensitive aquifers, and rivers determined eligible for Wild and Scenic River designation.



As previously mentioned, stipulations specified or included under this alternative would not buffer developed recreation sites and would allow exploration on all arterial and collector roads within 200 meters either side of the road centerline (without Timing Limitations (TL) in this corridor). All other stipulations would be apply. One exception is where arterial and collector roads would pass through or near "high recreation" areas on the Cedar City and Powell Ranger Districts, TL stipulations would apply. All other stipulations would be apply (as indicated in Table 2-1).

Implementing this alternative would require an amendment to the Dixie National Forest Land and Resource Management Plan (1986).

Table 2-4 displays the number of acres that would be leased under each stipulation by resource component (as listed in Table 2-1) for Alternative 2. The acres listed for each resource component indicate the number of acres of that resource that could be leased with the associated stipulation.

Those areas administratively available for leasing would be leased with protective lease stipulations as described below:

**Threatened, Endangered, Proposed and Sensitive Species**

Threatened,  
Endangered, &  
Proposed Species

No Lease

Sensitive Species

A NSO stipulation would be applied to protect areas of known locations of sensitive wildlife and plant species and/or their habitats.

**Wildlife**

Lease stipulations would be applied to specific wildlife habitats as indicated below. A NSO stipulation would preclude oil and gas activities in these critical wildlife areas:

- Critical Deer Fawning Range
- Critical Deer Winter Range
- Critical Elk Calving Range
- Critical Elk Winter Range
- Sage Grouse Leks

**Roadless Areas**

RARE II

No Lease

**Watersheds**

Sensitive Aquifers

No Lease

Streams & Lakes

A NSO stipulation would be applied to streams and lakes that are 40 acres or larger in size to meet State water quality standards by maintaining and improving surface and ground water quality, to provide habitats to maintain viable populations of fish and riparian dependent wildlife, maintain long term soil productivity, minimize man-caused soil erosion, and to maintain the integrity of associated ecosystems. The intent is to protect areas less that 40 acres to the same degree



but they would be protected under existing regulations (43 CFR 3101.1-2 and 36 CFR 228.108(j)) and not require a specific lease stipulation.

**Municipal Watersheds**

A NSO stipulation would be applied to areas designated as municipal watersheds to prevent disruption or degradation of water developed for or managed as municipal water supplies.

**Rockfalls & Landslides**

A NSO stipulation would be applied to rockfalls and landslides to maintain or improve water quality to meet State water quality standards, maintain long term soil productivity, minimize man-caused soil erosion, maintain the integrity of associated ecosystems, and to maintain habitat to provide viable fish populations.

**Slopes >40%**

A NSO stipulation would be applied to slopes of 40 percent or greater to meet State water quality standards by maintaining and improving surface and ground water quality, to maintain long term soil productivity, to minimize man-caused soil erosion, to maintain the integrity of associated ecosystems, to provide habitats to maintain viable populations of fish, and to enable or insure reclamation of the site.

**Areas of High Erosion Potential**

A NSO stipulations would be applied to soils with high erosion hazard to maintain or improve water quality to meet State water quality standards, maintain long term soil productivity, minimize man-caused soil erosion, maintain the integrity of associated ecosystems, and to maintain habitat to provide viable fish populations.

**Marginally Unstable Slopes**

A CSU stipulation would be applied to areas of marginally unstable slopes so activities will be designed and located to insure that slope stability can be maintained, to insure State water quality standards will not be exceeded, to insure fish habitat is maintained or improved, and that reclamation of the site can be accomplished.

**Vegetation**

**Riparian & Wetlands**

A NSO stipulation would be applied to riparian and wetland areas that are 40 acres or larger in size to meet State water quality standards by maintaining and improving surface and ground water quality, to provide habitats to maintain viable populations of fish and riparian dependent wildlife, maintain long term soil productivity, minimize man-caused soil erosion, and to maintain the integrity of associated ecosystems. The intent is to protect areas less that 40 acres to the same degree but they would be protected under existing regulations (43 CFR 3101.1-2 and 36 CFR 228.108(j)) and not require a specific lease stipulation.

**Recreation**

**Developed Sites**

A NSO stipulation would be applied to developed campgrounds trailheads to preclude surface disturbing activities that would impact the site, facilities, and the recreational experience.

**Semi-primitive Non Motorized**

No Lease



**TABLE 2-4**  
**Acres of Resource under each Leasing Option -- Alternative 2**

RESOURCE COMPONENT	LEASING OPTION					Total Acres
	NL	NSO	TL	CSU	SLT	
<b>Threatened, Endangered, Proposed, and Sensitive Species</b>						
T,E,&P Wildlife Species <sup>1</sup>	238,500	0	0	0	0	238,500
T,E,&P Plant Species <sup>1</sup>	7,100	0	0	0	0	7,100
Sensitive Wildlife Species	530,100	335,500	0	0	0	865,500
Sensitive Plant Species	365,400	246,100	0	0	0	611,500
<b>Wildlife</b>						
Critical Deer Fawning	121,900	58,900	0	0	0	180,800
Critical Deer Winter	89,500	53,900	0	0	0	143,400
Critical Elk Calving	95,900	58,600	0	0	0	154,500
Critical Elk Winter	150,100	79,000	0	0	0	229,100
Sage Grouse Leks	0	3,800	0	0	0	3,800
<b>Roadless Areas</b>						
RARE II Areas (Owens 11/89)	393,200	0	0	0	0	393,200
<b>Vegetation</b>						
Riparian & Wetlands	33,200	0	0	0	0	33,200
<b>Watersheds &amp; Soils/Geologic Hazards</b>						
Aquifers (sensitive)	350,500	0	0	0	0	350,500
Streams & Lakes	33,200	0	0	0	0	33,200
Municipal Watersheds	31,200	12,100	0	0	0	43,400
Rockfall & Landslide Areas	14,700	1,700	0	0	0	16,400
Slopes >40%	268,200	0	0	0	0	268,200
Areas of High Erosion Potential	73,200	24,600	0	0	0	97,600
Marginally Unstable Slopes	43,800	8,900	0	3,800	0	56,500
<b>Recreation</b>						
Developed Sites	6,700	6,800	0	0	0	13,500
Semi-Primitive Non-Motorized	508,100	0	0	0	0	508,100
Hunting Season	-- <sup>2</sup>	-- <sup>2</sup>	-- <sup>2</sup>	-- <sup>2</sup>	-- <sup>2</sup>	-- <sup>2</sup>
High Recreation Areas	20,700	8,400	0	0	0	29,100
<b>Visual Resources</b>						
VQO Retention	217,000	176,000	0	0	0	393,000
VQO Partial Retention	452,100	235,800	133,900	113,900	0	935,200
<b>Special Areas</b>						
Recreation Residences	0	100	0	0	0	100
Research Natural Areas	2,100	200	0	0	0	2,300
Ski Area	100	1,300	0	0	0	1,400
# Management Areas	212,400	48,800	0	0	0	261,200
<b>Total Acres<sup>3</sup></b>	<b>1,094,900</b>	<b>501,900</b>	<b>0</b>	<b>247,800</b>	<b>119,700</b>	<b>1,964,300</b>

NL = No Lease                      TL = Timing Limitation                      SLT = Standard Lease Terms  
NSO = No Surface Occupancy      CSU = Controlled Surface Use              LN = Lease Notice

<sup>1</sup> Known locations and habitat of all threatened, endangered, and proposed species would not be leased.  
<sup>2</sup> Leasing options applied to hunting season would be based on affected big game units.  
<sup>3</sup> The Total Acres shown represent the total area that would be leased under each leasing option for this alternative.



Hunting Season A Timing Limitation stipulation would preclude initiating oil and gas activities from five days before through the close of the hunting seasons, as shown in the State regulations, to maintain the quality of the hunting experience.

High Recreation Areas A NSO stipulation would be applied to these important recreation lands.

### Visual Resources

VQO Retention A NSO stipulation would be applied to maintain a VQO of Retention.

VQO Partial Retention A CSU stipulation would be applied to areas with a VQO of Partial Retention. Proposed activities within these areas must be designed or located in such a manner as to meet this objective within one year.

### Special Areas

Recreation Residence Areas A NSO stipulation would be applied to the two recreation areas to preclude impact to the facilities and recreational experience.

Research Natural Areas A NSO stipulation would be applied to the Research Natural Areas to insure they are maintained for the purposes they were designated.

Ski Area A NSO stipulation would be applied to the Brian Head Ski Area to preclude surface disturbing activities that would impact the site, facilities, and recreational experience.

# Management Areas A NSO stipulation would be applied to these areas to preclude occupancy for any mineral activity.

### Reasonable Foreseeable Development Scenario - Alternative 2

Under this alternative, four (4) exploratory wells would be reasonably foreseeable. Three of these wells would likely be drilled on the Teasdale and Escalante Ranger Districts, and the fourth would likely occur on the Cedar City District. The extensive acreage of No Lease and NSO within the Powell District would likely preclude or discourage any drilling activity in that area.

With the limited number of exploratory wells and limited accessibility with surface occupancy opportunities, it is unlikely that field development would occur, but for purposes of this analysis, development of a CO<sub>2</sub> field was be considered reasonable foreseeable as it is a known resource in the Escalante anticline.

The following is a summary description of the reasonably foreseeable development scenario (RFDS) in each Ranger District. Refer the RFDS in Appendix E for additional information.

**Pine Valley Ranger District** - No exploratory wells are reasonably foreseeable.

**Cedar City Ranger District** - One (1) exploratory well is reasonably foreseeable and would result in a direct disturbance of approximately 15 acres on the Markagunt Plateau.

**Powell Ranger District** - No exploratory wells are reasonably foreseeable.



**Escalante and Teasdale Ranger Districts** - Three (3) exploratory wells would be reasonably foreseeable on Escalante and Teasdale Ranger Districts, resulting in a disturbance of approximately 45 acres.

There is a reasonable potential for one (1) field development within the Escalante and Teasdale Ranger Districts. The field development would be located in the Escalante anticline, two (2) wells plus 25 future CO<sub>2</sub> wells are reasonably foreseeable. Development of the Escalante anticline field would result in disturbance totaling approximately 129 acres.

### **Alternative 3: Forest Plan Modification B**

Under this alternative, approximately 1,783,500 acres of Federal minerals within the analysis area would be administratively available for leasing. Table 2-5 displays the number of acres that would be leased under each stipulation by resource component (as listed in Table 2-1) for Alternative 3. The acres listed for each resource component indicate the number of acres of that resource that could be leased with the associated stipulation.

As previously mentioned, stipulations specified or included under this alternative would not buffer developed recreation sites and would allow exploration on all arterial and collector roads within 200 meters either side of the road centerline (without Timing Limitations (TL) in this corridor). All other stipulations would be apply. One exception is where arterial and collector roads would pass through or near "high recreation" areas on the Cedar City and Powell Ranger Districts, TL stipulations would apply. All other stipulations would be apply (as indicated in Table 2-1).

Implementing this alternative would require an amendment to the Dixie National Forest Land and Resource Management Plan (1986).

The leasing options that would apply to the key resources under Alternative 3 and the rationale for their application are described below:

#### **Threatened, Endangered, Proposed and Sensitive Species**

**Threatened, Endangered, & Proposed Species** A Lease Notice would be attached to the lease to inform the lessee of the presence of T&E and proposed species and/or their habitat within the lease boundary. Protection of the species and habitat would be insured through the Endangered Species Act and Regulation (36 CFR 228.108(f) rather than with a lease stipulation.

**Sensitive Species** A CSU stipulation would be applied to protect areas with known locations of sensitive species and/or their habitats. This stipulation would be applied to sensitive species that are not protected under the ESA, and would state that proposed activities within a lease would have to be located or conducted in a manner that would minimize potential impacts.

**Wildlife** Lease stipulations would be applied to specific wildlife habitats as indicated below. A Timing Limitation (TL) stipulation would preclude commencement of activities during the key period of use by wildlife.

- Critical Deer Fawning Range May 16 to July 1
- Critical Deer Winter Range November 1 to April 15



- Critical Elk Calving Range      May 1 to July 1
- Critical Elk Winter Range      November 1 to April 15
- Sage Grouse Leks                  March 15 to June 1

**Roadless Areas**

RARE II

A CSU stipulation would be applied which allows exploration only by means which do not require road building such as by helicopter.

**Watersheds**

Sensitive Aquifers

A Lease Notice would be attached to the lease to inform the lessee of the presence of sensitive aquifers in the lease area. Protection of these sensitive aquifers would be insured through the Clean Water Act rather than with a lease stipulation.

Streams & Lakes

A NSO stipulation would be applied to streams and lakes that are 40 acres or larger in size to meet State water quality standards by maintaining and improving surface and ground water quality, to provide habitats to maintain viable populations of fish and riparian dependent wildlife, maintain long term soil productivity, minimize man-caused soil erosion, and to maintain the integrity of associated ecosystems. The intent is to protect areas less than 40 acres to the same degree but they would be protected under existing regulations (43 CFR 3101.1-2 and 36 CFR 228.108(j)) and not require a specific lease stipulation.

Municipal Watersheds

A NSO stipulation would be applied to areas designated as municipal watersheds to prevent disruption or degradation of water developed for or managed as municipal water supplies.

Rockfalls & Landslides

A NSO stipulation would be applied to rockfalls and landslides to maintain or improve water quality to meet State water quality standards, maintain long term soil productivity, minimize man-caused soil erosion, maintain the integrity of associated ecosystems, and to maintain habitat to provide viable fish populations.

Slopes >40%

A NSO stipulation would be applied to slopes of 40 percent or greater to meet State water quality standards by maintaining and improving surface and ground water quality, to maintain long term soil productivity, to minimize man-caused soil erosion, to maintain the integrity of associated ecosystems, to provide habitats to maintain viable populations of fish, and to enable or insure reclamation of the site.

Areas of High Erosion Potential

A NSO stipulations would be applied to soils with high erosion hazard to maintain or improve water quality to meet State water quality standards, maintain long term soil productivity, minimize man-caused soil erosion, maintain the integrity of associated ecosystems, and to maintain habitat to provide viable fish populations.

Marginally Unstable Slopes

Standard Lease Terms



**TABLE 2-5**  
**Acres of Resource under each Leasing Option -- Alternative 3**

RESOURCE COMPONENT	LEASING OPTION					Total Acres
	NL	NSO	TL	CSU	SLT	
<b>Threatened, Endangered, Proposed, and Sensitive Species</b>						
T,E,&P Wildlife Species <sup>1</sup>	0	0	0	0	238,500	238,500
T,E,&P Plant Species <sup>1</sup>	0	0	0	0	7,100	7,100
Sensitive Wildlife Species	70,200	72,900	189,300	533,100	0	865,500
Sensitive Plant Species	77,200	117,600	190,000	226,700	0	611,500
<b>Wildlife</b>						
Critical Deer Fawning	17,000	42,200	121,600	0	0	180,800
Critical Deer Winter	700	23,300	119,400	0	0	143,400
Critical Elk Calving	3,900	24,600	126,000	0	0	154,500
Critical Elk Winter	1,700	46,200	181,200	0	0	229,100
Sage Grouse Leaks	0	3,800	0	0	0	3,800
<b>Roadless Areas</b>						
RARE II Areas (Owens 11/89)	86,000	91,300	52,000	163,900	0	393,200
<b>Vegetation</b>						
Riparian & Wetlands	1,100	32,100	0	0	0	33,200
<b>Watersheds &amp; Soils/Geologic Hazards</b>						
Aquifers (sensitive)	8,500	54,800	129,200	132,600	25,500	350,600
Streams & Lakes	1,100	32,100	0	0	0	33,200
Municipal Watersheds	3,800	39,600	0	0	0	43,400
Rockfall & Landslide Areas	0	16,400	0	0	0	16,400
Slopes >40%	38,000	230,200	0	0	0	268,200
Areas of High Erosion Potential	9,700	87,900	0	0	0	97,600
Marginally Unstable Slopes	0	37,900	12,400	6,000	200	56,500
<b>Recreation</b>						
Developed Sites	0	13,500	0	0	0	13,500
Semi-Primitive Non-Motorized	0	171,100	103,500	233,500	0	508,100
Hunting Season	-- <sup>2</sup>	-- <sup>2</sup>	-- <sup>2</sup>	-- <sup>2</sup>	-- <sup>2</sup>	-- <sup>2</sup>
High Recreation	0	29,100	0	0	0	29,100
<b>Visual Resources</b>						
VQO Retention	600	102,500	98,200	191,400	0	392,700
VQO Partial Retention	2,600	165,100	221,200	546,300	0	935,200
<b>Special Areas</b>						
Recreation Residences	0	100	0	0	0	100
Research Natural Areas	0	2,300	0	0	0	2,300
Ski Area	0	1,400	0	0	0	1,400
# Management Areas	0	98,000	69,900	93,300	0	261,200
<b>Total Acres<sup>3</sup></b>	<b>86,000</b>	<b>394,300</b>	<b>460,700</b>	<b>877,500</b>	<b>145,800</b>	<b>1,964,300</b>

NL = No Lease

TL = Timing Limitation

SLT = Standard Lease Terms

NSO = No Surface Occupancy

CSU = Controlled Surface Use

LN = Lease Notice

<sup>1</sup> Protection of all threatened, endangered, and proposed species would be stipulated in a Lease Notice attached to leases.

<sup>2</sup> Leasing options applied to hunting season would be based on affected big game units.

<sup>3</sup> The Total Acres shown represent the total area that would be leased under each leasing option for this alternative.



## Recreation

Developed Sites	A NSO stipulation would be applied to developed campgrounds and trailheads to preclude surface disturbing activities that would impact the site, facilities, and the recreational experience.
Semi-Primitive Non-Motorized	A CSU stipulation would be applied which allows exploration only by means which do not require road building such as by helicopter.
Hunting Season	Standard Lease Terms
High Recreation Areas	A NSO stipulation would be applied to these important recreation lands.

## Visual Resources

VQO Retention	A CSU stipulation would be applied to areas with a VQO of Retention. Proposed activities within this area must be designed or located in such a manner as to meet this objective within one year.
VQO Partial Retention	A CSU stipulation would be applied to areas with a VQO of Partial Retention. Proposed activities within these areas must be designed or located in such a manner as to meet this objective within one year.

## Vegetation

Riparian & Wetlands	A NSO stipulation would be applied to riparian and wetland areas that are 40 acres or larger in size to meet State water quality standards by maintaining and improving surface and ground water quality, to provide habitats to maintain viable populations of fish and riparian dependent wildlife, maintain long term soil productivity, minimize man-caused soil erosion, and to maintain the integrity of associated ecosystems. The intent is to protect areas less than 40 acres to the same degree but they would be protected under existing regulations (43 CFR 3101.1-2 and 36 CFR 228.108(j)) and not require a specific lease stipulation.
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## Special Areas

Recreation Residence Areas	A NSO stipulation would be applied to the two recreation residence areas to preclude impact to the facilities and recreational experience.
Research Natural Areas	A NSO stipulation would be applied to the Research Natural Areas to insure they are maintained for the purposes they were designated.
Ski Area	A NSO stipulation would be applied to the Brian Head Ski Area to preclude surface disturbing activities that would impact the site, facilities, and recreational experience.
# Management Areas	A CSU stipulation would be applied which allows exploration only by means which do not require road building such as by helicopter. Does not apply to management areas 1A# and 2B#.



### Reasonable Foreseeable Development Scenario - Alternative 3

Under this alternative, nine (9) exploratory wells are reasonably foreseeable. The NSO stipulations may require the use of directional drilling in some areas and other mitigation requirements would increase the cost of these wells, but would not preclude them.

The following is a summary description of the reasonably foreseeable development scenario (RFDS) in each Ranger District. Refer the RFDS in Appendix E for additional information.

**Pine Valley Ranger District** - One (1) exploratory well is reasonably foreseeable which would directly impact approximately 15 acres in the Western or Northern Bull Valley Mountains, or the Southern or Central Pine Valley Mountains.

**Cedar City Ranger District** - One (1) exploratory well is reasonably foreseeable which would directly impact approximately 15 acres on the Sevier Plateau or Paunsagant Plateau.

**Escalante and Teasdale Ranger Districts** - Six (6) exploratory wells are reasonably foreseeable for the Escalante and Teasdale Ranger Districts which would disturb a total of approximately 90 acres. The RFDS states that three (3) exploratory wells could occur in the Aquarius Plateau or Northern Escalante Mountains, two (2) could occur in the Escalante anticline, and one (1) could occur in the Southern Escalante Mountains or Table Cliffs Plateau or Kaiparowits Plateau/Escalante Benches.

Development of a CO<sub>2</sub> field is not likely to occur unless a regional pipeline is constructed. Should a pipeline be constructed, the existing resources in the Escalante anticline, and perhaps a smaller potential discovery on the Aquarius Plateau could foreseeably be developed. There is a reasonable potential for two (2) field developments within the Escalante and Teasdale Ranger Districts. One (1) field development would be located in the Escalante anticline, where two (2) wells plus 25 future CO<sub>2</sub> wells are reasonably foreseeable. Development of the Escalante anticline field would disturb a total of approximately 129 acres. Another field development in high CO<sub>2</sub> potential area on the Aquarius Plateau with 27 CO<sub>2</sub> wells is also reasonably foreseeable. A total of 54 wells are reasonably foreseeable between the two fields which would result in a total disturbance of approximately 265 acres.

### **Alternative 4: Forest Plan Modification C**

Under this alternative, approximately 1,783,500 of the Federal minerals within the analysis area would be administratively available for leasing. As previously mentioned, stipulations specified or included under this alternative would not buffer developed recreation sites and would allow exploration on all arterial and collector roads within 200 meters either side of the road centerline (without Timing Limitations (TL) in this corridor). All other stipulations would be apply. One exception is where arterial and collector roads would pass through or near "high recreation" areas on the Cedar City and Powell Ranger Districts, TL stipulations would apply. All other stipulations would be apply (as indicated in Table 2-1).

Implementing this alternative would require an amendment to the Dixie National Forest Land and Resource Management Plan (1986).

Table 2-6 displays the number of acres that would be leased under each stipulation by resource component (as listed in Table 2-1) for Alternative 4. The acres listed for each resource component indicate the number of acres of that resource that could be leased with the associated stipulation.



The leasing options that would apply to the key resources under Alternative 4 and the rationale for their application are described below:

### Threatened, Endangered, and Proposed Candidate Species & Sensitive Species

Threatened, Endangered, & Proposed Species      A Lease Notice would be attached to the lease to inform the lessee of the presence of T&E and proposed species and/or their habitat within the lease boundary. Protection of the species and habitat would be insured through the Endangered Species Act and regulation (36 CFR 228.108(f)) rather than with a lease stipulation.

Sensitive Species      Standard Lease Terms

**Wildlife**      Standard Lease Terms

### Roadless Areas

RARE II Watersheds      Standard Lease Terms

Sensitive Aquifers      Standard Lease Terms

Streams & Lakes      A CSU stipulation would be applied to streams and lakes that are 40 acres or larger in size. Activities will be designed and located to insure protection of function and values of riparian/wetlands/floodplains, aquatic habitat, and surface and groundwater quality. Special operating constraints may be required such as lined or closed system reserve pits, non-toxic drilling fluids, and n land application of wastewaters in a riparian zone. The intent is to protect areas less that 40 acres to the same degree but they would be protected under existing regulations (43 CFR 3101.1-2 and 36 CFR 228.108 (j)) and not require a specific lease stipulation.

Municipal Watersheds      A CSU stipulation would be applied to areas designated as municipal watersheds requiring activities to be located and/or designed to protect the quantity and quality of surface and groundwater.

Rockfalls & Landslides      A CSU stipulation would be applied to riparian and wetland areas that are 40 improve water quality to meet State water quality standards, maintain long term soil productivity, minimize man-caused soil erosion, maintain the integrity of associated ecosystems, and to maintain habitat to provide viable fish populations.

Slopes >40%      A CSU stipulation would be applied to slopes of 40 percent or greater so activities will be designed and located to insure that slope stability can be maintained, to insure State water quality standards will not be exceeded, and that reclamation of the site can be accomplished.

Areas of High Erosion Potential      A CSU stipulation would be applied to high erosion soils so activities will be designed and located to insure that soil erosion is minimized, to insure State water quality standards will not be exceeded, and that reclamation of the site can be accomplished.



**TABLE 2-6**  
**Acres of Resource under each Leasing Option -- Alternative 4**

RESOURCE COMPONENT	LEASING OPTION					Total Acres
	NL	NSO	TL	CSU	SLT	
<b>Threatened, Endangered, Proposed, and Sensitive Species</b>						
T,E,&P Wildlife Species <sup>1</sup>	0	0	0	0	238,500	238,500
T,E,&P Plant Species <sup>1</sup>	0	0	0	0	7,100	7,100
Sensitive Wildlife Species	70,200	5,900	0	320,300	469,100	865,500
Sensitive Plant Species	77,200	9,100	0	209,100	316,100	611,500
<b>Wildlife</b>						
Critical Deer Fawning	17,000	4,400	6,500	75,500	77,400	180,800
Critical Deer Winter	700	600	0	38,500	103,600	143,400
Critical Elk Calving	3,900	9,300	0	65,500	75,800	154,500
Critical Elk Winter	1,700	2,300	0	73,400	151,700	229,100
Sage Grouse Leks	0	0	0	0	3,800	3,800
<b>Roadless Areas</b>						
RARE II Areas (Owens 11/89)	86,035	14,519	0	86,069	203,578	390,201
<b>Vegetation</b>						
Riparian & Wetlands	1,100	2,300	0	29,800	0	33,200
<b>Watersheds &amp; Soils/Geologic Hazards</b>						
Aquifers (sensitive)	8,500	20,100	0	137,200	184,800	350,600
Streams & Lakes	1,100	2,300	0	29,800	0	33,200
Municipal Watersheds	3,800	1,800	14,000	23,800	0	43,400
Rockfall & Landslide Areas	0	16,400	0	0	0	16,400
Slopes >40%	38,000	7,900	0	222,300	0	268,200
Areas of High Erosion Potential	9,700	1,400	11,000	75,500	0	97,600
Marginally Unstable Slopes	0	23,100	0	25,100	8,300	56,500
<b>Recreation</b>						
Developed Sites	0	13,500	0	0	0	13,500
Semi-Primitive Non-Motorized	0	8,600	0	193,300	306,200	508,100
Hunting Season	-- <sup>2</sup>	-- <sup>2</sup>	-- <sup>2</sup>	-- <sup>2</sup>	-- <sup>2</sup>	-- <sup>2</sup>
High Recreation	0	700	0	18,700	9,700	29,100
<b>Visual Resources</b>						
VQO Retention	600	31,000	0	361,400	0	393,000
VQO Partial Retention	2,600	6,800	0	149,000	776,800	935,200
<b>Special Areas</b>						
Recreation Residences	0	100	0	0	0	100
Research Natural Areas	0	2,300	0	0	0	2,300
Ski Area	0	0	0	1,400	0	1,400
# Management Areas	0	27,100	0	122,400	111,700	261,200
<b>Total Acres<sup>3</sup></b>	<b>86,000</b>	<b>394,300</b>	<b>460,700</b>	<b>877,500</b>	<b>145,800</b>	<b>1,964,300</b>

NL = No Lease

TL = Timing Limitation

SLT = Standard Lease Terms

NSO = No Surface Occupancy

CSU = Controlled Surface Use

LN = Lease Notice

<sup>1</sup> Protection of all threatened, endangered, and proposed species would be stipulated in a Lease Notice attached to leases.

<sup>2</sup> Leasing options applied to hunting season would be based on affected big game units.

<sup>3</sup> The Total Acres shown represent the total area that would be leased under each leasing option for this alternative.



Marginally  
Unstable Slopes

Standard Lease Terms

### Vegetation

Riparian & Wetlands

A CSU stipulation would be applied to riparian and wetland areas that are 40 acres or larger in size. Activities will be designed and located to insure protection of function and values of riparian/wetlands/floodplains, aquatic habitat, and surface and groundwater quality. Special operating constraints may be required such as line or closed system reserve pits, non-toxic drilling fluids, and no land application of wastewaters in a riparian zone. The intent is to protect area less than 40 acres to the same degree but they would be protected under existing regulations (43 CFR 3101.1-2 and 36 CFR 228.108(j)) and not require a specific lease stipulation.

### Recreation

Developed Sites

A NSO stipulation would be applied to developed campgrounds that cover an area greater than 40 acres to preclude surface disturbing activities that would impact the site, facilities, and the recreational experience. A CSU stipulation would be applied to developed sites that are less than 40 acres in size.

Semi-Primitive  
Non-Motorized

Standard Lease Terms

Hunting Season

Standard Lease Terms

High Recreation Areas

Standard Lease Terms

### Visual Resources

VQO Retention

A CSU stipulation would be applied to areas with a VQO of Retention. Proposed activities within this area must be designed or located in such a manner as to meet this objective within one year.

VQO Partial Retention

Standard Lease Terms

### Special Areas

Recreation  
Residence Areas

Standard Lease Terms

Research  
Natural Areas

A NSO stipulation would be applied to the Research Natural Areas to insure they are maintained for the purposes they were designated.

Ski Area

A CSU stipulation would be applied to allow no occupancy on areas currently cleared for ski activities and which limits activities to the summer.

# Management Areas

Standard Lease Terms



## Reasonable Foreseeable Development Scenario - Alternative 4

Under this alternative, nine (9) exploratory wells would be reasonably foreseeable with no more than one (1) discovery expected. The discovery would most likely be for CO<sub>2</sub>. However, development of CO<sub>2</sub> field is not likely to occur unless a regional pipeline is constructed. Should a pipeline be constructed, the existing resources in the Escalante anticline, and perhaps a smaller potential discovery on the Aquarius Plateau could be developed. A field development in the Escalante anticline would involve approximately 25 development wells and associated field facilities. Should a second CO<sub>2</sub> field be discovered on the Aquarius Plateau, development could involve an additional 27 wells.

Although no areas of high hydrocarbon potential (i.e., oil or gas) occur on the Forest, there is a high level of interest in the Precambrian Chuar formation. A discovery in the Chuar formation, or any other area of the Forest, could result in development of an oil field similar to the Upper Valley oil field with approximately 38 wells.

The following is a summary description of the reasonably foreseeable development scenario (RFDS) in each Ranger District. Refer the RFDS in Appendix E for additional information.

**Pine Valley Ranger District** - One (1) exploratory well is reasonably foreseeable for this Ranger District which would directly impact approximately 15 acres on the Western or Northern Bull Valley Mountains, or the Southern or Central Pine Valley Mountains.

**Cedar City Ranger District** - One (1) exploratory well is reasonably foreseeable for this Ranger District which would directly impact approximately 15 acres on the Markagunt Plateau.

**Powell Ranger District** - One (1) exploratory well is reasonably foreseeable for this Ranger District which would directly disturb approximately 15 acres on the Sevier Plateau or Paunsagant Plateau.

**Escalante and Teasdale Ranger Districts** - Six (6) exploratory wells are reasonably foreseeable for the Escalante and Teasdale Ranger Districts. The RFDS states that three (3) exploratory wells could occur on the Aquarius Plateau or in the Northern Escalante Mountains, two (2) could occur in the Escalante anticline, and one (1) could occur in the Southern Escalante Mountains or Table Cliffs Plateau or Kaiparowits Plateau/Escalante Benches.

There is a reasonable potential for two (2) field developments within the Escalante and Teasdale Ranger Districts. One field development would be located in the Escalante anticline, two (2) wells plus 25 future CO<sub>2</sub> wells are reasonably foreseeable. Development of a field in the Escalante anticline would disturb a total of approximately 129 acres. Field development in another high CO<sub>2</sub> potential area on the Aquarius Plateau would consist of another 27 CO<sub>2</sub> wells. A total of 54 wells is reasonably foreseeable between the two potential fields which would result in a total disturbance of approximately 265 acres.

## **COMPARISON OF ALTERNATIVES**

This section presents a comparison of the alternatives. The following discussion focuses on comparing each of the alternatives in terms of the issues described earlier in this Chapter. Potential environmental effects of these alternatives are described and compared in Chapter 4 of this EIS.

Alternative 1, represents the No Action alternative, under which there would be no leasing. All the other alternatives would permit leasing on some part of the Dixie National Forest.



The Proposed Action is somewhat conservative in terms of leasing options. Of the total acres within the Forest boundary, 5 percent would not be leased (NL), 45 percent would be leased with the NSO stipulations, 14 percent with Timing Limitation (TL) stipulations, 29 percent with CSU stipulations, and 7 percent under standard lease terms (SLT).

With the exception of Alternative 1 (No Action/No Lease), Alternative 2 is the most restrictive leasing alternative with 56 percent of the total acres within the Forest boundary not available for leasing. Of the acres available for leasing, approximately 26 percent would be leased with NSO stipulations, 13 percent with CSU stipulations, and 6 percent under SLT.

Alternative 3 is most similar to the Proposed Action with the major difference being less acres with NSO stipulations and more acres with CSU stipulations. Of the total acres within the Forest boundary, 5 percent would not be leased (NL), 20 percent would be leased with NSO stipulations, 23 percent with TL stipulations, 45 percent with CSU stipulations, and 7 percent under SLT.

Alternative 4 is the least restrictive leasing alternative with 61 percent of acres available for lease under standard lease terms (SLT). Of the total acres within the Forest boundary, 5 percent would not be leased (NL), 2 percent would be leased with NSO stipulations, and 32 percent with CSU stipulations.

Table 2-7 compares the total acres of Federal minerals to which each stipulation would be applied under each of the alternatives.

All alternatives would have some activities that cause ground disturbance. Table 2-8 displays a comparison of the acres disturbed by alternative. The number and type of activities causing ground disturbance is shown followed by the gross acres and net acres of direct disturbance by type of activity. Net acres represent the acres remaining after reclamation of cut and fill slopes for roads and well pads.

Based on the RFDS and consideration of the leasing options applied under Alternatives 1 and 2, these alternatives would result in the least activity in terms of exploration and field development, and therefore, would result in the least number of acres disturbed. The Proposed Action and Alternatives 3 and 4 are virtually identical in terms of the type and number of activities anticipated, except the Proposed Action assumes one less exploratory well. Therefore, the gross and net acres of disturbance are very similar to those of Alternatives 3 and 4 (Table 2-8).

For the purposes of comparing the alternatives, a series of tables have been prepared that quantify the acres of land available for lease under each alternative and the leasing options that would apply. These tables display this in terms of the Ranger Districts, oil and gas potential areas (refer to Figure 2-1 and Appendix E), affected resources, and the leasing options that would be applied under each alternative.

### **Lands Available for Leasing**

No new leases would be issued under Alternative 1, No Action/No Lease, and as existing leases expire, they would not be reissued. This alternative would have significant impacts on the oil and gas industry in this region of southern Utah as exploration and development would be precluded on 1,869,639 acres of the total 1,967,296 acres within the Dixie National Forest.

As mentioned above, the Proposed Action is relatively conservative with 996,870 acres that would be available within the Dixie National Forest with generally minimal leasing constraints or restrictions (i.e., under TL or CSU stipulations, or standard lease terms (SLT)). Alternatives 3 and 4 would make the largest portion of the Forest available for leasing with generally minimal lease restrictions with 1,483,949 acres and



**TABLE 2-7**  
**Total Acres of Each Leasing Option by Alternative**

LEASING OPTION	ALTERNATIVE				
	Proposed Action	1 <sup>1</sup>	2	3	4
No Lease (NL) <sup>2</sup>	86,000	1,964,300	1,094,900	86,000	86,000
No Surface Occupancy (NSO)	881,400	0	501,900	394,300	39,900
Timing Limitations (TL)	279,600	0	0	460,700	0
Controlled Surface Use (CSU)	571,500	0	247,800	877,500	634,600
Standard Lease Terms (SLT)	145,800	0	119,700	145,800	1,203,800
<b>Total Acres</b>	<b>1,964,300</b>	<b>1,964,300</b>	<b>1,964,300</b>	<b>1,964,300</b>	<b>1,964,300</b>

<sup>1</sup> No Action Alternative

<sup>2</sup> includes private and Federal lands with private mineral ownership within the Forest boundary

1,838,368 acres, respectively. While, Alternative 2 would be more restrictive than the Proposed Action with 367,518 acres available under generally minimal lease restrictions. Table 2-7 shows the total number of acres available with each leasing option (i.e., NL, NSO, TL, CSU, SLT) that would be applied under each alternative.

The Proposed Action would provide substantial acres in areas determined to have high CO<sub>2</sub> and moderate oil and gas potential while protecting key resources by imposing surface occupancy restrictions (NSO) or by not leasing (NL) sensitive areas. Alternative 2, on the other hand, would either not lease (NL) or would lease under NSO stipulations broad areas throughout the Aquarius and Escalante anticline that are high CO<sub>2</sub> and moderate oil and gas potential areas where development is projected as likely to occur. This alternative would substantially limit the potential for oil and gas exploration and development on the Forest compared to the Proposed Action or Alternatives 3 and 4. Alternatives 3 and 4 would provide substantial acreage available for oil and gas and CO<sub>2</sub> development. These alternatives would exclude only those areas critically sensitive to exploration and development activities.

The Proposed Action would likely provide adequate acreage to meet the objectives of the Forest Plan, Forest Service Policy, and FLPMA, while Alternatives 3 and 4 would meet or exceed these objectives. Alternative 2 may not provide adequate acreage to meet these objectives. No lease (NL) for the entire Dixie National Forest, under Alternative 1, would not be consistent with the Forest Plan, Forest Service Policy, FLPMA, or the National Energy Policy.



Table 2-9 shows a comparison of the acres of leasing options that would be applied under each alternative within each of the ranger districts in the Dixie National Forest. This table displays the number of acres available with each leasing option (i.e., NL, NSO, TL, CSU, SLT) that would be applied under each alternative for each of the oil and gas potential areas within each ranger district.

### Comparison by Issue

The section compares the effects of the alternatives in terms of the issues described previously in this chapter. Table 2-10 displays a summary comparison of total acres (forest-wide) of key resource features to which leasing options were applied (Table 2-1) by alternative. Table 2-11 displays this same information broken down further by the ranger districts.

**Issue 1** The provisions of the Endangered Species Act would provide protection for threatened, endangered, and proposed (TEP) species which would be attached to leases granted under any of the action alternatives in the form of a Lease Notice (LN). With the exception of Alternative 1, No Action/No Lease, Alternative 2 would result in the least direct or indirect impacts to sensitive species and their habitats and critical wildlife habitats by either not leasing or leasing with the NSO stipulation all known locations and habitat areas.

The Proposed Action and Alternative 3 would result in some direct and indirect impacts to both sensitive species and wildlife. However, the timing limitation (TL) stipulations that would be applied to the majority of the habitat and known locations of sensitive species and critical wildlife habitat would suspend oil and gas activities for critical periods (refer to Chapter 4). Although leases granted under Alternative 4 would be somewhat less restricted than in other action alternatives, CSU stipulations and standard lease terms (SLT) would provide adequate protection of sensitive species and critical wildlife habitat. Direct and indirect impacts for this alternative are expected to be slightly higher than expected under the Proposed Action and Alternative 3.

**Issue 2** To date, no rivers have been identified as eligible for potential Wild and Scenic River designation on the Dixie National Forest. Although any of the action alternatives could adversely affect the potential eligibility of rivers or river segments, SLT and more restrictive leasing options would allow oil and gas activities to be relocated to minimize adverse effects. Additional analysis would be required during the Application for Permit to Drill (APD) phase.

**Issue 3** Alternative 4 is the only alternative that would result in any direct impacts to riparian areas. In other alternatives, riparian areas either would not be leased (NL) or would be leased with the NSO stipulations. Indirect impacts could occur under any of the alternatives where oil and gas activities would disturb areas adjacent to riparian areas causing some sedimentation impacts. However, SLT and more restrictive leasing options would allow roads and oil and gas facilities to be relocated up to 200 meters (656 feet) or activities suspended up to 60 days to minimize adverse impacts.

Similarly, Alternative 4 is the only alternative that may adversely effect water resources including municipal watersheds, streams and lakes, and wetland areas. All the other alternatives either would not grant leases in these areas or they would be leased with NSO stipulations which would eliminate direct impacts. Alternatives 1 and 2 would result in no direct impacts to sensitive aquifers. The provisions of standard lease terms (SLT) or lease notice (LN) under the Proposed Action and Alternatives 3 and 4 would likely not be effective in minimizing potential adverse effects to sensitive aquifers.

Potential direct impacts in high erosion areas, rockfall and landslide areas, and on slopes greater than 40% could occur under Alternative 4, but would not occur where these areas either would not be leased or



would be leased with the NSO stipulation under all other action alternatives. With the exception of Alternative 1, all of the alternatives would result in some direct impacts in areas of marginally unstable slopes; however, these impacts are expected to be minor to moderate because CSU or SLT stipulations would mitigate most adverse effects.

**Issue 4** All of the alternatives would result in some adverse effects to recreation and visual resources. No lease or the NSO stipulation under Alternatives 1 and 2 would result no direct impacts to the most visually sensitive areas (i.e., VQO Retention). The Proposed Action and Alternatives 3 and 4 could result in visual contrasts which would adversely effect key observation points and/or degrade the scenic values of affected landscapes. The CSU stipulations that would be applied by these alternatives would mitigate the most significant effects and require reclamation of disturbed areas which would limit effects to the short term, and may require affected areas to meet VQOs.

Effects to recreation resources would be least under the Proposed Action and Alternatives 1 and 2 which would apply the NSO stipulation to leases granted in developed recreation sites or high recreation areas (i.e., the areas most frequently used by forest visitors). Timing limitations (TL) under Alternative 2 would minimize potential adverse effects to hunting season(s). Similarly, under SLT, oil and gas activities could be suspended for up to 60 days which would minimize adverse effects to hunting season(s) under the Proposed Action and Alternatives 3 and 4. The Proposed Action and Alternatives 1 and 2 would have no direct impacts on semi-primitive non-motorized recreation opportunities. Alternatives 3 and 4 could result in direct impacts to semi-primitive non-motorized areas resulting a potential change to the mix of recreation opportunities available in affected areas.

**Issue 5** None to the alternatives would result in direct impacts to National Parks, National Monuments, or Wilderness areas in or adjacent to the Dixie National Forest. Although the potential for indirect adverse effects to the air quality of these areas would be greater under the Proposed Action and Alternatives 3 and 4, impacts are expected to be minor to negligible under all of the alternatives.

**Issue 6** The effects of the alternatives on opportunities to explore for and develop oil and gas resources with the Dixie National Forest depends on the area available for leasing under each alternative as described in the previous section (refer to *Lands Available for Leasing*).

**Issue 7** Some level of exploration and development is considered reasonably foreseeable in all alternatives, including Alternative 1, No Action/No Lease (on existing leases). Because the differences in the RFDS that would occur under each alternative are relatively minor, the socioeconomic effects associated all the alternatives would be very similar with the exception of an oil field development considered reasonably foreseeable in the Proposed Action and Alternatives 3 and 4. The socioeconomic effects that would result under these alternatives would include about twice the total cost per year in materials and labor, slightly less than twice the employment, and slightly less than twice the local wages than those that would be associated with either Alternatives 1 or 2.



**TABLE 2-8**  
**Comparison of Activities Causing Ground Disturbance by Alternative**

GROUND DISTURBING ACTIVITY	ALTERNATIVES				
	Proposed Action	1 <sup>1</sup>	2	3	4
<b>NUMBER AND TYPE OF ACTIVITY CAUSING DISTURBANCE</b>					
<b>EXPLORATION</b>					
Exploratory well pads	8	2	4	9	9
Miles road reconstruction	14.4	3.6	7.2	16.2	16.2
Miles new road construction	18.4	4.6	9.2	20.7	20.7
<b>CO<sub>2</sub> FIELD DEVELOPMENT</b>					
Production well pads	50	25	50	50	50
Gas production plant	2	1	2	2	2
Miles road	35	17.5	35	35	35
Miles pipeline outside of road	35	17.5	35	35	35
Check dams	20	10	20	20	20
<b>OIL &amp; GAS FIELD DEVELOPMENT</b>					
Production well pads	23			23	23
Injection well pads	13			13	13
Outpost well pads	2			2	2
Tank Batteries	4			4	4
Maintenance facilities	1			1	1
Miles road	40			40	40
Miles pipeline outside of road	40			40	40
Check dams	10			10	10
<b>ACRES OF DIRECT DISTURBANCE BY TYPE OF ACTIVITY (gross/net)<sup>2</sup></b>					
<b>EXPLORATION</b>					
Exploratory well pads	18.0/0	4.5/0	9.0/0	20.25/0	20.25/0
Miles road reconstruction	24.48/18.86	6.12/4.72	12.24/9.43	27.54/21.22	27.54/21.22
Miles new road construction	78.2/36.25	19.55/9.06	39.1/18.12	87.98/40.78	87.98/40.78
<b>CO<sub>2</sub> FIELD DEVELOPMENT</b>					
Production well pads	112.5/3	53.6/1.5	112.5/3	112.5/3	112.5/3
Gas production plant	10/10	5/5	10/10	10/10	10/10
Miles roads	109.6/93.4	54.8/46.7	109.6/93.4	109.6/93.4	109.6/93.4
Miles pipeline outside of road	19.4/0	9.7/0	19.4/0	19.4/0	19.4/0
Check dams	5/5	2.5/2.5	5/5	5/5	5/5
<b>OIL &amp; GAS FIELD DEVELOPMENT</b>					
Production well pads	51.75/1.38			51.75/1.38	51.75/1.38
Injection well pads	29.25/0.8			29.25/0.8	29.25/0.8
Outpost well pads	4.5/0			4.5/0	4.5/0
Tank Batteries	6/6			6/6	6/6
Maintenance facilities	0.25/0.25			0.25/0.25	0.25/0.25
Miles road	125.2/106.8			125.2/106.8	125.2/106.8
Miles pipeline out of roads	121.2/0			121.2/0	121.2/0
Check dams	2.5/2.5			2.5/2.5	2.5/2.5
<b>TOTAL GROSS ACRES DISTURBED</b>	<b>717.83</b>	<b>155.70</b>	<b>316.84</b>	<b>732.92</b>	<b>732.92</b>
<b>TOTAL NET ACRES DISTURBED</b>	<b>284.24</b>	<b>69.48</b>	<b>157.07</b>	<b>291.13</b>	<b>291.13</b>

<sup>1</sup> - No Action Alternative

<sup>2</sup> - *gross* acres indicates maximum anticipated disturbance and *net* acres refers to disturbance remaining following reclamation

Note: Blanks indicate no disturbance anticipated



**TABLE 2-9**  
**Acres of Leasing Option by Ranger District &**  
**Oil and Gas Potential Areas for Each Alternative**

Ranger District	Oil and Gas Potential Areas	NL				NSO				TL				CSU				SLT			
		Proposed Action	2	3	4	Proposed Action	2	3	4	Proposed Action	2	3	4	Proposed Action	2	3	4	Proposed Action	2	3	4
Pine Valley	Southern Bull and Northern Pine Valley Mountains	9,400	140,200	9,400	9,400	118,500	28,800	46,300	0	17,500	0	53,100	0	32,600	16,200	69,300	51,500	33,400	26,300	33,400	150,600
	Southern Central Pine Valley Mountains	40,800	115,800	40,800	40,800	75,000	20,400	32,700	2,000	11,500	0	31,000	0	11,600	2,800	34,300	42,600	1,600	1,500	1,600	55,100
	Western & Northern Bull Valley Mountains	0	81,400	0	0	65,400	5,200	11,200	100	2,500	0	11,600	0	32,900	18,900	78,200	12,800	28,300	23,800	28,300	116,300
	<i>subtotal</i>	<i>50,200</i>	<i>337,300</i>	<i>50,200</i>	<i>50,200</i>	<i>258,900</i>	<i>54,500</i>	<i>90,100</i>	<i>2,100</i>	<i>31,600</i>	<i>0</i>	<i>95,700</i>	<i>0</i>	<i>77,100</i>	<i>37,800</i>	<i>181,800</i>	<i>106,900</i>	<i>63,300</i>	<i>51,600</i>	<i>63,300</i>	<i>322,000</i>
Cedar City	Markagunt Plateau	7,100	124,300	7,100	7,100	134,700	102,500	74,800	10,700	24,300	0	33,100	0	187,400	134,300	238,400	131,000	50,800	43,200	50,800	255,500
	<i>subtotal</i>	<i>7,100</i>	<i>124,300</i>	<i>7,100</i>	<i>7,100</i>	<i>134,700</i>	<i>102,500</i>	<i>74,800</i>	<i>10,700</i>	<i>24,300</i>	<i>0</i>	<i>33,100</i>	<i>0</i>	<i>187,400</i>	<i>134,300</i>	<i>238,400</i>	<i>131,000</i>	<i>50,800</i>	<i>43,200</i>	<i>50,800</i>	<i>255,500</i>
Powell	Sevier & Paunsaugant Plateau	0	256,700	0	0	258,600	110,900	115,000	800	33,400	0	75,200	0	85,100	12,900	186,900	136,600	11,500	8,100	11,500	251,300
	<i>subtotal</i>	<i>0</i>	<i>256,700</i>	<i>0</i>	<i>0</i>	<i>258,600</i>	<i>110,900</i>	<i>115,000</i>	<i>800</i>	<i>33,400</i>	<i>0</i>	<i>75,200</i>	<i>0</i>	<i>85,100</i>	<i>12,900</i>	<i>186,900</i>	<i>136,600</i>	<i>11,500</i>	<i>8,100</i>	<i>11,500</i>	<i>251,300</i>
Escalante	Aquarius Plateau	0	39,200	0	0	19,500	43,800	11,700	3,000	38,200	0	40,800	0	37,400	12,600	42,400	41,600	5,400	4,800	5,400	55,700
	Area East of Boulder Mountain	100	51,400	100	100	24,500	8,700	10,600	2,800	23,800	0	35,800	0	11,600	0	13,500	29,100	0	0	0	28,000
	Escalante Anticline	28,600	60,800	28,600	28,600	16,100	9,700	6,400	2,200	13,900	0	20,000	0	11,600	100	15,200	20,200	400	100	400	19,600
	Southern Escalante Mountains	0	94,200	0	0	78,500	61,500	48,600	6,700	33,100	0	37,400	0	84,300	42,100	109,900	88,700	9,600	7,700	9,600	110,100
	<i>subtotal</i>	<i>28,700</i>	<i>245,500</i>	<i>28,700</i>	<i>28,700</i>	<i>138,500</i>	<i>123,600</i>	<i>77,300</i>	<i>14,800</i>	<i>109,000</i>	<i>0</i>	<i>134,000</i>	<i>0</i>	<i>145,000</i>	<i>54,800</i>	<i>181,000</i>	<i>179,700</i>	<i>15,500</i>	<i>12,600</i>	<i>15,500</i>	<i>213,400</i>
Teasdale	Aquarius Plateau	0	77,500	0	3,000	51,800	79,800	22,100	10,900	40,300	0	59,800	0	72,400	7,700	82,600	50,300	4,400	3,900	4,400	107,700
	Area East of Boulder Mountain	0	35,900	0	0	21,900	15,800	7,100	600	26,500	0	39,500	0	3,300	0	5,200	21,000	0	0	0	30,200
	East End of Boulder Mountain	0	17,300	0	0	16,900	12,000	7,700	100	12,400	0	21,200	0	300	300	700	8,200	300	300	300	21,700
	Escalante Anticline	0	300	0	0	100	2,700	100	0	2,100	0	2,100	0	900	0	900	1,000	0	0	0	2,100
	<i>subtotal</i>	<i>0</i>	<i>131,000</i>	<i>0</i>	<i>3,000</i>	<i>90,700</i>	<i>110,300</i>	<i>37,000</i>	<i>11,600</i>	<i>81,300</i>	<i>0</i>	<i>122,600</i>	<i>0</i>	<i>76,900</i>	<i>8,000</i>	<i>89,400</i>	<i>80,500</i>	<i>4,700</i>	<i>4,200</i>	<i>4,700</i>	<i>161,700</i>
<b>Total Acres of Each Leasing Option</b>		<b>86,000</b>	<b>1,094,800</b>	<b>86,000</b>	<b>89,000</b>	<b>881,400</b>	<b>501,800</b>	<b>394,200</b>	<b>40,000</b>	<b>279,600</b>	<b>0</b>	<b>460,600</b>	<b>0</b>	<b>571,500</b>	<b>247,800</b>	<b>877,500</b>	<b>634,700</b>	<b>145,800</b>	<b>119,700</b>	<b>145,800</b>	<b>1,203,900</b>

Note: Alternative 1 (No Action) not shown    NL = No Lease    CSU = Controlled Surface Use    SLT = Standard Lease Terms  
PA = Proposed Action    NSO = No Surface Occupancy    TL = Timing Limitation

Note: Acres generated from the GIS have been rounded to the nearest 100 acres and may not add up to ranger district totals.







**TABLE 2-10**  
**Summary Comparison of Total Acres for**  
**Each Resource by Leasing Option by Alternative**

RESOURCE	Alternative	LEASING OPTION					Total Acres	
		NL	NSO	TL	CSU	SLT		
Threatened, Endangered, Proposed & Sensitive Species	T,E,&P Wildlife <sup>1</sup>	PA	0	0	0	0	238,500	238,500
		2	238,500	0	0	0	0	238,500
		3	0	0	0	0	238,500	238,500
		4	0	0	0	0	238,500	238,500
	T,E,&P Plants <sup>1</sup>	PA	0	0	0	0	7,100	7,100
		2	7,100	0	0	0	0	7,100
		3	0	0	0	0	7,100	7,100
		4	0	0	0	0	7,100	7,100
	Sensitive Wildlife	PA	70,200	322,100	128,600	344,600	0	865,500
		2	530,100	335,400	0	0	0	865,500
		3	70,200	72,900	189,300	533,100	0	865,500
		4	70,200	5,900	0	320,300	469,100	865,500
	Sensitive Plants	PA	77,200	220,900	125,900	187,500	0	611,500
		2	365,400	246,100	0	0	0	611,500
		3	77,200	117,600	190,000	226,700	0	611,500
		4	77,200	9,100	0	209,100	316,100	611,500
Wildlife	Critical Deer Fawning	PA	17,000	98,900	64,900	0	0	180,800
		2	121,900	58,900	0	0	0	180,800
		3	17,000	42,200	121,600	0	0	180,800
		4	17,000	4,400	6,500	75,500	77,400	180,800
	Critical Deer Winter	PA	700	67,600	75,100	0	0	143,400
		2	89,500	53,900	0	0	0	143,400
		3	700	23,300	119,400	0	0	143,400
		4	700	600	0	38,500	103,600	143,400
	Critical Elk Calving	PA	3,900	67,400	83,200	0	0	154,500
		2	95,900	58,600	0	0	0	154,500
		3	3,900	24,600	126,000	0	0	154,500
		4	3,900	9,300	0	65,500	75,800	154,500
	Critical Elk Winter	PA	1,700	115,200	112,200	0	0	229,100
		2	150,100	79,000	0	0	0	229,100
		3	1,700	46,200	181,200	0	0	229,100
		4	1,700	2,300	0	73,400	151,700	229,100
	Sage Grouse Leaks	PA	0	0	3,800	0	0	3,800
		2	0	3,800	0	0	0	3,800
		3	0	0	3,800	0	0	3,800
		4	0	0	0	0	3,800	3,800
Roadless	Rare II Areas (Owens 11/89)	PA	86,000	307,200	0	0	0	393,200
		2	393,200	0	0	0	0	393,200
		3	86,000	91,300	52,000	163,900	0	393,200
		4	86,000	14,500	0	86,000	203,600	393,200
Vegetation	Riparian & Wetlands	PA	1,100	32,100	0	0	0	33,200
		2	33,200	0	0	0	0	33,200
		3	1,100	32,100	0	0	0	33,200
		4	1,100	2,300	0	29,800	0	33,200
Watersheds & Soils/ Geologic Hazards	Aquifers (sensitive)	PA	8,500	131,400	81,800	103,300	25,500	350,500
		2	350,500	0	0	0	0	350,500
		3	8,500	54,800	129,200	132,600	25,500	350,500
		4	8,500	20,100	0	137,200	184,800	350,500
	Streams & Lakes	PA	1,100	32,100	0	0	0	33,200
		2	33,200	0	0	0	0	33,200
		3	1,100	32,100	0	0	0	33,200
		4	1,100	2,300	0	29,800	0	33,200
	Municipal Watersheds	PA	3,800	39,600	0	0	0	43,400
		2	31,300	12,100	0	0	0	43,400
		3	3,800	39,600	0	0	0	43,400
		4	3,800	1,800	14,000	23,800	0	43,400

PA - Proposed Action

NL= No Lease

NSO = No Surface Occupancy

CSU = Controlled Surface Use

TL = Timing Limitation

SLT = Standard Lease Terms

<sup>1</sup> Protection of all threatened, endangered, and proposed wildlife and plant species would be stipulated in a Lease Notice attached to leases.

<sup>2</sup> Leasing options applied to hunting seasons would be based on affected big game units.



**TABLE 2-10**  
**Summary Comparison of Total Acres for**  
**Each Resource by Leasing Option by Alternative**

RESOURCE	Alternative	LEASING OPTION					Total Acres	
		NL	NSO	TL	CSU	SLT		
Rockfall & Landslide Areas Slopes >40% Areas of High Erosion Potential Marginally Unstable Slopes	PA	0	16,400	0	0	0	16,400	
	2	14,700	1,700	0	0	0	16,400	
	3	0	16,400	0	0	0	16,400	
	4	0	16,400	0	0	0	16,400	
	PA	38,000	230,200	0	0	0	268,200	
	2	268,200	0	0	0	0	268,200	
	3	38,000	230,200	0	0	0	268,200	
	4	38,000	7,900	0	222,300	0	268,300	
	PA	9,700	87,900	0	0	0	97,600	
	2	73,200	24,600	0	0	0	97,800	
	3	9,700	87,900	0	0	0	97,600	
	4	9,700	1,400	11,000	75,500	0	97,600	
	PA	0	46,200	1,500	8,200	600	56,500	
	2	43,800	8,900	0	3,800	0	56,500	
	3	0	37,900	12,400	6,000	200	56,500	
	4	0	23,100	0	25,100	8,300	56,500	
Recreation	Developed Sites	PA	0	13,500	0	0	0	13,500
		2	6,700	6,800	0	0	0	13,500
		3	0	13,500	0	0	0	13,500
		4	0	13,500	0	0	0	13,500
	Semi-Primitive Non-Motorized	PA	0	508,100	0	0	0	508,100
		2	508,100	0	0	0	0	508,100
		3	0	171,100	103,500	233,500	0	508,100
		4	0	8,600	0	193,300	306,200	508,100
	Hunting Season	PA	-- <sup>2</sup>	-- <sup>2</sup>	-- <sup>2</sup>	-- <sup>2</sup>	-- <sup>2</sup>	-- <sup>2</sup>
		2	-- <sup>2</sup>	-- <sup>2</sup>	-- <sup>2</sup>	-- <sup>2</sup>	-- <sup>2</sup>	-- <sup>2</sup>
		3	-- <sup>2</sup>	-- <sup>2</sup>	-- <sup>2</sup>	-- <sup>2</sup>	-- <sup>2</sup>	-- <sup>2</sup>
		4	-- <sup>2</sup>	-- <sup>2</sup>	-- <sup>2</sup>	-- <sup>2</sup>	-- <sup>2</sup>	-- <sup>2</sup>
	High Recreation Areas	PA	0	29,100	0	0	0	29,100
		2	20,700	8,400	0	0	0	29,100
		3	0	29,100	0	0	0	29,100
		4	0	700	0	18,700	9,700	29,100
Visual Resources	VQO Retention	PA	600	194,200	60,900	137,300	0	393,000
		2	217,000	176,000	0	0	0	393,000
		3	600	102,500	98,200	191,400	0	393,000
		4	600	31,000	0	361,400	0	393,000
	VQO Partial Retention	PA	2,600	374,200	150,500	407,900	0	935,200
		2	452,100	235,800	133,900	113,400	0	935,200
		3	2,600	165,100	221,200	546,300	0	935,200
		4	2,600	6,800	0	149,000	776,800	935,200
Special Areas	Recreation Residences	PA	0	100	0	0	0	100
		2	0	100	0	0	0	100
		3	0	100	0	0	0	100
		4	0	100	0	0	0	100
	Research Natural Areas	PA	0	2,300	0	0	0	2,300
		2	2,100	200	0	0	0	2,300
		3	0	2,300	0	0	0	2,300
		4	0	2,300	0	0	0	2,300
	Ski Area	PA	0	1,400	0	0	0	1,400
		2	100	1,300	0	0	0	1,400
		3	0	1,400	0	0	0	1,400
		4	0	0	0	1,400	0	1,400
	# Management Areas	PA	0	261,200	0	0	0	261,200
		2	212,400	48,800	0	0	0	261,200
		3	0	98,000	69,900	93,300	0	261,200
		4	0	27,100	0	122,400	111,700	261,200

PA - Proposed Action

NL= No Lease

NSO = No Surface Occupancy

CSU = Controlled Surface Use

TL = Timing Limitation

SLT = Standard Lease Terms

<sup>1</sup> Protection of all threatened, endangered, and proposed wildlife and plant species would be stipulated in a Lease Notice attached to leases.

<sup>2</sup> Leasing options applied to hunting seasons would be based on affected big game units.



**TABLE 2-11**  
**Detailed Comparison of Total Acres for Each Resource**  
**by Leasing Option by Alternative by Ranger District**

RESOURCE	Alternative	CEDAR CITY					PINE VALLEY					POWELL					ESCALANTE					TEASDALE					
		NL	NSO	TL	CSU	SLT	NL	NSO	TL	CSU	SLT	NL	NSO	TL	CSU	SLT	NL	NSO	TL	CSU	SLT	NL	NSO	TL	CSU	SLT	
Threatened, Endangered, Proposed & Sensitive Species	T,E,&P Wildlife <sup>1</sup>	PA	0	0	0	0	34,100	0	0	0	0	78,500	0	0	0	0	57,600	0	0	0	0	46,700	0	0	0	0	21,600
		2	34,100	0	0	0	0	0	78,500	0	0	0	0	0	0	0	0	46,700	0	0	0	0	0	0	0	0	0
		3	0	0	0	0	34,100	0	0	0	0	78,500	0	0	0	0	57,600	0	0	0	0	46,700	0	0	0	0	21,600
		4	0	0	0	0	34,100	0	0	0	0	78,500	0	0	0	0	57,600	0	0	0	0	46,700	0	0	0	0	21,600
	T,E,&P Plants <sup>1</sup>	PA	0	0	0	0	1,800	0	0	0	0	0	0	0	0	900	0	0	0	0	2,400	0	0	0	0	2,000	
		2	1,800	0	0	0	0	0	0	0	0	0	900	0	0	0	2,400	0	0	0	0	0	0	0	0	0	
		3	0	0	0	0	1,800	0	0	0	0	0	0	0	0	900	0	0	0	0	2,400	0	0	0	0	2,000	
		4	0	0	0	0	1,800	0	0	0	0	0	0	0	0	900	0	0	0	0	2,400	0	0	0	0	2,000	
	Sensitive Wildlife	PA	6,600	56,500	24,600	127,200	0	48,000	30,500	4,900	8,200	0	0	111,900	31,300	41,800	0	15,600	60,100	38,100	135,700	0	0	63,100	29,700	31,800	
		2	62,200	152,700	0	0	0	81,500	10,000	0	0	0	147,900	37,000	0	0	159,300	90,200	0	0	0	0	79,200	45,400	0	0	
		3	6,600	22,500	14,100	171,700	0	48,000	4,400	17,700	21,400	0	0	14,100	69,100	101,800	0	15,600	24,000	49,500	160,400	0	0	7,900	38,900	77,800	
		4	6,600	5,700	0	81,300	121,300	48,000	200	0	17,400	25,900	0	0	0	10,300	174,700	15,600	0	0	133,100	100,800	0	0	0	0	78,200
	Sensitive Plants	PA	700	6,200	6,100	4,300	0	49,200	60,300	6,000	15,800	0	0	60,800	10,100	57,800	0	27,300	41,800	39,700	45,000	0	0	51,800	63,900	64,500	
		2	5,900	11,600	0	0	0	111,800	19,500	0	0	0	55,600	73,200	0	0	106,400	47,500	0	0	0	0	85,800	94,500	0	0	
		3	700	5,200	6,400	5,100	0	49,200	19,400	29,200	33,500	0	0	50,700	15,300	62,700	0	27,300	22,900	49,700	54,000	0	0	19,400	89,400	71,400	
		4	700	700	0	5,300	10,700	49,200	2,000	0	23,000	57,100	0	0	700	0	60,500	67,600	27,300	2,300	0	64,800	59,500	0	3,400	55,600	
Wildlife	Critical Deer Fawning	PA	0	9,200	17,100	0	0	17,000	58,700	12,500	0	0	0	20,200	25,600	0	0	4,600	5,400	0	0	0	6,200	4,200	0	0	
		2	8,500	17,800	0	0	0	75,700	12,500	0	0	0	20,000	25,800	0	0	8,500	1,600	0	0	0	9,200	1,200	0	0	0	
		3	0	5,800	20,500	0	0	17,000	19,400	51,700	0	0	0	13,900	31,900	0	0	1,300	8,700	0	0	0	1,800	8,600	0	0	
		4	0	1,200	6,500	18,600	0	17,000	2,000	0	19,700	49,500	0	0	0	21,800	24,100	0	600	7,900	1,600	0	600	26,800	0	7,500	
	Critical Deer Winter	PA	0	7,000	3,100	0	0	300	26,400	17,100	0	0	0	2,600	100	0	0	400	6,900	28,000	0	0	0	24,700	26,800	0	0
		2	5,900	4,200	0	0	0	32,200	11,700	0	0	0	2,700	0	0	0	16,100	19,100	0	0	0	32,500	18,900	0	0	0	
		3	0	1,600	8,500	0	0	300	7,700	35,800	0	0	0	500	2,200	0	0	400	4,600	30,300	0	0	0	8,900	42,600	0	0
		4	0	0	0	1,600	8,500	300	0	0	9,000	34,500	0	0	0	0	600	2,100	400	0	13,100	21,800	0	600	14,200	36,600	0
	Critical Elk Calving	PA	0	800	4,200	0	0	3,900	12,700	3,000	0	0	0	4,200	4,200	0	0	25,500	34,000	0	0	0	24,200	37,800	0	0	
		2	200	4,700	0	0	0	17,300	2,300	0	0	0	4,300	4,100	0	0	37,600	22,000	0	0	0	36,500	25,600	0	0	0	
		3	0	800	4,200	0	0	3,900	5,500	10,200	0	0	0	1,400	7,000	0	0	7,500	52,100	0	0	0	9,600	52,500	0	0	
		4	0	0	0	800	4,200	3,900	0	0	6,800	8,900	0	0	0	0	2,900	5,500	0	3,400	0	29,400	26,700	0	5,900	25,600	
	Critical Elk Winter	PA	0	200	1,500	3,200	0	0	0	0	0	0	0	41,200	7,300	0	2,200	1,100	0	1,400	0	10,000	2,900	1,900	0	0	
		2	0	4,600	200	0	0	0	0	0	0	0	40,300	8,200	0	0	3,900	900	0	0	0	0	3,900	9,100	0	0	
		3	0	300	4,500	0	0	0	0	0	0	0	0	4,800	43,600	0	0	0	4,800	0	0	0	0	3,900	9,100	0	0
		4	0	0	0	200	4,700	0	0	0	0	0	0	0	0	12,000	36,300	0	0	300	4,500	0	0	2,600	10,400	0	
	Sage Grouse Leaks	PA	0	0	600	0	0	0	0	0	0	0	0	2,300	2,300	0	0	0	0	0	0	0	900	900	0	0	
		2	0	600	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	900	0	0	
		3	0	0	600	0	0	0	0	0	0	0	0	0	2,300	0	0	0	0	0	0	0	0	900	0	0	
		4	0	0	0	600	0	0	0	0	0	0	0	0	0	2,300	0	0	0	0	0	0	0	0	900	0	
	Roadless	Rare II Areas (Owens 11/89)	PA	7,100	7,600	0	0	0	50,200	74,400	0	0	0	0	136,200	0	0	28,700	25,000	0	0	0	64,000	0	0	0	0
			2	14,600	0	0	0	0	124,600	0	0	0	0	136,200	0	0	53,700	0	0	0	0	0	0	22,500	0	41,500	0
			3	7,100	0	0	7,600	0	50,200	0	74,400	0	0	0	68,700	52,000	15,500	0	28,700	0	25,000	0	0	6,800	0	57,200	0
			4	7,100	0	0	0	7,600	50,200	0	0	74,400	0	0	200	0	86,100	46,900	28,700	7,600	0	17,500	0	6,800	0	0	0
Vegetation	Riparian & Wetlands	PA	200	8,500	0	0	500	3,600	0	0	0	0	4,700	0	0	400	8,600	0	0	0	6,700	0	0	0	0	0	
		2	8,700	0	0	0	4,100	0	0	0	0	4,700	0	0	9,000	0	0	0	0	0	0	0	6,700	0	0	0	
		3	200	8,500	0	0	500	3,600	0	0	0	0	4,700	0	0	400	8,600	0	0	0	0	0	6,700	0	0	0	
		4	200	1,500	0	7,000	500	200	0	3,400	0	0	0	0	4,700	0	400	300	8,300	0	0	0	300	0	6,500	0	
Watersheds & Soils/ Geologic Hazards	Aquifers (sensitive)	PA	0	3,300	100	5,400	7,300	2,900	17,200	8,400	21,400	11,700	0	6,500	2,000	15,100	3,300	5,600	58,200	43,900	49,300	2,800	86,200	0	0	0	
		2	16,100	0	0	0	0	61,700	0	0	0	0	26,800	0	0	159,700	0	0	0	0	0	0	0	0	0	0	
		3	0	3,200	100	5,500	7,300	2,900	6,500	13,300	27,300	11,700	0	1,500	3,100	18,900	3,300	5,600	27,800	63,400	60,100	2,800	6,700	15,800	49,300	20,600	
		4	0	700	0	5,600	9,800	2,900	1,100	0	10,200	47,400	0	0	0	2,900	23,900	5,600	10,200	0	79,300	64,600	0	8,100	39,000	39,100	
	Streams & Lakes	PA	200	8,500	0	0	500	3,600	0	0	0	0	4,700	0	0	400	8,600	0	0	0	6,700	0	0	0	0	0	
		2	8,700	0	0	0	4,100	0	0	0	0	4,700	0	0	9,000	0	0	0	0	0	0	0	6,700	0	0	0	
		3	200	8,500	0	0	500	3,600	0	0	0	0	4,700	0	0	400	8,600	0	0	0	0	0	6,700	0	0	0	
		4	200	1,500	0	7,000	500	200	0	3,400	0	0	0	0	4,700	0	400	300	8,300	0	0	0	300	0	6,500	0	
	Municipal Watersheds	PA	100	14,000	0	0	3,700	11,100	0	0	0	0	0	4,900	0	0	6,400	0	0	0	2,300	800	0	0	0	0	
		2	6,700	7,400	0	0	12,800	2,100	0	0	0	0	3,100	1,800	0	0	0	6,500	0	0	0	0	3,100	0	0	0	
		3	100	14,000	0	0	3,700	11,100	0	0	0	0	0	4,900	0	0	0	700	0	5,800	0	0	900	0	2,200	0	
		4	100	0	14,000	0	0	3,700	200	0	10,900	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	

PA - Proposed Action      NL= No Lease      CSU = Controlled Surface Use      SLT = Standard Lease Terms  
 NSO = No Surface Occupancy      TL = Timing Limitation

<sup>1</sup> Protection of all threatened, endangered, and proposed wildlife and plant species would be stipulated in a Lease Notice attached to leases.  
<sup>2</sup> Leasing options applied to hunting seasons would be based on affected big game units.

Note: Acres generated from the GIS have been rounded to the nearest 100 acres and may not add up to ranger district totals.







TABLE 2-11 (cont.)  
Detailed Comparison of Total Acres for Each Resource  
by Leasing Option by Alternative by Ranger District

RESOURCE	Alternative	CEDAR CITY					PINE VALLEY					POWELL					ESCALANTE					TEASDALE					
		NL	NSO	TL	CSU	SLT	NL	NSO	TL	CSU	SLT	NL	NSO	TL	CSU	SLT	NL	NSO	TL	CSU	SLT	NL	NSO	TL	CSU	SLT	
Watersheds & Soils/ Geologic Hazards (cont.)	Rockfall & Landslide Areas	PA	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	9,100	0	0	0	0	0	7,300	0	0
		2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	8,300	800	0	0	0	6,400	900	0	0	
		3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	9,100	0	0	0	0	7,300	0	0	
		4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	9,100	0	0	0	0	7,300	0	0	
	Slopes >40%	PA	3,700	38,200	0	0	0	24,900	56,100	0	0	0	0	74,200	0	0	0	9,400	42,100	0	0	0	0	19,600	0	0	
		2	41,900	0	0	0	0	80,900	0	0	0	0	74,200	0	0	0	51,500	0	0	0	0	19,600	0	0	0		
		3	3,700	38,200	0	0	0	24,900	56,100	0	0	0	0	74,200	0	0	0	9,400	42,100	0	0	0	0	19,600	0	0	
		4	3,700	1,200	0	37,000	0	24,900	100	0	56,000	0	0	0	0	74,100	0	9,400	3,700	0	38,300	0	0	2,900	0	16,700	
	Areas of High Erosion Potential	PA	1,000	11,300	0	0	0	8,700	26,900	0	0	0	0	26,500	0	0	0	0	22,300	0	0	0	0	900	0	0	
		2	7,500	4,800	0	0	0	28,800	6,900	0	0	0	19,900	6,600	0	0	0	16,700	5,700	0	0	0	300	600	0	0	
		3	1,000	11,300	0	0	0	8,700	26,900	0	0	0	0	26,500	0	0	0	0	22,300	0	0	0	0	900	0	0	
		4	1,000	300	11,000	0	0	8,700	0	0	26,900	0	0	600	0	25,900	0	0	500	0	21,800	0	0	0	0	900	
	Marginally Unstable Slopes	PA	0	9,100	0	5,700	400	0	0	0	0	0	0	7,800	100	100	100	0	18,300	1,300	2,400	100	0	11,000	200	0	
		2	7,600	4,300	0	3,100	0	0	0	0	0	0	7,800	100	0	100	0	18,400	3,300	0	400	0	10,000	1,200	0	0	
		3	0	5,600	9,100	400	0	0	0	0	0	0	0	5,800	400	1,700	100	0	15,800	2,400	3,900	100	0	10,700	500	0	
		4	0	0	0	11,200	3,900	0	0	0	0	0	0	0	0	6,500	1,500	0	12,700	4,000	6,700	2,700	0	10,400	0	600	
Recreation	Developed Sites	PA	0	10,600	0	0	0	0	2,100	0	0	0	0	200	0	0	0	0	500	0	0	0	0	100	0	0	
		2	4,700	5,900	0	0	0	1,600	500	0	0	0	0	200	0	0	0	300	200	0	0	0	100	0	0	0	
		3	0	10,600	0	0	0	0	2,100	0	0	0	0	200	0	0	0	0	500	0	0	0	0	100	0	0	
		4	0	10,600	0	0	0	0	2,100	0	0	0	0	200	0	0	0	0	500	0	0	0	0	100	0	0	
	Semi-Primitive Non-Motorized	PA	0	58,100	0	0	0	0	198,300	0	0	0	0	201,300	0	0	0	0	49,100	0	0	0	0	1,300	0	0	
		2	58,100	0	0	0	0	198,300	0	0	0	201,300	0	0	0	0	49,100	0	0	0	0	1,300	0	0	0		
		3	0	14,400	3,400	40,300	0	0	57,900	56,100	84,300	0	0	78,200	36,500	86,700	0	0	20,600	7,400	21,100	0	0	100	1,100	0	
		4	0	1,900	0	27,500	28,700	0	600	0	59,800	137,900	0	600	0	77,700	123,100	0	5,500	0	28,200	15,500	0	0	100	1,100	
	Hunting Season	PA	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	
		2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	
		3	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	
		4	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	
	High Recreation Areas	PA	0	3,200	0	0	0	0	0	0	0	0	0	25,900	0	0	0	0	0	0	0	0	0	0	0	0	
		2	700	2,500	0	0	0	0	0	0	0	0	20,000	5,900	0	0	0	0	0	0	0	0	0	0	0	0	
		3	0	3,200	0	0	0	0	0	0	0	0	0	25,900	0	0	0	0	0	0	0	0	0	0	0	0	
		4	0	0	0	3,100	100	0	0	0	0	0	0	700	0	15,600	9,600	0	0	0	0	0	0	0	0	0	
Visual Resources	VQO Retention	PA	0	50,500	1,100	46,900	0	0	13,700	3,100	9,000	0	0	29,200	5,900	18,800	0	600	64,900	34,700	45,200	0	0	36,200	16,100	17,400	
		2	37,700	60,700	0	0	0	13,800	11,900	0	0	0	25,200	28,700	0	0	0	92,400	53,000	0	0	0	47,900	21,700	0	0	
		3	0	31,400	2,200	64,900	0	0	6,900	4,800	14,000	0	0	21,900	8,200	23,700	0	600	27,700	53,100	63,900	0	0	14,600	29,900	25,000	
		4	0	9,700	0	88,700	0	0	1,500	0	24,200	0	0	700	0	53,200	0	600	11,000	0	133,800	0	0	8,100	0	61,500	
	VQO Partial Retention	PA	0	56,100	15,500	139,500	0	0	92,100	12,800	63,600	0	0	134,400	17,600	60,600	0	2,600	58,000	53,900	92,100	0	0	33,600	50,700	52,100	
		2	49,500	27,700	133,900	0	0	106,700	23,900	0	37,800	0	138,300	61,500	0	12,800	0	99,700	52,100	0	54,700	0	57,900	70,600	0	8,000	
		3	0	23,500	20,500	167,100	0	0	35,300	34,000	99,200	0	0	56,100	40,000	116,600	0	2,600	37,000	59,000	108,100	0	0	13,200	67,800	55,500	
		4	0	800	0	22,500	187,800	0	600	0	34,700	133,200	0	0	0	47,100	165,500	2,600	2,900	0	34,100	167,100	0	2,600	0	10,600	
Special Areas	Recreation Residences	PA	0	100	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
		2	0	100	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
		3	0	100	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
		4	0	100	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
	Research Natural Areas	PA	0	100	0	0	0	0	0	0	0	0	0	600	0	0	0	0	1,600	0	0	0	0	0	0	0	
		2	100	0	0	0	0	0	0	0	0	0	600	0	0	0	1,400	200	0	0	0	0	0	0	0		
		3	0	100	0	0	0	0	0	0	0	0	0	600	0	0	0	0	1,600	0	0	0	0	0	0	0	
		4	0	100	0	0	0	0	0	0	0	0	0	600	0	0	0	0	1,600	0	0	0	0	0	0	0	
	Ski Area	PA	0	1,400	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
		2	100	1,200	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
		3	0	1,400	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
		4	0	0	0	1,400	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
# Management Areas	PA	0	45,100	0	0	0	0	29,100	0	0	0	0	99,600	0	0	0	0	56,700	0	0	0	0	30,700	0	0		
	2	26,700	18,400	0	0	0	23,800	5,300	0	0	0	87,400	12,300	0	0	47,000	9,700	0	0	0	27,500	3,200	0	0			
	3	0	17,200	4,900	23,000	0	0	13,300	9,400	6,500	0	0	34,100	24,500	41,000	0	0	22,400	17,500	16,800	0	0	11,000	13,600	6,000		
	4	0	10,700	0	13,800	20,700	0	2,100	0	14,500	12,500	0	800	0	33,200	65,700	0	6,800	0	39,900	9,900	0	6,700	0	21,000		

PA - Proposed Action  
 NL = No Lease  
 NSO = No Surface Occupancy  
 CSU = Controlled Surface Use  
 TL = Timing Limitation  
 SLT = Standard Lease Terms

<sup>1</sup> Protection of all threatened, endangered, and proposed wildlife and plant species would be stipulated in a Lease Notice attached to leases.

<sup>2</sup> Leasing options applied to hunting seasons would be based on affected big game units.

Note: Acres generated from the GIS have been rounded to the nearest 100 acres and may not add up to ranger district totals.



# FOREST PLAN ALTERNATIVE: PROPOSED ACTION

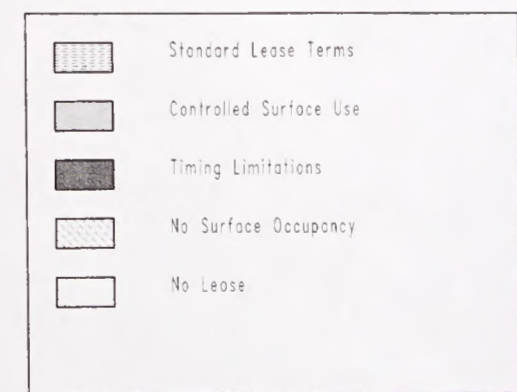


## USDA Forest Service Dixie National Forest



Developed Sites: NSO  
 SPNM: NSO  
 High Recreation: NSO  
 Roadless Areas: NSO  
 Recreation Residences: NSO  
 Research Natural Areas: NSO  
 Ski Areas: NSO  
 # Areas: NSO  
 TEP Species: LN  
 Sensitive Species: CSU  
 VQO Retention: CSU  
 VQO Partial Retention: CSU  
 Sensitive Aquifers: SL7  
 High Erosion: NSO  
 Marginally Unstable: SL7  
 Municipal Watersheds: NSO  
 Riparian: NSO  
 Rockfall/Landslide: NSO  
 Slope Exceeds Forty Percent: NSO  
 Critical Habitat: TL

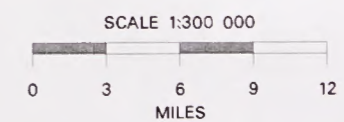
ACREAGE TOTALS  
 Standard Lease Terms: 127436  
 Controlled Surface Use: 678976  
 Timing Limitations: 220925  
 No Surface Occupancy: 856786  
 No Lease: 86140



General Area



Prepared by USDA Forest Service  
 Dixie National Forest GIS Staff  
 Using ARC/INFO GIS Software  
 April 1995



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# ALTERNATIVE 2: FOREST PLAN MODIFICATION A



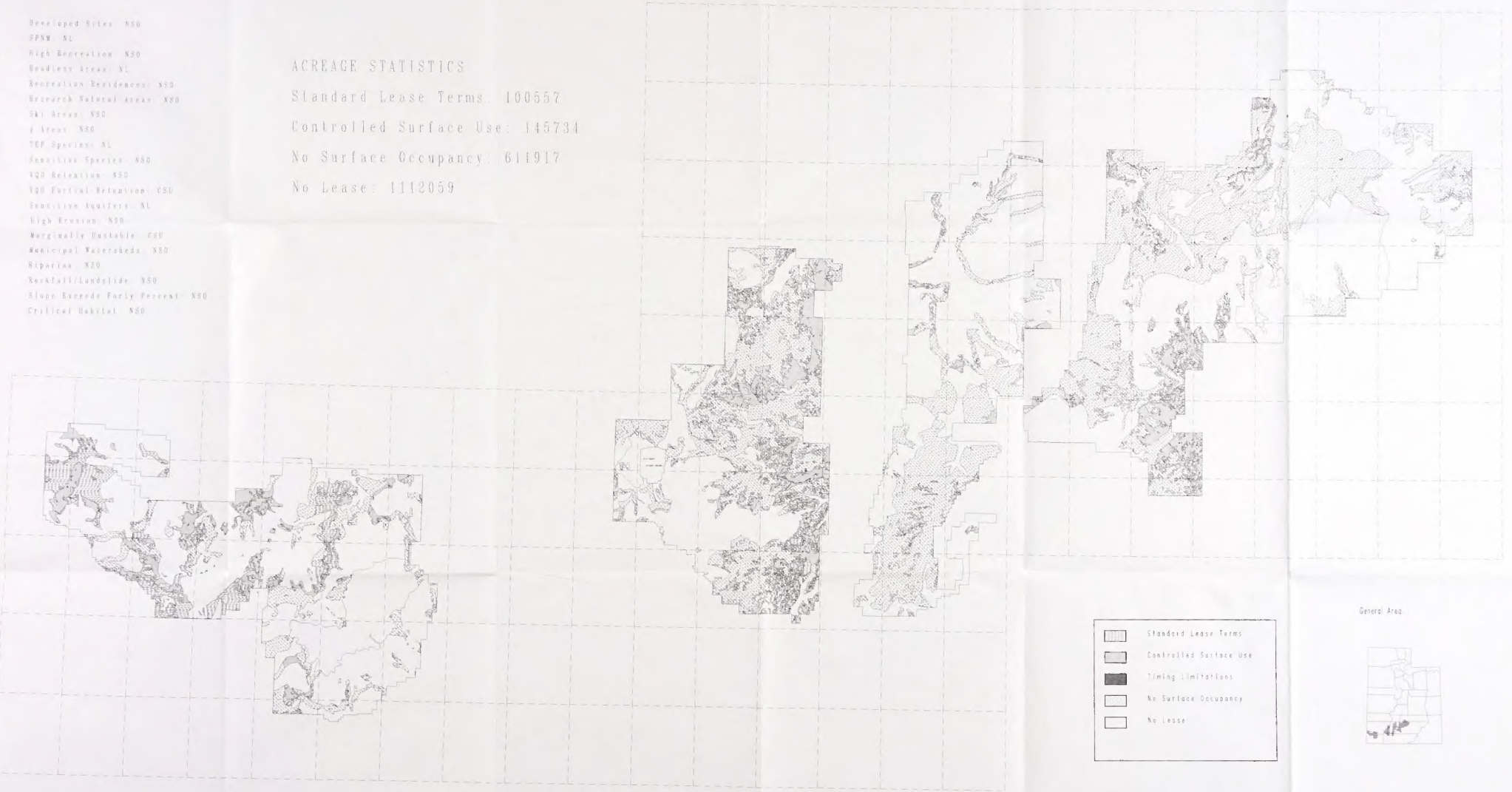
USDA Forest Service  
Dixie National Forest



- Developed Sites: NSD
- SPNV: NL
- High Recreation: NSD
- Wilderness Areas: NL
- Seclusion Residences: NSD
- Research Natural Areas: NSD
- Ski Areas: NSD
- J Areas: NSD
- TEP Springs: NL
- Sensitive Species: NSD
- Y2D Recreation: NSD
- Y2D Furbill Recreation: NSD
- Sensitive Aquifers: NL
- High Erosion: NSD
- Marginally Unstable: NSD
- Waterfowl Waterbeds: NSD
- Riparian: NSD
- Rockfall/Landslide: NSD
- Slope Exceeds Forty Percent: NSD
- Critical Habitat: NSD

## ACREAGE STATISTICS

Standard Lease Terms: 100557  
 Controlled Surface Use: 145734  
 No Surface Occupancy: 611917  
 No Lease: 1112059

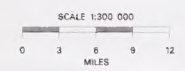


	Standard Lease Terms
	Controlled Surface Use
	Timing Limitations
	No Surface Occupancy
	No Lease

General Area



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# ALTERNATIVE 3: FOREST PLAN MODIFICATION B



## USDA Forest Service Dixie National Forest



- Developed Sites: NSD
- SPNM: CSU
- High Recreation: NSD
- Roadless Areas: CSU
- Recreation Reservations: NSD
- Research Natural Areas: NSD
- Ski Areas: NSD
- T Areas: CSU
- TEP Species: LN
- Sensitive Species: CSU
- YQO Retention: CSU
- YQO Partial Retention: CSU
- Sensitive Aquifers: LN
- High Erosion: NSD
- Marginally Unstable: SLT
- Municipal Watersheds: NSD
- Riparian: NSD
- Rockfall/Landslide: NSD
- Slope Exceeds Forty Percent: NSD
- Critical Habitat: TL

**ACREAGE STATISTICS**

- Standard Lease Terms: 127439
- Controlled Surface Use: 1029263
- Timing Limitations: 403786
- No Surface Occupancy: 329618
- No Lease: 96140

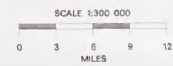


	Standard Lease Terms
	Controlled Surface Use
	Timing Limitations
	No Surface Occupancy
	No Lease

General Area



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# ALTERNATIVE 4: FOREST PLAN MODIFICATION C

USDA Forest Service  
Dixie National Forest



- Developed Sites: NSD
- SPSM: SLT
- High Renewal: SLT
- Roadless Areas: SLT
- Recreation Residences: SLT
- Research Natural Areas: NSD
- Ski Areas: CSU
- r Areas: SLT
- TEP Springs: LN
- Sensitive Species: SLT
- VQO Retention: CSU
- VQO Partial Retention: SLT
- Sensitive Aquifers: SLT
- High Erosion: CSU
- Marginally Unsuitable: SLT
- Municipal Watersheds: CSU
- Riparian: CSU
- Rockfall/Landslide: NSD
- Slope Exceeds Forty Percent: CSU
- Critical Habitat: SLT

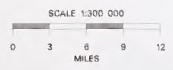
## ACREAGE STATISTICS

Standard Lease Terms: 1275829  
 Controlled Surface Use: 568884  
 Timing Limitations: 0  
 No Surface Occupancy: 39414  
 No Lease: 86140



	Standard Lease Terms
	Controlled Surface Use
	Timing Limitations
	No Surface Occupancy
	No Lease

General Area



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 Dixie National Forest GIS Staff  
 Using ARC/INFO GIS Software  
 April 1995

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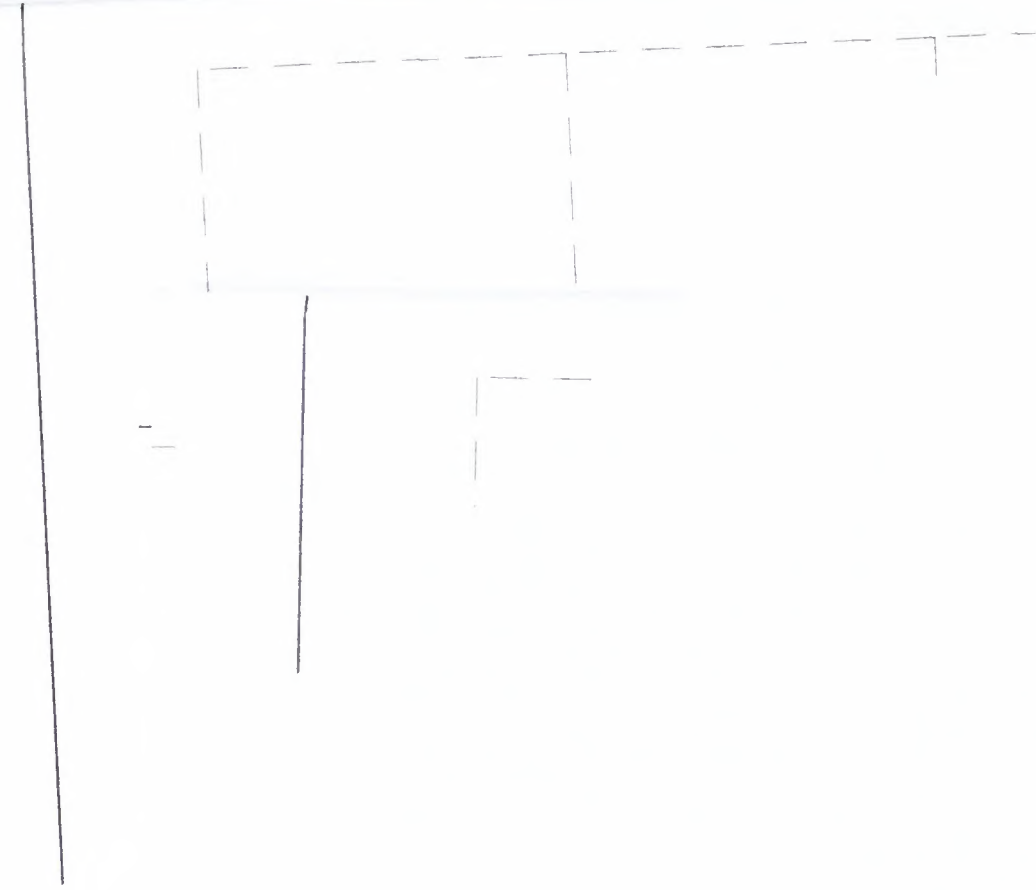
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**CHAPTER 3**

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***AFFECTED ENVIRONMENT***







**INTRODUCTION**

The purpose of this chapter is to describe the existing condition of the physical, biological, social and economic resources of the environment that may be affected by the implementation of any of the alternatives. Separate background reports were prepared for each of the resources discussed below. These unpublished reports are located in the project files at the Forest Supervisors' Offices. This information serves as a "base line" by which to measure the potential effects of the leasing options and alternatives discussed in Chapter 4 (Environmental Consequences). All resources relevant to this project are addressed; however, discussions focus on the resources related to the key issues. The existing condition of the resources also provides the context for assessing how the alternatives respond to the issues.

**TABLE 3-1  
Mineral Rights by Surface Ownership**

Surface Ownership	Mineral Ownership	Acres	Percent
Federal	Federal	1,865,941	94.9%
Non-Federal	Federal	3,698	0.2
Federal	Non-Federal	18,006	0.9
Non-Federal	Non-Federal	79,651	4.0
Total Acres		1,967,296	100

The study area covers 1,967,296 acres within the administrative boundary of the Dixie National Forest in southern Utah (Table 3-1). Within the Forest, the Federal government administers 1,883,947 acres of surface rights composed of four large land areas. The Forest also administers 1,869,639 acres of subsurface rights for oil and gas within its boundary. These lands will be managed in conformance with the standards and guidelines of the Dixie National Forest Land and Resource Management Plan (Forest Plan).

A summary of the management direction developed by the Forest Service to manage these lands, as documented in the Forest Plans, is provided below prior to the description of the affected environment.

The order in which the resource descriptions of the affected environment appear corresponds with the order of the issues and concerns identified during the scoping process, as presented previously in Chapter 2. Table 3-2 displays the relationship of the resources and the issues. For example, the description of the affected environment for Issue 1, a concern for the effects on wildlife and their habitat, is contained in the resource section titled *Wildlife and Fisheries*.

**FOREST PLAN MANAGEMENT DIRECTION**

The Dixie National Forest Land and Resource Management Plan (Forest Plan), 1986, guides all natural resource management activities and establishes management standards and guidelines for the Dixie National Forest. These documents describe resource management practices, levels of resource production



**TABLE 3-2  
Relationship of Resources to Issues**

Resource	Issue Number
Threatened, Endangered, Proposed, & Sensitive Species	1 & 3
Wildlife & Fisheries	1 & 3
Roadless Areas	2 & 5
Vegetation	3
Water	3
Air Quality	5
Soils	3
Recreation	4
Visual Resources	4
Socioeconomics	7
Minerals/Geology	6
Transportation System	--
Wild and Scenic Rivers	2
Cultural Resources	--
Special Areas	--

and management practices, and the availability and suitability of lands for resource management. The Forest Plans provide Forest-wide goals and objectives, and standards and guidelines. The following discussion highlights the Forest-wide goals and objectives, and the standards and guidelines that are most relevant to the issues, proposed action, and alternatives presented in this EIS. The management direction from the Dixie Forest Plan is presented by resource.

**Wildlife and Fish Resources**

A goal of the Forest is to manage to improve the quantity and quality of aquatic habitats through direct habitat improvement and coordination with other land use programs. Another goal is to maintain or enhance the terrestrial habitat for all wildlife species that presently occur on the Forest.

Management direction for Wildlife and Fish Resources are found in the Dixie National Forest Plan page IV-33 through 36. Some standards and guidelines include:

- Manage habitat for viable populations of all existing vertebrate wildlife species
- Manage waters capable of supporting self-sustaining trout populations to provide for those populations
- Manage and provide for recovery of endangered and threatened species
- Provide maximum habitat diversity.

**Water (Surface and Ground) Resources**

A goal of the Forest is to provide guidance to other resource activities to protect or improve water quality and quantity.

Management direction for Water Resources are found in the Dixie National Forest Plan page IV-42 and 43. Some standards and guidelines include:

- Maintain needed instream flows and protect public property and resources.
- Improve or maintain water quality to meet state water quality standards.



- Evaluate all management activities within 100 feet of any spring for impacts on springflow, riparian habitat and soil disturbance.
- Rehabilitate disturbed areas that are contributing sediment directly to perennial streams as a result of management activities to maintain water quality and re-establish riparian vegetation.
- Reduce erosion to natural rate in the season of disturbance and sediment yields within one year of the activity through necessary mitigation measures, such as water barring and re-vegetation when erosion is caused by management activities.

### **Air Quality**

Management direction for air resources are found in the Dixie National Forest Plan page IV-55. Some standards and guidelines include:

- Comply with State and Federal Air Quality Standards (FSM 2120 and 5180).

### **Soils/Geomorphology Resources**

A goal of the Forest is to provide guidance to other resource activities to protect or improve soil productivity. Management direction for Soil Resources are found in the Dixie National Forest Plan page IV-48 and 49. Some standards and guidelines include:

- Maintain soil productivity, minimize man-caused soil erosion, and maintain the integrity of associated ecosystem.
- Limit intensive ground disturbing activities on unstable slopes and highly erodible sites.
- Use site preparation methods which are designed to keep fertile, friable topsoil essentially intact.
- Give roads and trails special design considerations to prevent resource damage on capability areas.

### **Recreation Resources**

The Recreation Opportunity Spectrum (ROS) is used on the forest as a guideline for the management of recreation resources. Refer to the Forest Plans for management direction of the specific management areas. Management direction for Recreation Resources are found in the Dixie National Forest Plan page IV-27 through 31. Some standards and guidelines include:

- Construct, reconstruct, and maintain developed sites in accordance with the established recreation opportunity spectrum (ROS) classification(s) for the management area.
- Provide a broad spectrum of dispersed recreation opportunities in accordance with the established ROS classification for the management area.



## Visual Resources

The Forest Service Visual Management System is used as a guideline for the management of visual resources on the Forest. Management direction for Visual Resources are found in the Dixie National Forest Plan page IV-26 and 27. Some standards and guidelines include:

- Apply the Visual Management System to all National Forest System lands.
- Rehabilitate all existing projects and areas which do not meet the adopted visual quality objective(s) specified for each management area.
- Plan, design, and locate vegetation manipulation in a scale which retains the color and texture of the characteristic, borrowing directional emphasis of form and line from natural features.
- Meet the visual quality objectives of retention and partial retention one full growing season after completion of a project. Meet modification and maximum modification objectives three full growing seasons after completion of a project.
- Determine sensitivity levels in accordance with FSH 2309.16, Agriculture Handbook Number 462, Volume 2, Chapter 1, Sensitivity Levels.
- Blend soil disturbance into natural topography to achieve a natural appearance, reduce erosion and rehabilitate and re-vegetate ground cover; and, re-vegetate disturbed soils by the following growing season.
- Choose facility and structure design, color of materials, location and orientation to meet the adopted visual quality objective(s) for the management area.

## Minerals/Geologic Resources

A goal of the Forest is to integrate the exploration and development of mineral and energy resources on the Forest with the use and protection of other resource values. Management direction for Minerals are found in the Dixie National Forest Plan page IV-43 through 45. Some standards and guidelines include:

- Administer areas with producing sites and known reserves with consideration of ongoing and potential mineral activities.
- Avoid or minimize significant public or private investments in and near areas where mineral activities can be expected in the foreseeable future.
- In designated Wilderness, ensure that provisions in operating plan satisfy the rights of the claimant while creating the least impact on Wilderness values and for restoration of disturbed lands.
- Provide reasonable protection for the purposes for which the lands were classified (e.g., research natural areas, national recreation areas, national recreation trails etc.) and for reasonable reclamation of disturbed lands to a condition suitable for those purposes.
- On unclassified lands, provide for reasonable reclamation of disturbed lands.



- Minimize or, as appropriate, prevent adverse impacts on surface resources.
- Review cases of suspected abuse of the mining laws.
- Leasing, permitting, or licensing of National Forest System lands will be based on site specific considerations using appropriate standards and guidelines for the management unit concerned.
- Forest Service authorizes common variety and exploration and disposal under terms and conditions to prevent, minimize or mitigate adverse impacts on surface resources and uses.

### **Transportation System**

Management direction for the Transportation System are found in the Dixie National Forest Plan page IV-49 through 53. Some standards and guidelines include:

- Construct and reconstruct local roads to provide access for specific resource activities (e.g., campgrounds, trailheads, mineral leases, timber sales, etc.).

### **Wild and Scenic Rivers**

There were no rivers or streams classified as Wild and Scenic during the preparation of the Forest Plan, resulting in no Forest Plan management direction for Wild and Scenic Rivers.

In spring of 1994, the Dixie National Forest reevaluated streams and rivers for eligibility for potential designation as Wild and Scenic Rivers. A list of 18 rivers in southern Utah was compiled by the Dixie National Forest and submitted for review to any interested groups. There was substantial controversy surrounding the list of rivers and currently the situation is unresolved. At present, the Dixie National Forest will adhere to what is stated in the Forest Plan EIS.

### **Cultural and Paleontological Resources**

Management direction for Cultural Resources are found in the Dixie National Forest Plan page IV-26. Some standards and guidelines include:

- Protect, find an adaptive use for, or interpret all cultural resources on National Forest System Lands which are listed on or eligible for inclusion in the National Register of Historic Places, as detailed in the forest protection/maintenance and interpretive plans
- Nominate or recommend cultural resource sites to the National Register of Historic Places
- Protect and foster public use and enjoyment of cultural resources.

### **Forested Vegetation Management**

A goal of the Forest is to harvest timber in coordination with other resources and to improve the growth rate in timber stands through silvicultural treatment. Management direction for forested vegetation are found in the Dixie National Forest Plan page IV-37 through 41. Some standards and guidelines include:



- Identify lands available and suitable for timber production on a sale-by-sale basis
- Provide for wildlife habitat improvement and enhancement of other renewable resources in sale area improvement plans.

### **Nonforested Vegetation Management**

A goal of the Forest is to cooperate with counties and other land managers in controlling noxious weeds.

Management direction for insects and disease are found in the Dixie National Forest Plan page IV-36 and 37. Some standards and guidelines include:

- Achieve or maintain satisfactory range conditions on all rangelands
- Control noxious farm weeds.

### **Fire Management**

Management direction for fire are found in the Dixie National Forest Plan page IV-54. Some standards and guidelines include:

- Plan and provide a level of protection from wildfire that will meet management objects for the area
- Take suppression action on all escaped fires.

### **Administrative Sites and Special Areas Management**

Management direction for Special Areas and Uses are found in the Dixie National Forest Plan page IV-45 and 46. Some standards and guidelines include:

- Do not approve any Special Use applications that can be reasonably met on private or other Federal Lands unless it is clearly in the public interest
- Do not approve Special Use applications for areas adjacent to developed sites unless the proposed use is compatible with the purpose and use of the developed site
- Management concerns identified by the ID team will be resolved in the environmental assessment before approval of Special-Use Permits.

### **Insect and Disease Management/Suppression**

Management direction for insects and disease are found in the Dixie National Forest Plan page IV-55. Some standards and guidelines include:

- Prevent or suppress epidemic insect and disease populations that threaten forest stands with an integrated pest management approach consistent with resource management objectives.



## **THREATENED, ENDANGERED, PROPOSED, AND SENSITIVE PLANT AND WILDLIFE SPECIES**

This section describes the existing environment to address:

- Issue 1**            The effects of oil and gas leasing and possible subsequent exploration and development activities on wildlife and wildlife habitat.

The section describes the threatened, endangered, and proposed candidate wildlife and plant species that are known to occur or may occur in the Dixie National Forest. Forest Service and State of Utah sensitive species are also described in this section.

### **Special Status Species**

Special status species include species that are currently listed by FWS, proposed for listing, or are candidates under review for listing as threatened or endangered under the Endangered Species Act; species considered special status or rare by Utah Division of Wildlife Resources (UDWR); Forest Service sensitive and Management Indicator Species; and species for sport, commercial, or aesthetic value as determined by the appropriate agency. Special status wildlife species are presented in Table 3-3 and the locations of potential habitat are shown Figure 3-1. Federal and State of Utah Codes are defined in the glossary, Chapter 8.

### **Threatened or Endangered Species**

Two Federally-listed endangered raptors, the peregrine falcon and the bald eagle, are known to occur on the Dixie National Forest. The Mexican spotted owl, recently listed as threatened, has been surveyed for in some localities on the Dixie National Forest, however no nests have been located (Ron Rodriguez, Personal Communication, 1993). The Utah prairie dog, also a Federally-listed threatened species, occurs on the Dixie National Forest. The southwestern willow flycatcher, was Federally-listed as endangered on February 17, 1995. Due to new information collected on the adjacent Fishlake National Forest, potential for occurrences of this species exists on the Dixie National Forest (Rodriguez 1995). The spotted bat, Colorado River cutthroat, Bonneville cutthroat trout, and leatherside chub are Candidate Category 2 species which are known to occur on the Dixie National Forest. Species listed as threatened or endangered are protected under regulations set forth in the Endangered Species Act. Candidate species are not afforded this protection, but they are considered in the planning process.

### **Sensitive Species**

The Forest Service has identified 12 sensitive species, eight of which are also Federally-listed threatened and endangered species and candidate species. These species are afforded special consideration in the planning process. Three mammals, seven birds, and two fish are sensitive species which occur within the area. These are presented on Table 3-3 and are discussed below. Figure 3-2 shows the locations of potential habitat for sensitive wildlife species.

The issue associated with old growth is centered on its relationship with the northern goshawk. For this reason, potential effects to old growth forest communities are addressed in the context of potential effects to the northern goshawk as described later in this section.



**TABLE 3-3**  
**Special Status Species Known or Likely to Occur**  
**Within the Dixie National Forest**

Common Name	Scientific Name	Status	
		F	S
<b>Birds</b>			
Bald Eagle	<i>Haliaeetus leucocephalus</i>	E,S	E
Peregrine Falcon	<i>Falco peregrinus</i>	E,S	E
Southwestern Willow Flycatcher	<i>Empidonax traillii extimis</i>	E,S	S3
Flammulated Owl	<i>Otus flammeolus</i>	S	
Three-toed Woodpecker	<i>Picoides tridactylus</i>	S	S2
Mexican Spotted Owl	<i>Strix occidentalis lucida</i>	T,S	T
Northern Goshawk	<i>Accipiter gentilis</i>	S	S1
Ferruginous Hawk	<i>Buteo regalis</i>	C2	T
Lewis' Woodpecker	<i>Melanerpes lewis</i>		S3
Western Bluebird	<i>Sialia mexicana</i>		S3
Williamson's Sapsucker	<i>Sphyrapicus thyroideus</i>		S2
Yellow-billed Cuckoo	<i>Coccyzus americanus</i>		T
Caspian Tern	<i>Sterna caspia</i>		S1
Black Tern	<i>Chlidonias niger</i>		S1
Burrowing Owl	<i>Athene cunicularia</i>		S1
Common Yellowthroat	<i>Geothlypis trichas</i>		S1
Short-eared Owl	<i>Asio flammeus</i>		S1
Yellow-breasted Chat	<i>Icteria virens</i>		S1
American White Pelican	<i>Pelecanus erythrorhynchos</i>		S2
Mountain Plover	<i>Charadrius montanus</i>		S2
Osprey	<i>Pandion haliaetus</i>		S3
Long-billed Curlew	<i>Numenius americanus</i>		S3
Swainson's Hawk	<i>Buteo swainsoni</i>		S3
Bell's Vireo	<i>Vireo bellii</i>		S3



**TABLE 3-3**  
**Special Status Species Known or Likely to Occur**  
**Within the Dixie National Forest (cont.)**

Common Name	Scientific Name	Status	
		F	S
<b>Mammals</b>			
Utah Prairie Dog	<i>Cynomys parvidens</i>	T,S	T
Spotted Bat	<i>Euderma maculatum</i>	C2,S	S1
Western Big-eared Bat	<i>Plecotus townsendii</i>	S	
Red Bat	<i>Lasiurus borealis</i>		S1
Kit Fox	<i>Vulpes macrotis nevadensis</i>		S1
Northern Pocket Gopher	<i>Thomomys talpoides</i>		S1
Merriam's Kangaroo Rat	<i>Dipodomys merriami</i>		S2
Southern Grasshopper Mouse	<i>Onychomys torridus</i>		S2
Pika	<i>Ochotona princeps</i>		S2
Ringtail	<i>Bassariscus astutus</i>		S2
Northern Flying Squirrel	<i>Glaucomys sabrinus</i>		S2
Big Free-tail Bat	<i>Tadarida brasiliensis mexicana</i>		S3
<b>Amphibians</b>			
Boreal Toad	<i>Bufo boreas</i>		S1
<b>Fish</b>			
Colorado Cutthroat Trout	<i>Oncorhynchus clarki pleuriticus</i>	C2,S	S1
Bonneville Cutthroat Trout	<i>O. c. utah</i>	C2,S	S1
Leatherside Chub	<i>Gila copei</i>	C2	S2
Sources: USDA Forest Service 1986a, UDWR 1993b			

KEY:

F=Federal Status  
E=Endangered  
T=Threatened  
P=Proposed for Listing  
C1=Candidate Category 1  
C2=Candidate Category 2  
3C=Dropped from consideration  
S=Forest Service Sensitive

S=State Status  
O=Extinct  
X=Extirpated  
E=Endangered  
T=Threatened  
S=Sensitive  
1. declining populations  
2. limited distribution  
3. both 1 and 2



## Birds

### Peregrine Falcon (*Falco peregrinus*). FE; FSS

Suitable nesting habitat exists within the Dixie National Forest for peregrine falcons, where cliff faces exist adjacent to riparian areas. Two known nests are located within the Cedar City Ranger District and other sightings have been made, but no other nests are known to occur within the National Forest. Several nests occur within National Park Service lands adjacent to the Dixie National Forest. Forest-wide surveys have not been conducted and site-specific information is limited (Rodriguez, Personal Communication, 1993).

### Bald Eagle (*Haliaeetus leucocephalus*). FE; FSS

There are only two known bald eagle nest sites in the State of Utah, both in mature, riparian woodlands along the Colorado River (UDWR 1993b). Migratory eagles winter throughout the state. They occupy higher elevations in the fall, and as open water freezes, they move to the foothills to feed on small mammals and carrion. Bald eagle wintering range on the Dixie National Forest exists within the Pine Valley Mountain Wilderness Area on the Pine Valley Ranger District. They also winter east of Baker Dam Reservoir, which is outside Dixie National Forest; however, a small portion of the range for this wintering population overlaps into the Pine Valley Ranger District (USDA Forest Service 1993).

### Mexican Spotted Owl (*Strix occidentalis lucida*). FT; FSS

There are 22 known nesting pairs of spotted owls in Utah. Although formal surveys have not been conducted throughout the state (UDWR 1993b), surveys have been conducted on the Dixie National Forest on a site-by-site basis, generally driven by timber sales. There are confirmed occurrences of Mexican spotted owls foraging on the Dixie National Forest; and, although, suitable habitat exists, no nest sites are known in the area (Rodriguez, Personal Communication, 1994). Mexican spotted owls are known to nest on lands adjacent to the Forest Service, specifically on National Park Service lands.

### Southwestern Willow Flycatcher (*Empidonax trailii extimis*). FE; FSS

The southwestern willow flycatcher is a subspecies which is difficult to distinguish from the northern subspecies. Willow flycatchers nest in dense riparian areas, dominated by willow thickets, *Baccharis*, and arrowweed, often with an overstory of scattered cottonwoods, generally at elevations below 7000 feet. Willow flycatchers also inhabit streams along mountain meadows and in areas where exotics, such as tamarisk and Russian olive exist. The loss of riparian habitats resulting from agricultural development and the introduction of exotic species constitute threats to this species. Additionally, the riparian habitat they require is scarce throughout their range.

The southwestern willow flycatcher breeds throughout suitable habitat in the Southwest and is a transient species in southern Utah. No critical habitat for this species has been proposed in Utah. Due to new information collected on the adjacent Fishlake National Forest, there is potential for southwestern willow flycatcher to occur on the Dixie National Forest (Rodriguez 1995).



Flammulated Owl (*Otus flammeolus*). FSS

Although no surveys have been conducted for the flammulated owl on the Dixie National Forest, flammulated owl vocalizations were recorded during spotted owl surveys done between 1989 and 1992 (Rodriguez 1993). Nesting habitat exists throughout the higher elevation forested areas. Flammulated owls nest from approximately May 1 through July 15, depending on local conditions.

Three-toed Woodpecker (*Picoides tridactylus*). FSS

Three-toed woodpeckers are permanent residents throughout the Rocky Mountains, the intermountain west, and Canada. Nesting pairs are known to occur on the Dixie National Forest. However, no formal surveys forest-wide surveys have been conducted and densities are presumed to be low. Nesting occurs from March 1 through September 1 (Rodriguez, Personal Communication, 1993).

Northern Goshawk (*Accipiter gentilis*). Federal Candidate C2; FSS

The northern goshawk was added to the Forest Service Region 4 sensitive species list in October of 1991. Declines in populations are most likely related to timbering, although fire suppression, livestock grazing, drought, and toxic chemicals may also be factors (Reynolds and others 1991). Nineteen goshawks within 16 nesting territories were located during a study conducted on the Dixie National Forest in 1991 by Johansson and White. In 1992, 18 of 28 known nests (56%) were active and in 1993, 22 of 50 known nests (44%) were active. Northern goshawks nest from March 1 through September 30 (Rodriguez 1993).

*Goshawks and Old Growth*

The primary habitat components for goshawks that require special attention and protection in any land/forest disturbing scenario is the nest area and post fledging family area (PFA). Nest areas are generally about 30 acres in size and contain one or more stands of large, old growth stands with a dense canopy cover. Most goshawk pairs have 2 to 4 nest areas within a home range (home ranges total about 6,000 acres). PFAs are about 400-450 acres in size, more or less centered on nest stands, and because of their size, may contain a variety of forest types. PFAs correspond to territories (i.e., the area within the home range that is defended by the adult birds) and are important for fledging birds in that they provide hiding cover and prey for developing hunting skills (Reynolds et al., 1991).

Removal of trees within nest areas should be avoided whenever possible. At a minimum, at least three nest areas within a given goshawk pair's home range should be maintained and three potential replacement nest areas should be identified and protected within each pair's home range. PFAs are more amenable to disturbance, and may actually be enhanced by limited opening of small patches. Activities within PFAs should be limited to the period between October and February.

## **Mammals**

Utah Prairie Dog (*Cynomys parvidens*). FT; FSS

The Utah prairie dog is endemic to southwestern Utah and population numbers have declined from 95,000 individuals historically to 2,000 in 1974 (UDWR 1993b). The decline results from efforts to "control" the populations in the early 1900s, when prairie dogs were considered pests. Which resulted in the elimination of some colonies (Collier and Spillett 1973). Habitat loss, overgrazing, degradation of habitat quality, and



drought are also factors which have led to the decline in numbers (Collier and Spillett 1975). Recovery efforts have been in progress since the 1970s and the Utah Prairie Dog Recovery Plan has helped guide these efforts (FWS 1991b).

Utah prairie dog colonies are scattered throughout suitable habitat on all ranger districts of the Dixie National Forest, with the exception of the Pine Valley Ranger District (USDA Forest Service 1993). Approximately 13,096 acres of Utah prairie dog habitat is known to exist on the Dixie National Forest.

Spotted Bat (*Euderma maculatum*). C2; FSS

Spotted bats are known from British Columbia south into Mexico and are relatively rare throughout their range. No known populations of spotted bats occur on the Dixie National Forest, however, there have been no surveys conducted at this point in time. Suitable habitat is limited within the forest, although some exists adjacent to forest boundaries, along the Pink Cliffs (Rodriguez 1993).

Western Big-eared Bat (*Plecotus townsendii*). FSS

Western big-eared bats occur from British Columbia south into Mexico and east to South Dakota, Oklahoma and Texas, with isolated populations scattered east (Spahr and others 1993). No known populations of these bats occur on the Dixie National Forest, although no formal surveys have been conducted at this point in time. Suitable habitat occurs within the forest and adjacent to forest boundaries along the Pink Cliffs.

## **Fish**

There are two native subspecies of cutthroat trout inhabiting Utah waters on the Dixie National Forest, the Colorado and Bonneville cutthroats. Habitat alteration and the introduction of non-native fish have contributed to their decline (UDWR 1993b). Cutthroat trout hybridize with non-native species of trout which have been historically introduced for sport fishing. Genetic studies are required to determine the purity of a population. Pure populations of these trout have been reduced in range and number, however, they are not in immediate danger of extinction (UDWR 1993d). A statewide management plan has been drafted which recommends conservation measures designed to ensure the continued existence of these subspecies (UDWR 1993d).

Colorado Cutthroat Trout (*Onchorhynchus clarki pleuriticus*). C2; FSS

Remnant populations of Colorado cutthroat trout exist in the East and West Forks of Boulder Creek on the Escalante Ranger District. UDWR transplanted a population of the trout in Durfey Creek on the Escalante RD during the summer of 1993 (Hepworth, Personal Communication, 1993).

Bonneville Cutthroat Trout (*Onchorhynchus clarki utah*). C2; FSS

Pure populations of Bonneville cutthroat trout exist on the Pine Valley Ranger District in Water and Reservoir Canyons, and Deep Creek on the Powell Ranger District. Transplanted populations inhabit South Ash Creek, Harmon Creek, Mill Creek, Leap Creek, and Leads Creek, including all its tributaries on the



Forest. A transplant was completed by UDWR for Threemile Creek and its tributaries on the Cedar City Ranger District during the summer of 1994 (Hepworth, Personal Communication, 1993).

### **State of Utah Species of Concern**

Species of concern on the state level, many of which overlap those identified on the federal level, are presented in Table 3-3. State-listed endangered species likely to occur in the area are peregrine falcon and bald eagle; the Utah prairie dog and Mexican spotted owl are listed as threatened. Big game species of concern are elk, deer, and pronghorn. Game birds, including mourning dove and wild turkey; and, numerous non-game species are considered sensitive. Species are classified as sensitive due to declining populations and/or to limited distribution (UDWR 1993b).

Species that are sensitive due to declining populations which occur, or potentially occur, on the Dixie National Forest include spotted bat, western big-eared bat, northern goshawk, common yellowthroat, yellow-breasted chat, Colorado and Bonneville cutthroat trout, and boreal toad. Those which are sensitive due to limited distribution include southern grasshopper mouse, mountain plover, Williamson's sapsucker and three-toed woodpecker. Big freetail bat, Lewis' woodpecker, and willow flycatcher are sensitive due to limited distribution and declining populations.

### **Threatened, Endangered, Proposed, and Sensitive Plant Species**

Threatened, Endangered, Proposed, and Sensitive (TEP&S) plant species lists were obtained from the Dixie National Forest EIS (1986) and the Forest Service Region 4 list of TEP&S plant species. Distributional information and habitat requirements were obtained from the Utah Endangered, Threatened, and Sensitive Plant Field Guide (1991).

GIS maps were used to indicate existing and potential plant locations within the five ranger districts. The maps indicate a composite of several single-species coverage from known location of plants and potential habitat using known locations, habitat descriptions from District files, Brigham Young University (BYU) Herbarium labels, the Utah Natural Heritage Program, and the Utah Endangered, Threatened, and Sensitive Plant Species Field Guide (1991). Other data sources for the map include Forest Service Region 4 Regional Office Plant Location Maps, Dixie National Forest District Files, Utah geology maps, and ortho photos.

### **TEP&S Plant Species Habitat in Each Ranger District**

Figure 3-3 shows the location of potential habitat of threatened, endangered, or proposed plant species, while Figure 3-4 shows the potential habitat of sensitive plant species. Table 3-4 lists the status and habitat characteristics of TEP&S plant species occurring in each of the ranger districts of the Dixie National Forest.

Pine Valley Ranger District - This district contains large areas of potential TEP&S plant species and habitat primarily in the eastern region of the district and contains the Pine Valley Mountains, and the Pine Valley Mountain Wilderness Area. Additional smaller areas of potential TEP&S plant species and habitat occur north, west and south of the Pine Valley Mountains.

Cedar City Ranger District - This district contains relatively smaller regions of potential TEP&S plant species and habitat. A narrow border exists along the edge of the Markagunt Plateau along the southern edge of the district and includes a small region of the Ashdown Gorge Wilderness Area. In the northern region



of the district, another small area of potential habitat exists around the Twin Peaks. Arizona Willow habitat exists in the spruce coverytype near Brian Head and Navajo Lake.

Powell Ranger District - Potential TEP&S plant species and habitat occurs throughout the southern half of this district along the Paunsagaunt Plateau, Arizona Willow habitat exists along the East Fork of the Sevier River .

Escalante and Teasdale Ranger Districts - These districts contain relatively large areas of potential TEP&S plant species and habitat. In the southwestern region of the Escalante Mountains, habitat occurs primarily along the western side, while in the northwestern region, potential plant species and habitat occurs along the Aquarius Plateau. Most of the eastern region of this district, which contains the Boulder Mountains and the Box-Death Hollow Wilderness Area, is within areas of potential TEP&S species and habitat.

## WILDLIFE AND FISHERIES

This section addresses:

- Issue 1**            The effects of oil and gas leasing and possible subsequent exploration and development activities on wildlife and wildlife habitat.
  
- Issue 3**            The effects of oil and gas leasing and possible subsequent exploration and development activities on water, soils, and riparian values.

A great diversity of wildlife species exists within the various habitats identified on the Dixie National Forest. Approximately 350 species of mammal, bird, amphibian and reptile, and fish species are known to occur within the variety of habitats on the Dixie National Forest Forest Plan. General species lists of wildlife likely to occur within the area are in the project files. These lists are based on existing literature and agency data. They are not intended to provide complete habitat information for each species, but will provide a measure of the diversity of wildlife on the forest.

Small mammals in the area include shrews, bats, lagomorphs (rabbits and hares), chipmunks, and mice. Predators expected to occur include coyote, bobcat, weasel, and badger. Elk, mule deer, and pronghorn antelope are big game mammals known to occur within the project area. Other large mammals on the Dixie National Forest are cougar and black bear.

A wide variety of birds are found throughout the diverse habitats either seasonally, as transients, or as permanent residents. Violet-green swallows, black-capped chickadees, mountain bluebirds, ruby-crowned kinglets, and warbling vireos are all associated with higher elevation coniferous or aspen woodlands. Riparian areas and wet meadows provide habitats for common nighthawks, broad-tailed hummingbirds, dippers, solitary vireos, and yellow warblers. Raptors in the area include Cooper's hawk, goshawk, sharp-shinned hawk, golden eagle, American kestrel, great-horned owl, and long-eared owl, short-eared owl, flammulated owl, pigmy owl, saw-whet owl, red-tailed hawk, ferruginous hawk, rough-legged hawk, Swainson's hawk, peregrine falcon, prairie falcon, and wintering bald eagle.

Reptiles are relatively limited in the project area, occurring mainly where moisture is available. Amphibian species include tiger salamander, western boreal toad, chorus frog, and northern leopard frog. Reptiles occur mostly at the lower elevations in the southwest portions of the forest. They include northern plateau lizard, Great Basin whiptail, Great Basin sagebrush lizard, coachwhip, gopher snake, Utah mountain king snake, western garter snake, western diamond rattlesnake, and sidewinder rattlesnake.



**TABLE 3-4  
Threatened, Endangered, Proposed, and Sensitive Plant Species of Dixie National Forest**

Scientific Name	Common Name	Global/ State Rank <sup>1</sup>	Federal Status	Habitat Characteristics	District Distribution					
					Pine Valley District	Cedar City District	Powell District	Escalante District	Teasdale District	
<i>Astragalus henrimontanensis</i>	Dana milkvetch	G2/S2	3C	Ponderosa pine, pinyon-juniper, and sagebrush communities on gravelly loam soil, 7,000 to 9,200 feet elevation, flowers April-May. <sup>3</sup>				X		X
<i>Astragalus limnocharis</i> var. <i>limnocharis</i>	Navajo Lake milkvetch	G1T1/S1	C2	Herbaceous community with scattered bristlecone pine on the Wasatch Limestone Formation between 8,800 to 10,500 feet elevation, flowers July-August. <sup>3</sup>		X	X			
<i>Astragalus limnocharis</i> var. <i>tabulaeus</i>	Table Cliff milkvetch	G1T1/S1	C2	Steep, unstable limestone slopes on the Pink member of the Wasatch Limestone Formation, 9,200 to 10,170 feet elevation, flowers June-August. <sup>3</sup>				X		
<i>Astragalus zionis</i> var. <i>vigulus</i>	Guard milkvetch	G4?T1/S1	No Federal Status	On sandstone and sandy, gravelly soils in mixed desert shrub, mountain brush, and riparian communities 4,400 to 8,000 feet elevation. <sup>4</sup>	X					
<i>Botrychium paradoxum</i>	Paradox moonwort	G1/S1	C2	Meadow habitats, also in snowfields, secondary growth pastures. Elevations from two collections are 9,875 and 9,820 feet. <sup>5</sup>		X	X	X		X
<i>Castilleja aquariensis</i>	Aquarius paintbrush	G2/S2	C1	Sagebrush and grass meadow communities adjacent to aspen-subalpine fir on clay-loam soils at about 9,800 to 11,000 feet elevation, flowers July-August. <sup>3</sup>				X		X
<i>Castilleja parvula</i> var. <i>parvula</i>	Tushar paintbrush	G2T1/S1	C2	Alpine areas on igneous gravels and outcrops between 10,000 to 12,100 feet elevation, flowers July. <sup>3</sup>		X		X		
<i>Castilleja parvula</i> var. <i>revealii</i>	Reveal paintbrush	G2T1/S1	C2	Ponderosa pine/bristlecone pine community on gravelly soils of the Wasatch Limestone Formation between 7,500-8,300 feet elevation, flowers late June-August. <sup>3</sup>		X	X			



TABLE 3-4  
Threatened, Endangered, Proposed and Sensitive Plant Species of Dixie National Forest (cont.)

Scientific Name	Common Name	Global/ State Rank <sup>1</sup>	Federal Status	Habitat Characteristics	District Distribution				
					Pine Valley District	Cedar City District	Powell District	Escalante District	Teasdale District
<i>Cryptantha ochroleuca</i>	Yellow-white cats eye	G1G2/S1 S2	C2	Pinyon-juniper, ponderosa, and bristlecone pine communities on the Pink Limestone member of the Wasatch Formation between 7,500 to 9,350 feet elevation, flowers May-June. <sup>4</sup>			X		
<i>Cymopterus minimus</i>	Cedar Breaks biscuitroot	G3/S3	C2	Bristlecone, ponderosa pine, and spruce-fir communities on Wasatch Limestone at 8,000 to 10,400 feet elevation, flowers July-August. <sup>3</sup>		X			
<i>Draba sobolifera</i>	Creeping draba	G2/S2	3C	Alpine tundra and spruce-fir communities in igneous gravels and talus between 7,500 to 12,000 feet elevation, flowers July-August. <sup>3</sup>			X		
<i>Eriogonum aretioides</i>	Widtsoe buckwheat	G1/S1	C2	Bristlecone pine, ponderosa pine, Douglas fir, and Rocky Mountain juniper communities on the Pink Limestone member of the Wasatch Formation between 7,400 to 8,710 feet elevation, flowers late May- August. <sup>3</sup>			X	X	
<i>Gilia caespitosa</i>	Rabbit Valley gillia	G1/S1	C1	Pinyon-juniper community on the Carmel and Navajo formations between 5,200 and 8,515 feet elevation, flowers June-July. <sup>3</sup>					X
<i>Haplopappus crispus</i>	Pine Valley goldenbush	G2/S2	C2	Ponderosa pine, fir, manzanita, and aspen communities between 5,970 and 9,200 feet elevation, flowers August-October. <sup>3</sup>	X				
<i>Heterotheca jonesii</i>	Jones goldenaster	G2/S2	3C	Ponderosa pine, manzanita, pinyon-pine, and Douglas-fir communities on sandstone or in sand between 4,000 and 9,450 feet elevation, flowers May- September. <sup>3</sup>				X	
<i>Jamesa americana</i> var. <i>zionis</i>	Zion jamesia	G5T1?/S1 ?	C2	Mountain brush and spruce-fir communities, mostly on cliffs and other rocky places at 4,000 to 10,500 feet elevation. <sup>4</sup>		?			



**TABLE 3-4  
Threatened, Endangered, Proposed and Sensitive Plant Species of Dixie National Forest (cont.)**

Scientific Name	Common Name	Global/ State Rank <sup>1</sup>	Federal Status	Habitat Characteristics	District Distribution				
					Pine Valley District	Cedar City District	Powell District	Escalante District	Teasdale District
<i>Lepidium montanum</i> var. <i>neeseae</i>	Neeses' peppergrass	G4T1/S1	3C	Open areas in ponderosa pine and spruce-fir communities on the Navajo Sandstone Formation at 7,300 to 9,000 feet elevation, flowers May-early June. <sup>3</sup>			X	X	
<i>Penstemon bracteatus</i>	Red Canyon beardtongue	G2/S2	C2	Ponderosa pine, pinyon-juniper, limber pine, and brittlecone pine-manzanita communities on the Pink and White Limestone members of the Wasatch Formation between 6,900 to 8,320 feet elevation, flowers May-July. <sup>4</sup>		X			
<i>Penstemon parvus</i>	Little penstemon	G2/S2	C2	Sagebrush-grass, and spruce communities on Tertiary volcanic gravels between 8,200 and 10,170 feet elevation, flowers late June-August. <sup>3</sup>				X	X
<i>Penstemon pinorum</i>	Pinyon penstemon or Pine Valley Mountain penstemon	G1/S1	C2	Pinyon-juniper community between 5,600 to 5,800 feet elevation, flowers May-June. <sup>3</sup>	X				
<i>Potentilla angelliae</i>	Angell potentilla	S1	C2	Open spruce-fir of upper subalpine zone on rocky, basaltic outcroppings. May be endemic to Boulder Mountain.					X
<i>Senecio malmstenii</i>	Podunk groundsel	G1/S1	No Federal Status	Often in meadows of sagebrush, mountain brush, ponderosa pine, aspen, lodgepole pine, spruce-fir, and alpine tundra communities between 4,500 to 11,200 feet elevation. <sup>4</sup>			X		
<i>Salix arizonica</i>	Arizona willow	G2/S1	PE	Along riparian corridor above 8,500 feet elevation in unshaded or partially-shaded wet meadows, streambanks, commonly located in or adjacent to perennial water. <sup>6</sup>	?	X	X	?	?



TABLE 3-4  
Threatened, Endangered, Proposed and Sensitive Plant Species of Dixie National Forest (cont.)

Scientific Name	Common Name	Global/ State Rank <sup>1</sup>	Federal Status	Habitat Characteristics	District Distribution				
					Pine Valley District	Cedar City District	Powell District	Escalante District	Teasdale District
<i>Silene petersonii</i>	Maquire campion, Wasatch limestone catchfly or peterson catchfly	G3/S3	C2	Ponderosa pine, Rocky Mountain juniper, bristlecone pine, spruce-fir, and aspen- sagebrush communities on open calcareous and igneous gravels between 6,955 and 11,200 feet elevation, flowers July-August. <sup>4</sup>		X	X	X	
<i>Sphaeromeria capitata</i>	Rock tansy	G3/S1	No Federal Status	Bristlecone pine on Cedar Breaks Limestone at about 5,000 to 7,000 feet elevation, flowers May. <sup>3</sup>			X		
<i>Thelesperma subnudum</i> var. <i>alpinum</i>	Bicknell thelesperma	G?T1/S1	C2	Restricted to the Navajo Sandstone and Carmel limestone on the peculiar vari- colored phase in pinyon-juniper, mountain brush and bristlecone pine communities at 7,380 to 9,000 feet elevation, flowers late June-July. <sup>3</sup>					X

Key:

- 3b Names that, on the basis of current taxonomic understanding, do not represent taxa meeting the Endangered Species Act's definition of *species*.
- 3c Taxa that have proven to be more abundant or widespread than was previously believed, and/or those that are not subject to any identifiable threat.
- C1 Notice of Review, Category 1 (substantial biological information on file to support the appropriateness of proposing to list as endangered or threatened is possible. Appropriate, but substantial biological information is not on file to support an immediate rulemaking).
- C2 Notice of Review, Category 2 (current information indicates that proposing to list as endangered or threatened is possible. Appropriate, but substantial biological information is not on file to support an immediate rulemaking).
- G1 Critically imperiled globally because of extreme rarity.
- G2 Imperiled globally because of rarity.
- G3 Either very rare and local throughout its range or found locally in a restricted range.
- G4 Apparently secure globally, though it may be quite rare in parts of its range, especially at the periphery.
- T The Nature Conservance Ranking
- S State Ranking
- PE Proposed Endangered
- ? Might occur on Forest
- 2 Locations were obtained from the Utah Endangered, Threatened and Sensitive Plant Guide (1991).
- 3 Utah Endangered, Threatened and Sensitive Plant Guide (1991).
- 4 Welsh et. al. 1987, A Utah Flora Brigham Young University, 893 pp.
- 5 Personal communication with Ben Franklin, Utah Natural Heritage Program, Salt Lake City, January 13, 1995.
- 6 U.S. Fish and Wildlife Service, 1992, Handbook of Arizona's Endangered, Threatened and Candidate Plants, U.S. Fish and Wildlife Service, Phoenix, Arizona.

Note: Locations were interpreted from the Utah Endangered, Threatened and Sensitive Plant Guide (1991)



The lakes and waterways which traverse the project area support numerous fish species, including rainbow trout, brown trout, brook trout, and several subspecies of cutthroat trout including Colorado cutthroat trout and Bonneville cutthroat trout. These are discussed in detail in the background report addressing fisheries. Most streams in the area are Class III fisheries streams, no Class I streams or lakes have been designated on the Dixie National Forest (refer to classification definitions under *Fisheries* later in this chapter). Many lakes and reservoirs are stocked with game fish by the UDWR. Although the larger lakes, such as Panguitch and Navajo Lakes, are developed for recreation, there are also numerous small lakes supporting good fisheries.

### **Management Indicator Species (MIS)**

Another category of special status species is management indicator species. The Forest Service incorporates these species and their habitats into the planning process. Table 3-5 lists each management indicator species and the vegetation type with which it is associated.

These ecological indicators 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. (Forest Service 1982) Some MIS species are designated as such due to the high level of interest given them by the public, including Bonneville and other trout, mule deer, elk, peregrine falcon, and bald eagle. Macroinvertebrates are ecological indicators for aquatic systems.

### **Wildlife Habitat**

#### **Habitat Classification**

The State of Utah is responsible for managing wildlife resources within the State. UDWR has ranked wildlife habitat and use areas as critical value, high value, substantial value, and limited value. A brief description is presented below.

Critical value habitats are necessary to sustain the existence or introduction of one or more species of historic or existing high interest wildlife during critical periods of their life cycle. These areas are to be protected from any of man's activities which would result in any destruction, loss or permanent occupancy by man or facility developments. Examples include calving, fawning, or lambing areas; riparian areas; and, critical movement corridors.

High value habitats are intensive use areas for one or more species of historic or existing high interest wildlife. These areas are to be protected from any human activities that would result in destruction, loss of permanent occupancy or significant acreage (more than 25 acres) by man or facility developments. Specific examples include less critical seasonal habitat, important feeding areas, and natural wetlands.

Substantial value habitats support populations of one or more species of existing high interest wildlife. These areas are to be protected from any human activities which would result in the destruction, loss of occasional occupancy of moderate acreage by man or facility developments.

Limited value habitats are occasional use areas for one or more species of existing high interest wildlife. These areas are to be protected from some human activities that would result in destruction or loss of an



**TABLE 3-5**  
**Management Indicator Species For the Dixie National Forest**

Common Name	Vegetation Type
Mule Deer <sup>1</sup>	Grass-forb, sagebrush, mountain brush, pinon-juniper, sapling-mature aspen, sapling mature conifer
Rocky Mountain Elk <sup>1</sup>	Grass-forb, sapling-mature aspen, sapling-old growth conifer
Wild Turkey	Mountain brush, pole-mature aspen, mature-old growth conifer
Goshawk	Riparian trees, mature aspen, mature-old growth conifer
Common Flicker	Mature aspen, mature conifer
Yellowbreasted Chat <sup>2</sup>	Riparian shrub-tree
Bonneville Cutthroat Trout	Headwater streams
Resident Trout <sup>1</sup> : Rainbow, Brook, Brown, Cutthroat	Streams, rivers, lakes, reservoirs
Macroinvertebrates	Streams, rivers, lakes, reservoirs
<sup>1</sup> denotes high demand species <sup>2</sup> although listed in the Resource Management Plan, this species is not known to occur on the forest	

Source: USDA, FS 1986

unreasonable acreage by man or facilities. Species areas include yearlong big game habitat and lower class (5 and 6) lakes and streams.

### **Big Game Habitat**

Within the project area habitat exists for elk, mule deer, and pronghorn. These big game species are found on the Dixie National Forest throughout the year, utilizing a variety of vegetation types. Elk and mule deer



generally require areas in early successional stages for feeding and mid- to late successional habitats for protective cover from predators and weather.

Summer and winter range, rated as having critical, high or potential value; and, calving/fawning areas exist for several big game species. Critical seasonal range, for example, critical winter habitat for elk, provides resources necessary for survival during harsh winters.

Historically, elk ranged from northern Canada through most of the United States, including the plains (Clark 1987, Zeveloff 1988). Commercial and subsistence hunting, along with fencing of rangelands resulted in a drastic decline at the beginning of this century. Current management practices have resulted in an increase in elk populations in habitats ranging from deserts to coniferous forests (Clark 1987). Elk are often found in high mountain meadows during warmer months, but they migrate to lower elevations when snow cover makes food unavailable. They may seek out "yards" in river bottoms and canyons as well as lower mountain meadows in the winter (Larrison and Johnson 1981). The availability and condition of winter range is the most limiting factor for elk.

Mule deer are one of the most popular game species in western North America. They occur in habitats ranging from desert scrub and grassland to mountain shrub and coniferous forests (Burt and Grossenheider 1976). Mule deer are especially common in edge habitat where dense understory is found along the border of forested areas (Stewart 1942). They 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 where cover and forage are available. These areas are important to their survival.

On the Dixie National Forest, winter range, which is critical to the survival of big game species during harsh winter conditions, exists for deer and elk. Acreage of critical habitat within the study area are approximately 229,169 for elk and 143,343 for deer. These areas, shown in Figure 3-5, provide food and cover. Elk utilize shrubgrass vegetation areas adjacent to conifer woodlands and mule deer browse in grassland/hardwood areas below 7,000 feet in elevation.

Aspen and mixed aspen-conifer vegetation types at higher elevations constitute big game transition areas during spring and fall migration. Elk utilize lower elevation aspen woodlands, primarily on the south and west aspects for transitional habitat. Migration between seasonal ranges generally occurs along fairly well-established routes.

Approximately 154,462 acres of elk calving (Figure 3-5) and 180,845 acres of mule deer fawning areas exist within the project area (Figure 3-6). These areas provide the necessary seclusion from outside disturbance as well as isolating individuals from others of the same species and providing cover for the ewe or cow and the newborn young. Elk calving occurs from April through June, often in aspen groves; mule deer fawning occurs in spring and summer (Zeveloff 1988). On the Dixie National Forest, elk calving occurs from May 1 through July 1 and mule deer fawning occurs from May 16 through July 1 (Rodriguez 1993). This can vary from year to year depending on climatic conditions.

Pronghorn antelope occur throughout western North America from Canada to northern Mexico. Habitat ranges from desert scrub and grasslands in the southwest to sagebrush and grasslands of higher plateaus and mountain basins (Clark 1987, Hoffmeister 1986). Pronghorns prefer areas of rolling or dissected hills and mesas with grasses and scattered shrubs (Hoffmeister 1986). High value habitat for pronghorns exists on the Teasdale Ranger District, on Roundup and Hay Lakes Flats; on the Powell Ranger District on the east portion of the Paunsagunt Plateau; and between the Powell and Cedar City Ranger Districts. A small area on the Teasdale Ranger District has been designated as critical habitat (UDWR 1993a).



## **Other Mammals Habitat**

Black bear inhabit forested areas interspersed with meadows on the Dixie National Forest. High value black bear habitat exists throughout forested areas on the Teasdale and Escalante Ranger Districts; on the southern section of the Powell Ranger District; and, on the southeast Cedar City District (Nowak and Paradiso 1983, UDWR 1993a). Pockets of critical habitat are on the northern and eastern portions of the Teasdale Ranger District and on the northern portion of the Powell Ranger District (USDA Forest Service 1993).

Cougars, or mountain lions, can thrive in a variety of habitats including montane coniferous forests, swamps, grassland, and dry brush country (Nowak and Paradiso 1983). They occur forest wide (Rodriguez, Personal Communication, 1993) and den in rock crevices and caves. The average home range for mountain lions in Utah is 544 km<sup>2</sup> (Lindzey 1981). Home ranges and the degree of overlap between home ranges is determined by a number of factors, including the number and vulnerability of prey (usually deer), vegetation and topography (Siedensticker, and others, 1973).

Suitable habitat for beaver requires perennial streams and woodlands. Critical value habitat which are able to support active colonies of beaver occur on Swain's Creek, Navajo Lake, Mammoth Creek, and Red Creek Reservoir on the Cedar City Ranger District; and, on the Tropic Reservoir and other streams on the southern portion of the Powell Ranger District (UDWR 1993a).

## **Raptor Habitat**

Suitable habitat for a number of raptor species exists throughout the various habitat types on the Dixie National Forest, including the Federally-listed bald eagle and peregrine falcon discussed previously. Other sensitive raptor species include the northern goshawk and the golden eagle. Site-specific information is considered scarce and outdated for the State of Utah (Quinn, Personal Communication, 1991). Surveys for protected and high-interest species, such as the Mexican spotted owl are being conducted on a site-by-site basis. Due to the sensitive nature of raptor nest locations and the need to protect these species from disturbance, this information is not mapped in this document (USDA Forest Service 1993).

Specific habitat requirements vary for different raptor species, however, all suitable habitat must include appropriate roosting and nesting sites with an adequate prey base in the vicinity. Although appropriate habitat exists for a number of hawks and eagles, only a few scattered nest sites have been located on the Dixie National Forest (UDWR 1993a). Several species of owls nest on the forest, however, only flammulated owl nests have been located (Rodriguez 1994).

## **Upland Game Habitat**

Upland game species which occur on the Dixie National Forest include ring-necked pheasant, wild turkey, sage grouse, blue grouse, band-tailed pigeon, mourning dove and quail. Habitat has been identified within the state as having high or critical value to these species (UDWR 1993c).

Mourning doves inhabit open woodlands and cultivated lands and arid desert country where some water is available (AOU 1983). Mourning dove nesting areas are located on the Dixie National Forest in the north and northeast portions of the Teasdale Ranger District. Other mourning dove nesting areas are adjacent to the Dixie National Forest between the Powell and Escalante, and Powell and Cedar City Ranger Districts. Band-tailed pigeons occupy mountain forests, primarily in oaks (AOU 1983). High value band-



tailed pigeon habitat exists east of the Pine Valley Ranger District, a small portion of which extends into the Dixie National Forest; and, in the vicinity of Cedar City, off the forest (UDWR 1993a).

Pheasants inhabit open country and riparian areas (AOU 1983). Critical habitat for ring-necked pheasant exists north of the Pine Valley Ranger District and a small area of high value habitat exists south of Grover in the Teasdale Ranger District.

Wild turkeys inhabit deciduous or mixed conifer forests and open woodlands in mountainous areas. Two subspecies of wild turkey, Merriam's and Rio Grande, are found in southern Utah. Wild turkeys inhabit all five ranger districts on the forest. Large areas of high value habitat for Merriam's turkey exist in the Pine Valley Mountain Wilderness, in the southwest corner of the Powell Ranger District, and in the southwest portion of the Cedar City Ranger District. The southwest corner of the Cedar City Ranger District also is included in a larger critical nesting area. Merriam turkey nesting occurs from April 15 through July 1 and brooding occurs from May 15 through June 30 (Rodriguez, Personal Communication, 1993). Critical habitat covers most of the eastern portion of the Teasdale Ranger District and the central portion of the Escalante District. Critical habitat for the Rio Grande subspecies is located off the National Forest between the Escalante and Powell Ranger Districts and also near New Harmony, Pine Valley Ranger District.

Sage grouse inhabit foothills, plains, and mountain slopes where sagebrush is dominant (AOU 1983). Critical value habitat exists on the Teasdale Ranger District near Roundy and Hay Lakes Flats; between Powell and Cedar City Ranger Districts; and around Panguitch Lake. Habitat is limited by elevation and topography. Prior to breeding, males assemble on ancestral leks or communal areas where they participate in courtship displays. These strutting grounds are located in openings or clearings in sagebrush or where sagebrush is low and scattered (Ryser 1986). Several strutting grounds are located adjacent to the National Forest, primarily north of the Teasdale Ranger District. Four strutting grounds are located on the Dixie National Forest, although, the current status of these leks is not known. One is on the Cedar City District and three are on the Powell Ranger District.

Blue grouse inhabit coniferous forests, particularly fir, and open situations with a mixture of deciduous trees and shrubs (AOU 1983). Breeding males inhabit open sagebrush/grass/forb habitat types adjacent to open timber stands at elevations above 6,500 feet. Females utilize sagebrush areas for nesting cover and habitats with tall grasses and forbs, often between timber and sagebrush flats, for brooding. Although migration is minimal, blue grouse often move to mature conifer stands in the winter. Critical value habitat exists throughout suitable habitat on most of the Escalante and Teasdale Ranger Districts, the northern and southern portions of the Powell Ranger District, all of the Cedar City Ranger District, and the central Pine Valley Ranger District (UDWR 1993a).

### **Wetland/Riparian Habitat**

Riparian areas within the National Forest include lakesides, streamsides, valley bottoms, wetlands, floodplains, and wet meadows. Approximately 34,409 acres of riparian areas exist within the project area (Figure 3-8). These areas, characterized by high water tables during most of the growing season, comprise a key habitat for a high percentage of the wildlife population. Riparian areas in good condition are naturally diverse and attract a diverse array of wildlife. The condition of riparian habitats on the forest range from those in poor condition, generally due to grazing activities, to high quality habitat (USDA Forest Service 1986; Rodriguez 1994). Some areas have been fenced to facilitate rehabilitation, in accordance with the Forest Plan.

Several species are dependent on these riparian areas, which provide non-winter habitat for elk and mule deer. Some of the elk calving and elk winter ranges correspond to identified wetlands on the Dixie National



Forest. Although shorebird and water bird nesting is limited on the higher elevation lakes due to freezing, these lakes and wetland areas are important during migration.

### **Aquatic Habitat**

Aquatic habitats include 400 miles of streams and over 3,100 acres of lakes and reservoirs which support numerous fisheries and waterfowl populations (Forest Plan). Other wildlife depend on aquatic resources for shelter (e.g., beavers) and as habitat for their prey base (e.g., bald eagles).

The average habitat condition for fisheries streams is 65% of optimum and the average fish production for lakes and reservoirs is estimated to be 70% of its potential (Forest Plan). Stream habitat is degraded in some areas by lack of riparian vegetation resulting in unstable bank conditions and high sediment loads associated with livestock grazing, roads, timber harvest, off-highway vehicle use, and areas of highly erosive soils/geology.

Water quality is declining in some of the major lakes and reservoirs, such as Panguitch Lake and Navajo Lake, on the Dixie National Forest. Monitoring at Panguitch Lake has indicated a slight improvement in water quality, however, this has not been substantiated by sufficient data. Approximately two miles of riparian area upstream from the lake has been rehabilitated, however, nutrient levels are still high (Judd 1989; Personal Communication 1994). While nutrient levels in Panguitch Lake are relatively high, other lakes may be limited by low nutrient levels. Overall, fish production on the Forest may be limited by winter kills, fluctuating water levels, excessive aquatic vegetation, low nutrient levels, competition from non-game fish, and degraded spawning, rearing, and over wintering habitat (Forest Plan).

Many species of waterfowl utilize aquatic habitat on the Dixie National Forest as either permanent residents or, more commonly, migrants. High value waterfowl habitat exists at scattered locations throughout the forest. Enterprise Reservoir on the Pine Valley Ranger District; Panguitch and Navajo Lakes on the Cedar City Ranger District; the Tropic Reservoir on the Teasdale Ranger District; and several small lakes near the boundary of the Teasdale and Escalante Ranger Districts are high value waterfowl areas (UDWR 1993a).

### Fisheries

The waterways on the Dixie National Forest support a variety of fish populations which are presented on Table 3-6. The state has defined six stream classes and four quality ratings that may be applied to streams on the Forest. These classes are defined as follows:

CLASS I: Streams of top quality fishing in the State. They should be preserved and improved for fishery and similar recreational uses. These streams are generally outstanding in natural beauty and of a unique type. They are accessible by modern car at suitable points, and larger waters are floatable with suitable launching facilities. Productivity is such that it supports high fish populations in good condition of one or more species of the more desirable game fish. Natural reproduction or the stocking of small fish maintains an excellent sport fishery. There are no Class I streams on the Dixie National Forest.

CLASS II: Streams of great importance to the State fishery. These are productive streams with high aesthetic value and should be preserved. Fishing and other recreational uses should be the primary consideration. They are moderate to large in size and may have some human development, such as farms or commercial establishments, along them. Many Class II streams



**TABLE 3-6**  
**Fish Species That Occur or May Occur in Streams, Lakes, and Reservoirs**  
**within the Dixie National Forest**

Common Name	Scientific Name
<b>FAMILY: Salmonidae</b>	
Grayling Rainbow Trout Cutthroat Trout Bonneville Cutthroat Trout Colorado Cutthroat Trout Brown Trout Brook Trout Tiger Trout Splake	<i>Thymallus arcticus</i> <i>Oncorhynchus clarki</i> <i>Salmo clarki</i> <i>Salmo clarki utah</i> <i>Salmo clarki pleuriticus</i> <i>Salmo trutta</i> <i>Salvelinus fontinalis</i> <i>Salmo trutta</i> X <i>Salvelinus fontinalis</i> <i>S. fontinalis</i> X <i>S. namaycush</i>
<b>FAMILY: Cyprinidae</b>	
Utah Chub Leatherside Chub Virgin Spinedace Woundfin Speckled Dace Redside Shiner Golden Shiner	<i>Gila atraria</i> <i>Gila copei</i> <i>Lepidomeda mollispina</i> <i>Plagopterus argentissimus</i> <i>Rhinichthys osculus</i> <i>Richardsonius balteatus</i> <i>Notemigonus crysoleucas</i>
<b>FAMILY: Catostomidae</b>	
Utah Sucker Mountain Sucker Desert Sucker	<i>Catostomas ardens</i> <i>C. platyrhynchus</i> <i>C. clarki</i>
<b>FAMILY Ictaluridae</b>	
Black Bullhead Channel Catfish Mountain Whitefish Mottled Sculpin	<i>Ictalurus melas</i> <i>I. punctatus</i> <i>Prosopium williamsoni</i> <i>Cottus bairdi</i>
<b>FAMILY: Centrarchidae</b>	
Green Sunfish Smallmouth Bass	<i>Lepomis cyanellus</i> <i>Micropterus dolomieu</i>

Source: Lee, et al. 1980; FS 1994







1986c). There are no existing mineral leases within the Pine Valley Wilderness. No leasing is allowed within the Pine Valley Wilderness as set forth in the Utah Wilderness Act of 1984 (P.L. 98-428).

The soils on the top portion of the Pine Valley Mountain vary from deep, loamy soils on the north and east aspects to shallow, stony and cobbly soils, with significant areas of bedrock exposures, on the south and west exposures. The steep escarpment slopes of the mountain are composed primarily of quartz monzonite bedrock exposures, which form steep cliffs on the southern and eastern flanks. In the lower portion of the wilderness, highly erosive soils formed in the Carmel Formation, and extremely stony and bouldry pedimental slopes are found.

Vegetation consists mainly of Gambel Oak, Live Oak, Mountain Mahogany, Manzanita, Serviceberry, Squaw Apple, Bitterbrush, Sagebrush, Engelmann spruce, Sub Alpine fir, White fir, Aspen, Douglas-fir, Limber pine and Ponderosa pine. The area is interdispersed with small, grassy meadows of twenty-five acres or less.

Recreation use of the Wilderness includes a wide variety of activities such as hiking, backpacking, horseback riding, camping, deer hunting, and sightseeing. The exact number of Recreation Visitor Days (RVD) use the Wilderness receives is not known, but use estimates (USDA Forest Service 1993) are; 1990 - 6,500 RVDs; 1991 - 10,500 RVDs; 1992 - 12,500 RVDs. Most use occurs during the months of July, August, and September. A network of approximately 90 miles of system trails provide access to and through the Wilderness. The Whipple National Recreation Trail provides one of the major accesses into the Wilderness. The Pine Valley Mountain has a moderate opportunity for solitude, because of the topography of the area, and available camping areas. Also, the size and topographic features of the area make it possible to view the Interstate Highway and communities in the valley from many places on the Mountain. The opportunity for primitive recreation is moderate.

**Box-Death Hollow Wilderness** The Box-Death Hollow Wilderness contains 26,000 acres and is located in Garfield County, Utah, approximately five miles north of the town of Escalante, Utah. The Box-Death Hollow Wilderness lies between Township 32 1/2 South, through Township 34 South, and Range 2 East through Range 3 1/2 East, Salt Lake Base Meridian.

There are several existing leases within the Box-Death Hollow Wilderness which are recognized under the Utah Wilderness Act (P.L.98-428). These leases were issued prior to the enactment of the Federal Land Policy and Management Act of 1976 (FLPMA). Three of the leases within the Wilderness were placed in suspension because approval of an exploratory drilling plan was delayed. The lessee can reactivate the suspended leases by filing and receiving approval from the BLM and Forest Service of an Application for Permit to Drill. (APD) The letter suspending the leases stated, "Such suspension shall remain in effect for an indefinite period of time ending on the first of the month during which (a) approved drilling activity is commenced on the separate leases or (b) a final decision is made not to permit drilling operations to be conducted because of the inclusion of such leased lands in the National Wilderness Preservation System." No further leasing is allowed within the Box-Death Hollow Wilderness as set forth in the Utah Wilderness Act of 1984 (P.L.98-428).

Approximately 24,600 acres of the Box-Death Hollow Wilderness lie within the Know Geologic Structure (KGS) (USDA Forest Service 1986d). The Phipps-Death Hollow Study Area, which is undergoing review by the BLM for possible designation as wilderness is adjacent to Box-Death Hollow to the south and outside the National Forest Boundary.

Steep-walled canyons with gray-orange crossbedded Navajo sandstone, mesas, and plateaus are the major land forms. The major vegetation includes open stands of overmature ponderosa pine and pinyon-juniper.



The Wilderness is divided into two separate canyon tributaries of the Escalante River. The steeply dipping Escalante monocline, dissected by Pine Creek on the west side, running north and south, makes up the portion of the wilderness called The Box. The gently dipping monocline to the east of The Box contains the headwaters of Death Hollow Creek, the second major tributary.

Present activities within the Wilderness include hiking, walking, horseback riding, camping hunting, and nature study. The total annual use in 1988 (USDA Forest Service 1988) was approximately 2,700 RVDs. Current use estimates (USDA Forest Service 1993) are; 1990 - 1,000 RVDs; 1991 - 2,000 RVDs; and 1992 - 2,000 RVDs.

The most heavily used travel route within the Wilderness is down Pine Creek from Blue Spruce Campground to Hells Backbone Loop Road (No. 153), North of Escalante.

Outside of the Box-Death Hollow Wilderness, Management Areas 8a and 8b exhibit characteristics that are normally associated with wilderness lands. These areas are undeveloped and there is little evidence of past activities. These areas can provide a sense of solitude and isolation and there is an opportunity for primitive, unconfined recreation. These areas contain existing leases for CO<sub>2</sub> which will expire in 1999 and will not be available for future leasing if production is not established prior to lease expiration. There are existing leases which were issued prior to the Utah Wilderness Act and some will continue to exist after the 1999 date.

**Ashdown Gorge Wilderness** The Ashdown Gorge Wilderness is located on the Cedar City Ranger District of the Dixie National Forest, in Iron County, Utah in Township 36 & 37 South, Range 9 West, Salt Lake Base Meridian. There are no existing leases within the Ashdown Gorge Wilderness. No leasing is allowed within the Ashdown Gorge Wilderness as set forth in the Utah Wilderness Act of 1984 (P.L.98-428).

The 7,000 acre area includes portions of the tributary drainages to Ashdown Gorge Creek, including Potato Hollow, Shooting Star, Slide Hollow, Blowhard Hollow, Den Hollow, Ashdown Creek, Spring Creek, Story Canyon, Rattlesnake Creek, and Lake Creek which are outside of Cedar Breaks National Monument. There are 320 acres of private property nestled in the lower portion and the eastern boundary is bordered against Cedar Breaks National Monument. Practically all of the wilderness is visible from Cedar Breaks view points.

The geologic formation of the Ashdown Gorge Wilderness was created by a series of depositions laid down during the Cretaceous, Paleocene, Eocene, and Oligocene periods. During the Miocene and Pliocene periods the land area was lifted, and subsequent erosion has shaped the area into its present form.

The area is subjected to intense summer thunderstorms which fall upon the barren slopes of the Wasatch Limestone within Cedar Breaks, and results in frequent sediment laden floods. Outside of the barren limestone formations, the other soils are generally well vegetated, with brush - grass on the drier sites and aspen - conifers on those holding more moisture. A significant stand of Bristlecone pine, known as the Twisted Forest, is located in the northern corner of the wilderness.

Ashdown Gorge has not been heavily used by visitors. The steepness of the area, the lack of suitable camping sites and the relative smallness of the area all contribute to the low use. Generally a one day trip is all that is necessary to see the majority of the area. Current use estimates (USDA Forest Service 1993) are; 1990 - 1,700 RVDs; 1991 - RVDs; 1992 - 1,700 RVDs. It is possible to view most of the area from different vantage points around it. Future use is expected to gradually increase. Historical visits have been from permittees and herders managing the sheep grazing permitted in the area during the summer, and from big game hunters during the fall.



## Roadless Resources

The term "roadless character" refers to an area of at least 5,000 acres, without development and maintained roads, and substantially natural. Roadless areas have varying degrees of wilderness characteristics. Wilderness is specifically defined in the Wilderness Act of 1964 (P.L. 88-577); one requirement is roadless, undeveloped condition, and roadless condition can be and is viewed by some as a resource worth protecting in its own right.

Roadless characteristics include; natural integrity, apparent naturalness, remoteness, solitude, special features, and manageability/boundaries. Definitions of these characteristics are provided in Chapter 8, Glossary.

In 1979, the Roadless Area Review and Evaluation (RARE II) inventoried roadless areas on National Forest System lands. The purpose of RARE II was to identify all lands exhibiting wilderness characteristics which could be considered for inclusion in the National Wilderness Preservation System. Prior to the Utah Wilderness Act of 1984, the Forest Planning process had developed an inventory of lands that were essentially unroaded and undeveloped, meeting the minimum definition of wilderness, and qualified for wilderness evaluation per National Forest Management Act (NFMA) Regulation 219.17. The inventory contained 30 roadless areas, totalling 638,390 acres Forest-wide. This inventory and description of each area is filed with the Forest's forest planning records, and a copy is in the project files for this oil and gas leasing EIS project. After passage of the Wilderness Act of 1984 the Forest had a total of 555,390 acres of land that met the minimum requirements for wilderness that were not included in the Utah Wilderness Act.

The Forest reevaluated all Rare II Areas in 1989 in response to a request by Congressman Wayne Owens. Some of the areas were determined to have roads, and other development thus reducing the areas available for further study to 386,101 acres. This EIS evaluates the effects of oil and gas leasing and subsequent development on 21 roadless areas containing 386,101 acres shown on Figure 3-7.

Mineral leases exist on four of the 21 roadless areas. The areas with mineral leases are Table Cliffs-Henderson Canyon Roadless Area (Number 07030), Hog Ranch Roadless Area (Number 07032), McGath Lake-Auger Hole Roadless Area (Number 07034, and Boulder Mountain/Boulder Top/Deer Lake Roadless Area (07040). Table 3-7 shows the number of acres of roadless areas by oil and gas potential and ranger district.

## **Description of Roadless Areas**

**North Hills Roadless Area (Number 07001) - 21,271 acres** This section presents a brief description of the location, principal uses, presence or absence of mineral leases and eligibility of the roadless areas for wilderness classification. A detailed profile of roadless areas is contained in the Roadless and Wilderness Background Report on file at the Dixie National Forest Service offices.

The area is on the Pine Valley Ranger District, and is near the Nevada state line. One-hundred percent of the area is moderate oil and gas potential. Access to the area is poor with low standard roads only, except for a small portion on the south edge of the area being served by the Shoal Creek Road FR300. There are no trails in the area.

The topography ranges from gently rolling to steep rocky slopes at about 6,000 feet elevation. Principle uses are livestock grazing and dispersed recreation, mostly big game hunting. The annual recreation use is light - less than 1,000 recreation visitor days.



**TABLE 3-7**  
**Acres of Roadless Areas by Oil and Gas Potential and Ranger District**

Roadless Area No.	Roadless Area Name	Acres	Oil & Gas Potential	Oil & Gas Potential Area	Ranger District
07001	North Hills	21,271	Moderate O&G	Western & Northern Bull Valley	Pine Valley
07002	Pine Park	7,418	Moderate O&G	Western & Northern Bull Valley	Pine Valley
07002	Pine Park	814	Low O&G	Southern Bull Valley & Northern Pine Valley Mountain	Pine Valley
Subtotal - Pine Park		8,232			
07004	Rock Canyon	14,640	Moderate O&G	Western & Northern Bull Valley	Pine Valley
07004	Rock Canyon	33	Low O&G	Southern Bull Valley & Northern Pine Valley Mountain	Pine Valley
Subtotal - Rock Canyon		14,673			
07007	Moody Wash	12,584	Low O&G	Southern Bull Valley & Northern Pine Valley Mountain	Pine Valley
07007	Moody Wash	8,343	Moderate O&G	Western & Northern Bull Valley	Pine Valley
Subtotal - Moody Wash		20,927			
07008	Mogotsu	4,385	Moderate O&G	Western & Northern Bull Valley	Pine Valley
07008	Mogotsu	6,147	Low O&G	Southern Bull Valley & Northern Pine Valley Mountain	Pine Valley



**TABLE 3-7**  
**Acres of Roadless Areas by Oil and Gas Potential and Ranger District (cont.)**

Roadless Area No.	Roadless Area Name	Acres	Oil & Gas Potential	Oil & Gas Potential Area	Ranger District
Subtotal - Mogotsu		10,532			
07009	Atchison	16,889	Low O&G	Southern Bull valley & Northern Pine Valley Mountain	Pine Valley
07011	Cove Mountain	12,322	Low O&G	Southern Bull Valley & Northern Pine Valley Mountain	Pine Valley
07011	Cove Mountain	1,210	Moderate O&G	Western & Northern Bull Valley	Pine Valley
Subtotal - Cove Mountain		13,532			
07013	Stoddard Mountain	11,927	Low O&G	Southern Bull Valley & Northern Pine Valley Mountain	Pine Valley
07017	Cottonwood	6,696	Moderate O&G	Southern & Central Pine Valley Mountain	Pine Valley
07019	Hancock	7,296	Moderate O&G	Markagunt Plateau	Cedar City
07022	Mineral Canyon	7,372	Moderate O&G	Markagunt Plateau	Cedar City
07024	Red Canyon North	5,917	Moderate O&G	Sevier & Paunsagaunt Plateau	Powell
07026	Horse Valley	12,974	Moderate O&G	Sevier & Paunsagaunt Plateau	Powell
07027	Deer Creek	37,562	Moderate O&G	Sevier & Paunsagaunt Plateau	Powell



**TABLE 3-7**  
**Acres of Roadless Areas by Oil and Gas Potential and Ranger District (cont.)**

Roadless Area No.	Roadless Area Name	Acres	Oil & Gas Potential	Oil & Gas Potential Area	Ranger District
07028	Casto Bluff	79,828	Moderate O&G	Sevier & Paunsagaunt Plateau	Powell
07030	Table Cliffs	18,096	Moderate O&G	Southern Escalante Mountains	Escalante
07032	Hog Ranch	203	High CO <sub>2</sub>	Aquarius Plateau	Escalante
07032	Hog Ranch	5,240	Moderate O&G	Southern Escalante Mountains	Escalante
Subtotal - Hog Ranch		5,443			
07034	McGath Lake - Auger Hole	4,612	High CO <sub>2</sub>	Escalante anticline	Escalante
07034	McGath Lake - Auger Hole	2,437	Moderate O&G	Southern Escalante Mountains	Escalante
Subtotal - McGath Lake/ Auger Hole		7,049			
07038	Long Neck Mesa	6,439	Moderate O&G	Area East of Boulder Mountains	Teasdale
07038	Long Neck Mesa	12,266	Low O&G	East End of Boulder Mountains	Teasdale
07038	Long Neck Mesa	17,973	Moderate O&G	Area East of Boulder Mountains	Escalante
07038	Oak Creek	2,605	Moderate O&G	Area East of Boulder Mountains	Teasdale
Subtotal - Long Neck Mesa /Oak Creek		39,283			
07039	Happy Valley	6,445	Moderate O&G	Area East of Boulder Mountains	Teasdale



**TABLE 3-7**  
**Acres of Roadless Areas by Oil and Gas Potential and Ranger District (cont.)**

Roadless Area No.	Roadless Area Name	Acres	Oil & Gas Potential	Oil & Gas Potential Area	Ranger District
07040	Boulder Mountain	48	Moderate O&G	Aquarius Plateau	Teasdale
07040	Boulder Mountain	26,999	High CO <sub>2</sub>	Aquarius Plateau	Teasdale
07040	Deer Lake	11,636	Moderate O&G	Area East of Boulder Mountains	Escalante
07040	Deer Lake	203	High CO <sub>2</sub>	Escalante anticline	Teasdale
07040	Deer Lake	2,719	High CO <sub>2</sub>	Aquarius Plateau	Escalante
Subtotal - Boulder Mountain / Deer Lake		41,605			
Total Roadless Area Acres		393,549			



The area does not qualify for wilderness classification because roads subdivide one portion of the area into less than 5,000 acres.

**Headwaters/Pine Park Bench/Pine Park Roadless Area (Number 007002) - 8,232 acres** The area is on the Pine Valley Ranger District and borders on the Nevada state line; 90% of the area is moderate oil and gas potential and 10% is low oil and gas potential. Access to the area is poor with dry weather roads suitable for pickups only. About 5 miles of Forest trail 001 bisects the area.

The topography ranges from gently rolling to steep rocky slopes at about 6,000 feet elevation. Principle uses on the area are livestock grazing and dispersed recreation, mostly big game hunting and hiking from Pine Park Campground visitors. The annual recreation use is light - less than 2,000 recreation visitor days. The BLM land contiguous to the area has identified wilderness potential. Both Nevada BLM Inventory Unit NV-050-0166 and Utah BLM Inventory Unit UT-040-123, Cougar Canyon (one area) have been identified for further study.

The area contains no distinct management boundary for a potential wilderness because of irregular topography and the location of roads and developments. The drainage divides around Pine Park Basin could possibly form a boundary in conjunction with BLM lands.

A separate study coordinated with BLM would be needed to judge the wilderness characteristics if the area, or portions of the area, were joined.

**Rock Canyon Roadless Area (Number 007004) - 14,673 acres** The area is on the Pine Valley Ranger District and is near the Nevada state line, about 30 miles northwest of St. George, Utah. All but 34 acres of the area is moderate oil and gas potential, the remaining acres are low oil and gas potential. Access to the perimeter is good with Forest Roads Number 300 and 900 serving the area. Low standard roads suitable for pickup travel also serve portions. There are no trails in the area.

The topography ranges from gently rolling to steep rocky slopes at about 6,000 feet elevation.

Principle uses on the area are livestock grazing and dispersed recreation, mostly big game hunting. The annual recreation use is light - less than 2,000 recreation visitor days.

The area contains no distinct management boundary for a potential wilderness because of irregular topography and the location of roads and developments. The drainage divides around Pine Park Basin could possibly form a boundary in conjunction with BLM lands.

**Moody Wash Roadless Area (Number 07007) - 20,927 acres** The area is in the west portion of the Pine Valley Ranger District about 25 miles north of St. George, Utah; 40% of the area is moderate oil and gas potential and 60% is low oil and gas potential. Access to most of the area is poor with low standard, dry weather roads suitable for pickup travel only. A small portion on the northwest corner is served by a paved road, FR900. Forest trail 004 crosses a portion of the area.

The topography ranges from gently rolling to steep rocky slopes at about 6,000 feet elevation. Principle uses on the area are livestock grazing and dispersed recreation, mostly big game hunting. The annual recreation use is light - less than 2,000 recreation visitor days. Over 1,000 acres of private land is within the unit. The private land is mostly mining property - now inactive.

There are no particular attractions to the unit. Scenic values are low to moderate due to dominance of pinyon-juniper covered slopes and lack of surface water. The area is typically dry, pinyon-juniper lands common to the intermountain west.



Not all of the acres of roadless lands would qualify for possible wilderness classification because roads and developments have subdivided the area into several areas with less than 5,000 acres that exceed the minimum size.

**Mogotsu Roadless Area (Number 07008) - 10,532 acres** The area is in the central portion of the Pine Valley Ranger District about 20 miles north of St. George, Utah; 58% of the area is low oil and gas potential and 42% is moderate potential for oil and gas. Access to the area varies from poor to good. Low standard, dry weather roads suitable for pickup travel only serve the west and east edges. The east edge is served by State Highway 18. Forest trail 002 crosses a portion of the area.

The topography ranges from gently rolling to steep rocky slopes at about 6,000 feet elevation. Principle uses on the area are livestock grazing and dispersed recreation, mostly big game hunting. The annual recreation use is light - less than 2,000 recreation visitor days. About 50 acres of private land is within the unit.

Not all of the 10,532 acres of roadless lands would qualify for possible wilderness classification because roads and developments have subdivided the area into several small areas with less than 5,000 acres.

**Atchinson Roadless Area (Number 07009) - 16,889 acres** The area is in the central portion of the Pine Valley Ranger District about 20 miles north of St. George, Utah. The entire area is rated low potential for oil and gas occurrence. Access to the area is good with high standard paved or surfaced roads approaching the perimeter on nearly all sides. There are no trails in the area. Low standard, dry weather roads suitable for pickup travel only serve the west and east edges. The east edge is served by State Highway 18. Forest trail 002 crosses a portion of the area.

The topography ranges from gently rolling to steep rocky slopes, with an average elevation of about 6,000 feet. Principle uses on the area are livestock grazing and dispersed recreation, mostly big game hunting. The annual recreation use is light - less than 1,000 recreation visitor days.

The area contains no distinct management boundary for a potential wilderness because of irregular topography and the location of roads and development.

**Cove Mountain Roadless Area (Number 07011) - 13,533 acres** The area is in the north portion of the Pine Valley Ranger District about 25 miles southwest of Cedar City, Utah; about 9% of the area is rated as moderate potential for oil and gas occurrence and 91% is rated low potential for occurrence. Access to the area is good with both surfaced and nonsurfaced roads on the perimeter. There are no trails in the area.

The topography ranges from gently rolling to steep rocky slopes, with an average elevation of about 7,000 feet. Principle uses of the area are livestock grazing and dispersed recreation, mostly big game hunting. The annual recreation use is light - less than 1,000 recreation visitor days. Some geothermal energy investigations have been conducted near the area, and portions of the area may be underlain by geothermal resources.

The area contains no distinct management boundary for a potential wilderness because of irregular topography and the location of roads and development.

**Stoddard Mountain Roadless Area (Number 07013) - 11,927 acres** The area is in the northeast portion of the Pine Valley Ranger District about 15 miles southwest of Cedar City, Utah. The entire area has a low potential for oil and gas occurrence. Access to the area is good with surfaced roads on the north and south boundaries. The edge of the area is served by Shoal Creek Road FR300. The Big Hollow (No. 3017), Duncan (No. 3005) and Dry Lakes (No. 3010) trails traverse through this area.



The topography ranges from gently rolling to steep rocky slopes, with an average elevation of about 7,000 feet. Principle uses on the area are livestock grazing and dispersed recreation, mostly big game hunting. The annual recreation use is light - less than 1,000 recreation visitor days.

The area contains no distinct management boundary for a potential wilderness because of irregular topography and the location of roads and development.

**Cottonwood Roadless Area (Number 07017) - 6,696 acres** The area is within the Pine Valley Ranger District and is about 10 miles northwest of St. George, Utah. The entire area has a moderate potential for oil and gas occurrence. Access to the area is poor with low standard, dry weather roads only. There are no trails in the area.

The unit is extremely narrow and is identified only because it is contiguous to other Federal Land identified as having wilderness potential. The area is known as BLM UT 040-046.

The topography is generally level, but dissected by steep walled rocky canyons and is about 6,000 feet in elevation. Principle uses of the area are livestock grazing and dispersed recreation, mostly big game hunting. The annual recreation use is light - less than 1,000 recreation visitor days.

While the area is scenic, there are no particular attractions to the unit. The area is typically dry, pinyon-juniper lands common to the intermountain west. The contiguous BLM area is larger, more scenic and has been identified as having wilderness potential.

The area, by itself, contains no distinct management boundary for a potential wilderness because of irregular topography and the location of roads and development.

**Hancock Roadless Area (Number 07019) - 7,296 acres** The area is on the Cedar City Ranger District and in the central portion of the Markagunt Plateau, 20 miles east of Cedar City, Utah. The entire area is moderate potential for oil and gas occurrence. Access to the perimeter of the areas is poor with low standard, dry weather roads suitable for pickup travel only. Forest Trail No. 053 transects the area.

The topography varies from gentle plateau lands to steep rocky slopes, with an average elevation of about 9,000 feet. Principle uses on the area are timber harvesting, livestock grazing, and dispersed recreation - mostly big game hunting and hiking. The annual recreation use is low - less than 1,000 recreation visitor days.

While the unit is scenic, with its cinder cones, lava beds, and timber stands, it is not uniquely scenic. Nationally acclaimed Cedar Breaks National Monument is only a short distance away. There are no particular attractions to the unit other than the volcanic formations.

Much of the timbered area contains no distinct management boundary for a potential wilderness because of the irregular topography and the location of roads and development. However, the lava flows do create distinct boundaries in some areas.

**Mineral Canyon Roadless Area (Number 07022) - 7,372 acres** The area is within the Cedar City Ranger District and is 10 miles northeast of Parawan, Utah. The entire area is moderate potential for oil and gas occurrence. Access to the area is poor with low standard, dry weather roads suitable for pickup travel only. Forest Service Trails 047, 036, and 031 provide access to the south and east perimeter.



The topography is generally steep and rocky with an average elevation of about 7,000 feet. Principle uses on the area livestock grazing and dispersed recreation, mostly big game hunting. The annual recreation use is moderate - less than 2,000 recreation visitor days.

The area contains no distinct management boundary for a potential wilderness because of irregular topography and the location of roads and developments.

**Red Canyon North Roadless Area (Number 07024) - 5,917 acres** The area is within the Powell Ranger District and is about 10 miles southeast of Panguitch, Utah. The entire area is moderate potential for oil and gas occurrence. Access to the area varies from good to poor with low standard, dry weather roads suitable for pickup travel only, serving the north and east portions. State Highway 12 provides all weather, year round access to the south boundary. There are no Forest Service trails in the area.

The topography is characterized by the pink and white limestone cliffs capped with sandstones and conglomerates of the Wasatch Formation. The average elevation is nearly 8,000 feet.

The principle uses on the area are livestock grazing and dispersed recreation - mostly viewing scenery. The annual recreation use is light - less than 1,500 recreation visitor days. Some logging in Casto Canyon has occurred in the past and evidence of roads and stumps are obvious. A commercial trail ride has existed in the south portion of the area for many years. Scattered stands of commercial timber are of poor quality, hence timber harvesting has not occurred.

Scenic values are high due to the colorful rock formations and highly dissected topography. Viewing the scenery is the principal attraction to the area. The area contains several threatened and endangered plant species.

The area has a fairly distinct management boundary for a potential wilderness. An area can be defined by using the National Forest boundary, the edge of Casto Canyon, State Highway 12 and Horse Bench.

The natural integrity and naturalness of the area is only moderate because of the area's small size and proximity to heavy traffic on State Highway 12.

**Horse Valley Roadless Area (Number 07026) - 12,974 acres** The area is within the Powell Ranger District and is about 10 miles northeast of Panguitch, Utah. The entire area is moderate potential for oil and gas occurrence. Access to the area is poor with low standard, dry weather roads suitable only for pickup travel. There are no trails in the area.

The topography ranges from gentle foothill lands to step rocky hillsides with an average elevation of 8,000 feet. Principle uses on the area are livestock grazing and dispersed recreation, mostly big game hunting. The annual recreation use is light - less than 1,000 recreation visitor days. Some areas have been developed through range re-vegetation and road construction.

The area contains no distinct management boundary for a potential wilderness because of irregular topography and the location of roads and developments.

**Deer Creek Roadless Area (Number 07027) - 37,562 acres** The area is within the Powell Ranger District and is about 15 miles northeast of Panguitch, Utah. The entire area is moderate potential for oil and gas occurrence. Access to the area is poor with low standard, dry weather roads suitable for pickup travel only. Forest Trails 056, 076, and 079 bisect the area.

The topography is rough and steep with rock outcrops. The average elevation is about 8,000 feet.



Principle uses on the area are livestock grazing and dispersed recreation - mostly big game hunting. The annual recreation use is light - less than 1,000 recreation visitor days. Big game animals found on the area include elk from the Mount Dutton herd and deer.

The area contains no distinct management area boundary for a potential wilderness because of irregular topography.

**Casto Bluff Roadless Area (Number 07028) - 79,828 acres** The area is within the Powell Ranger District and is about 10 miles northeast of Panguitch, Utah. The entire area is moderate potential for oil and gas occurrence. Access to the area is poor with low standard, dry weather roads suitable for pickup travel only. Forest trails 058, 064, 071, and 077 bisect the area.

The topography varies from gentle plateau lands to steep rocky canyons and slopes, with an average elevation of 8,000 feet. Principle uses on the area are livestock grazing and dispersed recreation - mostly big game hunting. The annual recreation use is light - less than 1,000 recreation visitor days. The low quality and scattered nature of the timber has discouraged timber harvest in the past. Both deer and elk, from the Mount Dutton herd, are hunted.

The area in its entirety, contains no distinct management boundary for a potential wilderness because of irregular topography and irregularly shaped perimeter. Practical management boundaries could be delineated for smaller portions of the area.

**Table Cliffs-Henderson Canyon Roadless Area (Number 07030) - 18,096 acres** The area is within the Escalante Ranger District and is about 20 miles west of Escalante, Utah. The entire area is moderate potential for oil and gas occurrence. Access to the area is poor with low standard, dry weather roads suitable for pickup travel only. Forest trails 091, 095, and 096 bisect the area.

The area lies just north and east of Bryce Canyon National Park. The Table Cliff Plateau is approximately 10,000 feet in elevation and is nearly flat on top. Because of its elevation and topography, it supports a mixed stand of spruce, alpine fir, aspen, and bristlecone pine. Some of the bristle pine are estimated to be 3,000 years old. The south rim, known as Powell Point, provides an excellent view of the Southern Utah Desert, along with prominent land features. Most noticeable of the land features are Bryce Canyon National Park, Navajo Mountain - just east of Lake Powell, and Henry Mountains. On either side of the plateau are nearly vertical cliffs that drop approximately 2,000 feet.

The cliff faces are colored with shades of pink, red, white, and purple.

The area to the west of the Table Cliffs Plateau forms part of the headwaters of the Paria River that drains into the Colorado River. This area has been carved by erosion leaving flat mesas from 2 to 10 acres in size, and on flat ridges divided by steep, rough canyons with nearly vertical rock walls. These rough canyons are covered with sagebrush, grass, pinyon, and juniper.

Except for cattle trailing from Tropic up Burro Canyon to Cameron Wash, there is no domestic livestock grazing in the area. In the early 1900's, a small sawmill was set up in Henderson Canyon and a part of the pine type logged. More recently, a minor amount of logging has taken place on the north and east portions of the area. The logging occurred prior to the RARE II inventory. Some coal and oil exploration has occurred and more is expected in the future. Approximately 6,500 acres which is about 33 percent of the area is now under lease for oil and gas. Coal preference lease applications also extend into the north portion of the area. An electronic site and powerline corridor are located in the west portion of the area.



The wildlife in the area consists of deer, birds, and small furbearing animals. Recreation uses is light -less than 1,000 recreation visitor days annually and associated with deer hunting and site-seeing from Powell Point.

The area is contiguous to both the Bryce Canyon National Park proposed wilderness and a BLM area identified as having wilderness potential. The BLM area is known as BLM UT-040-268, The Blues.

The area contains no distinct management area boundary for a potential wilderness because of irregular topography. However, in conjunction with the BLM area, a boundary possibly could be found. The powerline corridor has caused a portion on the west to be subdivided from the main area. The road toward Powell Point on the east side is an intrusion that affects wilderness characteristics in that area.

**Hog Ranch Roadless Area (Number 07032) - 5,443 acres** The area is within the Escalante Ranger District and is about 10 miles northwest of Escalante, Utah. Access to the area is fair with surfaced all weather roads, but suitable for pickup travel only. The entire area is moderate potential for oil and gas occurrence and about 4% is high potential for CO<sub>2</sub>. Forest trails 097, 102, and 327 bisect the area.

The topography is generally steep and rocky, with an average elevation of about 7,000 feet.

Principle uses of the area are timber harvesting, livestock grazing and dispersed recreation - mostly big game hunting. The annual recreation use is light - less than 1,000 recreation visitor days. Extensive areas of timber in the center of the area have been harvested. Mineral leases occur in one section (640 acres) which is about five percent of the area.

While the unit is scenic, with its timbered slopes, it is not uniquely scenic. There are no particular attractions to the unit.

The area contains no distinct management boundary for a potential wilderness because of the broken up topography and the location of roads and developments. Only 6,400 acres of the roadless areas land would qualify for possible wilderness classification because roads and development have subdivided the area into three roadless areas. The size of the other two areas is 3,840 acres and 2,560 acres. The minimum size for an area to qualify as wilderness is 5,000 acres.

**McGath Lake-Auger Hole Roadless Area (Number 07034) - 7,050 acres** The area is within the Escalante Ranger District and is about 15 miles north of Escalante, Utah. Access to the area is poor with low standard, dry weather roads suitable for pickup travel only. The entire area is moderate potential for oil and gas occurrence and 65% of the area is high potential for CO<sub>2</sub>. Forest trails 106, 107, 108, and 109 bisect the area.

The topography is generally steep and rocky, with an average elevation of about 9,000 feet.

Principle uses of the area are timber harvesting, livestock grazing and dispersed recreation - mostly big game hunting. The annual recreation use is light - less than 1,000 recreation visitor days. Extensive areas of timber on the south and east have been harvested. Mineral leases exist on about 3,500 acres which is about 50 percent of the area.

While the unit is scenic, with its timbered slopes and live streams, it is not uniquely scenic. There are no particular attractions to the unit. The area is typical mid-elevation, timbered lands common to the intermountain west.



The area contains no distinct management boundary for possible wilderness because of irregular topography and the location of roads and development.

**Long Neck Mesa/Steep Creek/Oak Creek-Steep Creek/Oak Creek Roadless Area (Number 07038) - 39,285 acres** The area is within the Escalante and Teasdale Ranger Districts and is about 15 to 20 miles northeast of Escalante, Utah; 48% of the area is low potential for oil and gas occurrence and 52% of the area is moderate potential for oil and gas occurrence. Access to the area is mostly poor with low standard, dry weather roads suitable for pickup travel only. However, the Boulder Grover Road, an all weather road, serves the west side of the area. Forest trails 113 and 126 bisect the area.

Topography varies, but in general, it is extremely rough, sharply dissected and is made up of high cliffs and deep canyons with an average elevation of 7,000 feet.

Principle uses on the area are timber harvesting, livestock grazing and dispersed recreation - mostly big game hunting. The annual recreation use is light - less than 1,000 recreation visitor days. Large areas of the unit have been developed through timber harvest, range re-vegetation and road construction.

While the unit is scenic, with its timbered slopes, colorful cliffs and rock outcrops, it is not uniquely scenic. The area is typical of mid-elevation, highly dissected and cliffy lands common to southern Utah.

Identifying a practical management boundary for a potential wilderness would be difficult because of the irregular topography and the location of roads and developments. The roadless area has been subdivided by roads into 7 areas, of which only two areas exceed the minimum 5,000 acre size. One area contains 28,680 acres and the other 7,040 acres. The area is contiguous to both BLM and NPS areas identified as having wilderness potential. The BLM area is known as UT-040-061, Steep Creek. The NPS area can be described as the Capital Reef National Park Recommended Wilderness area.

**Happy Valley Roadless Area (Number 07039) - 6,445 acres** The area is within the Teasdale Ranger District and is about 15 miles southeast of Teasdale, Utah. The entire area is moderate potential for oil and gas occurrence. Access to the area is generally poor with low standard, dry weather roads suitable for pickup travel only, except the Boulder-Grover Road, an all weather road that serves the west side of the area. Forest trail 123 bisects the area.

The topography varies, but in general, it is steep with sharply dissected canyons, rock cliffs and several pinyon-juniper benches, with an average elevation of about 7,000 feet.

Principle uses of the area are timber harvesting, livestock grazing and dispersed recreation - mostly big game hunting. The annual recreation use is light - less than 1,000 recreation visitor days. Large areas of the unit have been developed through timber harvesting, range re-vegetation, and road construction.

While the unit is scenic, with its timber slopes, colorful cliffs and rock outcrops, it is not uniquely scenic. There are no particular attractions to the unit. The area is typical mid-elevation, highly dissected and cliffy lands common to southern Utah.

The area contains no distinct management boundary for a potential wilderness because of the irregular topography and the location of roads and developments. The roadless area has been subdivided by roads and developments in three areas, of which only one area exceeds the minimum size at 7,040 acres.

**Boulder Mountain/Boulder Top/Deer Lake Roadless Area (Number 07040) - 48,050 acres** The area is within the Teasdale and Escalante Ranger District and is south of Teasdale, Utah. The entire area is rated moderate potential for oil and gas occurrence and 71% of the area is high potential for CO<sub>2</sub>



occurrence. This unit includes most of the slopes immediately below the Boulder Rim, and all of the Boulder Top. Access to the area is mostly poor with low standard, dry weather roads suitable for pickup travel only, except for the Boulder-Grover Road, an all weather road, that serves the east side of the unit. Forest trails 114, 115, 116, 117, 118, 119, 121, and 140 bisect the area.

The topography varies from flat plateau top lands to steep rocky cliffs, with an average elevation of about 9,000 feet.

Principle uses of the area are timber harvesting, livestock grazing and dispersed recreation - mostly big game hunting and fishing. The annual recreation use is moderate, estimated at more than 10,000 recreation visitor days. Large areas of the unit have been developed through timber harvesting, range re-vegetation and road construction. Mineral leases exist on about 2,000 acres which is less than 3 1/2 percent of the area.

Scenery on the unit varies from common to spectacular. From common pinyon-juniper slopes, to jewel-like mountain lakes with spectacular cliffs of the Boulder Rim as a background. The area has many physical attractions.

The area contains no distinct management boundary for a potential wilderness because of the irregular topography and the location of roads and developments. Of the acres of roadless land, the largest qualifying area is 28,160 acres on the north slopes below the Boulder Rim. The remaining unit is a 14,080 acre area on the south slopes below the Boulder Rim. Roads and development have subdivided the area into many acres below the minimum size of 5,000 acres.

## **VEGETATION**

This section addresses:

**Issue 1**            The effects of oil and gas leasing and possible subsequent exploration and development activities on wildlife and wildlife habitat.

**Issue 3**            The effects of oil and gas leasing and possible subsequent exploration and development activities on water, soils, and riparian values.

### **Old Growth**

The issue involving old growth centers on Issue 1, especially the relationship of goshawk habitat to old growth forest. For this reason, old growth is described in the context of its relationship to goshawk habitat under the section titled *Threatened, Endangered, Proposed and Sensitive Wildlife and Plant Species* earlier in this chapter.

### **Wetland-Riparian Areas**

Studies of wetland-riparian resources were initiated as part of a regional environmental inventory for the purposes of oil and gas leasing in the four districts of the Dixie National Forest. Data on riparian-wetland areas were obtained from the Environmental Impact Statement for the Dixie National Forest: Land and Resource Management Plan (USDA Forest Service 1986a, 1986b) and from Dixie National Forest resource and GIS maps that delineate the 100 foot buffer area. Vegetation communities and principal species were



also observed during a site reconnaissance that was conducted in June 1993. The Dixie National Forest EIS (Forest Plan) defines riparian areas as *areas of land that are directly influenced by water*.

Wetlands consist of riverine, lacustrine, and palustrine systems (Cowardin et al., 1979). Riverine systems include streams that occur in most of the valleys. Palustrine systems consist of wet meadows, shrubland sedge-dominated fens, seeps, ponds, and small lakes (e.g., less than 8 hectares). Lacustrine systems contain mostly open water and consist of lakes and reservoirs greater than 8 hectares in size. Because of the dry climate and steep topography of this region, wetlands in this area are typically small and are primarily restricted to the narrow bands bordering streams, small lakes and ponds, and reservoirs. Wetlands that meet criteria of U.S. Army Corp of Engineers (1987) are considered to be jurisdictional to Section 404 of the Clean Water Act, and require a permit prior to dredge and fill activities.

The Dixie National Forest occupies almost two million acres. Riparian habitat comprises only 1 percent of the total Forest land base. Approximately 19,000 acres of riparian habitat, 3,100 acres of lakes and reservoirs, and 400 miles of streams exist within the Dixie National Forest. Wetland/Riparian areas are shown on Figure 3-8.

Many riparian areas are currently considered to be below their potential in terms of vegetative structure, density, and species diversity. This condition is considered to be a result of past and/or current overuse and overgrazing by permitted livestock. Stream habitat is presently degraded in some areas by lack of streamside cover, poor bank stability, high sediment load, and lack of pool areas. For instance, the East Fork of the Sevier River in the Powell Ranger District has been identified as having unstable banks which have resulted in excessive sedimentation and a decrease in fisheries values (Forest Plan). However, a recently implemented Allotment Management Plan is expected to rectify these conditions.

### Management Practices

Two methods of management practices of riparian areas are currently in use in the Dixie National Forest:

- Management Prescription 9A of Riparian Areas
- Management Prescription 9B for Intensive Management of Riparian Areas.

The goals of Management Prescription 9A are to provide healthy, self-perpetuating plant communities, meet water quality standards, provide habitats for viable populations of wildlife and fish, and provide stable stream channel and still water body shorelines. Livestock grazing is at a level that will assure maintenance of the vigor and regenerative capacity of the riparian plant communities.

The goals of Management Prescription 9B Areas are to enhance riparian ecosystems, improve water quality, improve wildlife and habitat, increase wildlife populations, and improve stream channel stability. In general, direction for these areas are similar to Riparian Area Prescription 9A, but are more intensively managed, particularly with respect to grazing practices.

The following text lists the streams and rivers for which some reach of the stream or river has been listed for Management Prescription 9A. Table 3-8 lists the streams and rivers for which some reach is subject to Management Prescription 9B (Intensive Riparian Management).

Pine Valley District - Santa Clara River, Middle Fork Santa Clara River, Lloyd Creek, Forsyth Creek, Pinto Creek, Little Pinto Creek, Pine Creek, Little Pine Creek.



TABLE 3-8

Streams And Rivers Subject To Management Prescription 9B - Intensive Riparian Management

Pine Valley District	Cedar City District	Powell District	Escalante/Teasdale District
Leeds Creek	Duck Creek	-	Single Tree Creek
South Ash Creek	-	-	Chokecherry Creek
Harmon Creek	-	-	Pleasant Creek
Mill Creek	-	-	Oak Creek
Leap Creek	-	-	-

Cedar City District - Stout Canyon, Tommy Creek, Mammoth Creek, Right Fork Bunker Creek, Castle Creek, Clear Creek, Ipson Creek, Center Creek, Indian Hollow Creek, Three Mile Creek, South Fork Three Mile Creek, Caddy Creek, Little Creek, Red Creek, Cottonwood Canyon, Sandy Creek, Deep Creek, Rattlesnake Creek, Butler Creek.

Powell District - East and West Fork of Hunt Creek, Deer Creek, Mountain Spring Fork of Deer Creek, Smith Creek, East Fork Sevier River, Badger Creek, Crawford Creek, Blubber Creek, Right Fork Blubber Creek, Willow Spring Creek.

Escalante/Teasdale District - Clay Creek, Birch Creek, Ranch Creek, North Creek, unnamed stream near Mud Lake Flat, Antimony Creek, Hall Creek, White Creek, South Fork Beck Hollow, Twitchell Creek, Pine Creek, The Box, Hungry Creek, Blue Spring Creek, West Branch Pine Creek, Sandy Creek, Grimes Creek, Sweetwater Creek, Bear Creek, Boulder Creek, East and West Fork of Boulder Creek, Dark Valley Creek, Deer Creek, East and West Fork of Deer Creek, Frisky Creek, Steep Creek, Bear Creek, Oak Creek, South Fork of Dry Creek, Durfey Creek, Tantalus Creek, Pleasant Creek, Larb Hollow Gulch, Wildcat Creek, Sulphur Creek, Rock Creek, Fish Creek, Spring Creek, Spring Branch, Donkey Creek, Boulder Creek, Bullberry Creek, East Government Creek, Lost Creek, unnamed stream near Griffin Spring.

**Wetland-Riparian Areas Within Each Ranger District**

Pine Valley Ranger District - In the western region of this district, a relatively small number of riparian areas exist in the form of small lakes and streams. The most significant features are the Upper and Lower Enterprise Reservoirs. The eastern region has several larger drainages including the Santa Clara River, the Pinto and Little Pinto Creek as well as several other drainages that join Ash Creek.

Cedar City Ranger District - This district contains two large lakes, Panguitch Lake and Navajo Reservoir, and several drainages. Panguitch Lake is the largest lake in the Forest and constitutes 20 percent of the total water yield for the entire Forest. Some of the larger drainages in this district include Panguitch Creek, Mammoth Creek, Pass Creek, and Assay Creek.

Powell Ranger District - This district is interspersed with some small lakes and drainages. The Tropic Reservoir, the largest body of water in this district, is located on the East Fork of the Sevier River. Other large drainages include Hunt Creek, Cottonwood Creek, Deer Creek, and Sanford Creek.



Escalante and Teasdale Ranger District - 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. Many drainages occur around the perimeter of the plateau. Some of the larger lakes and reservoirs in this district include: Pine Lake, Cyclone Lake, Jacobs Reservoir, Roundy Reservoir, Big Lake, Dry Lake, Pollywog Lake, Row Lakes, Purple Lake, Blind Lake, Spectacle Lake, Lower Bown Reservoir, Lake Philo, Donkey Reservoir, Grass Lake, Torgerson Lake, and North Creek Reservoir.

## **WATER RESOURCES (Surface and Ground)**

This section addresses the water portion of:

- Issue 3** The effects of oil and gas leasing and possible subsequent exploration and development activities on water, soils, and riparian values.

### Surface Water

The Dixie National Forest straddles the major surface water divide between the Colorado River Basin and the Great Basin. Within the Upper Colorado Basin (upstream of Lee's Ferry), the study area includes a substantial portion of the headwaters of the Fremont River, Escalante River, and a small portion of the headwaters of the Paria River. Within the Lower Colorado Basin (downstream of Lee's Ferry), the study area includes a substantial portion of the headwaters of the Santa Clara River, Ash Creek, and a small portion of the headwaters of the East Fork of the Virgin River. Within the Great Basin, the study area includes the headwaters of the main stem of the Sevier River, the headwaters of the East Fork of the Sevier River, and the headwaters of creeks draining north into the Escalante Desert.

Annual precipitation for the study area is strongly controlled by elevation and varies from over 40 inches at the divide between the Sevier River and North Fork of the Virgin River, and at the headwaters of Ash Creek, to less than 8 inches in the area immediately east of Panguitch Lake. The summers are generally hot and dry, while the winters are cold and relatively moist. The winter storms are produced by cold fronts that are regional in extent and produce most of their precipitation in the form of snowfall. The summer storms are typically short duration, local thunderstorms that can generate flash flooding.

Elevations below 8000 feet generally have annual precipitation in the range of 10 to 16 inches, with an average around 12 inches. Elevations above 8000 feet have precipitation exceeding 20 inches, with an average around 28 inches.

Over 60 percent of the rainfall occurs during months outside the growing season. Surficial soil layers can be saturated without significant depletion by evapotranspiration and significant recharge can occur to any available aquifer storage, or to surface runoff.

The impact of these two trends is that the shallow surficial soils at the high elevations (which have more rain and shorter growing seasons) become and remain saturated for most of the year, contributing to groundwater recharge. Thicker, continuous soil deposits at lower elevations receive less rainfall and have longer growing seasons, and may or may not contribute to groundwater recharge, depending upon rainfall in individual years.



## Stream Flow

Stream flow has been measured at numerous gaging stations in or near the Dixie National Forest by the U.S. Geological Survey (USGS) (Table 3-9). For gages at higher elevations, the timing of the annual peak flows is typically in the late spring and early summer, with the magnitude and duration of the flows dependent upon the depth of winter snowfall and the late spring temperatures. For gages at lower elevations the annual peak flow is later and can coincide with the thunderstorms during July to October.

The extreme peak flows for the high elevation, gaged Sevier River watersheds have typically been associated with snowmelt events, while the extreme peak flows in the lower elevation, gaged Upper Colorado River basins have typically been associated with summer thunderstorms. The Virgin River extreme peak flows have occurred mid-winter, and during the summer.

The minimum flows of the streams within the study area during extreme dry periods ("low flows") are sustained by groundwater discharge from springs. As the higher elevations receive the most precipitation and have the most groundwater recharge, the gages measuring flows from the highest percentage of high elevation watershed tend to have the largest low flows. Table 3-10 shows the extreme low flows (those that on average would be expected to occur once every two years) for sites in or near the National Forest where there is sufficient data to make a statistical low flow evaluation. The sites are arranged in order of increasing low flow per square mile.

## Water Quality

The State of Utah Water Quality Standards (UWQS) (UAC 317-2) classify stream segments and specific lakes within the state according to their protected beneficial uses. Also, all surface waters located within the outer boundaries of National Forests, whether on public or private lands, are protected under Utah's Anti-degradation Policy. New point sources of pollution and non-point sources are to be controlled through implementation of mitigation measures, best management practices or regulatory programs. All stream segments in the Dixie National Forest are designated as High Quality Waters (Category 1). Three major watersheds are protected for domestic purposes: the upper Fremont River (Teasdale Ranger District), Pleasant Creek (Teasdale Ranger District), and the upper Santa Clara River (Pine Valley Ranger District). All the stream segments in Dixie National Forest are protected for water related recreation (i.e. boating, not including bathing), and are protected for cold water species of game fish, with the exception of the Paria River (protected for non-game fish), and tributaries of the Escalante River which enter the river below the confluence with Boulder Creek (this includes a small portion of the extreme southeast corner of Escalante Ranger District). All streams within the Dixie National Forest, with the exception of Pleasant Creek, are protected for agricultural use.



**Table 3-9  
Summary of Flows Measured at Current USGS Gaging Stations In or Near Dixie National Forest**

Gage #	Gage	Dates of Gage Operation	Type of Gage	Max Flood (cfs)	Date of Max Flood	Basin Area (sq.mi.)	Average Flows for Flow Record in Cubic Feet per Second (CFS)												
							Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
<b>Sevier River Basin, Great Basin</b>																			
1017345	Mammoth Creek above West Hatch Ditch Near Hatch	1964+	Cont.	838	06/19/83	105	11.8	11.7	13	29.7	174	174	58.9	33.7	25.4	21.4	17.7	14.3	49
1017450	Sevier River near Hatch (NRFS Station)	1911-28.39+	Cont.	1490	05/26/22	340	56	59.6	66.1	113	242	242	109	83.2	71.3	68.4	66.9	61.9	108
1018000	Sevier River near Circleville	1912, 14-27.49+	Cont.	1980	12/26/71	986	112	123	129	134	239	194	87.8	81.5	79.8	95.6	121	123	127
1018390	East Fork Sevier River near Ruby's Inn	1961+	Cont.	448	05/23/80	71.6	8.18	9.66	14.9	34.4	52.7	22.6	10.2	9.44	8.82	10.1	10.3	8.93	16.7
1018900	East Fork Sevier River near Kingston	1913+	Cont.	2030	05/12/41	1207	23.1	29.1	44.4	72.4	144	143	142	116	77.9	34.2	26.9	22	73.2
<b>Escalante Basins, Great Basin</b>																			
1024800	Coal Creek near Cedar City	1915-19.35+	Cont.	4620	07/23/69	80.9	9.86	11.7	17.3	55.9	143	67.1	21.9	17.5	13.5	12.5	11.3	10.2	32.8
<b>Virgin River Basin, Lower Colorado</b>																			
940445	East Fork Virgin River near Glendale	1966+	Cont.	640	07/27/76	74.2	17.3	19.5	24	38.9	32.5	16	12.5	12.2	11.6	14.1	16	17.2	19.3
9407000	Ash Creek above Toquerville	1942, 1984+	Cont.	842	08/03/88	190	0.2	2.81	3.64	8.53	3.26	0.62	0.18	1.13	0.15	0.054	1.23	0.77	1.75
940840	Santa Clara River near Pine Valley	1959+	Cont.	776	12/06/66	18.7	2.78	3.19	5.75	16.9	33.3	24.5	9.85	5.68	3.85	3.55	3.97	3.99	9.8
9409100	Santa Clara River abv. Baker Reservoir	1990+	Cont.	2080	12/06/66	116	0.67	4.19	1.52	1.77	2.22	2.85	2.74	3.22	3.19	1.02	0.67	0.69	2.04
9409880	Santa Clara River at Gunlock	1969+	Cont.	2810	02/14/80	271	16.5	35.6	42.2	39.7	42.8	31.7	11.4	9.46	8.36	11.2	15.4	15.5	23.2
<b>Dirty Devil Basin, Upper Colorado</b>																			
933023	Fremont River near Caineville	1967+	Cont.	8800	07/24/84	1208	92.2	98.7	103	102	67.6	45.7	50.6	62.2	59.1	67.7	87	89.2	76.9
9330410	Bull Creek near Hanksville	1983+	Cont.	200	08/05/83	7.53	0.27	0.28	0.33	1.15	5.99	4.79	1.99	1.19	1.18	0.73	0.52	0.36	1.62
<b>Escalante River Basin, Lower Colorado</b>																			
933700	Pine Creek near Escalante	1950-55.57+	Cont.	1010	08/02/67	68.1	2.12	2.21	2.63	7.23	18.6	7.37	5.98	4.97	3.89	3.04	2.81	2.27	5.28
933750	Escalante River near Escalante	1909-13.42-55.71	Cont.	3450	08/01/53	320	6.71	8.89	12.1	14.5	25.9	19.9	6.86	7.66	6.83	7.09	6.8	5.77	10.8
<b>Kanab Creek Basin, Upper Colorado</b>																			
940360	Kanab Creek near Kanab	1979+	Cont.	1130	08/20/84	198	13.7	19.8	24.2	26.7	11.2	7.51	7.74	9.92	10.1	12.3	11.3	13.3	13.9



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**TABLE 3-10**  
**Seven-Day Low Flows For Selected Sites In or Near The Dixie National Forest**

Stream Gage	Basin Area (sq.mi.)	Flow with 2 Year Recurrence Interval	
		cfs	cfs per sq. mi.
Birch Creek near Escalante	36	0	0.000
Skutumpah Creek near Glendale	14.8	0	0.000
Immediate drainage near Glendale	2.49	0	0.000
Midway Creek near Hatch	25.7	0	0.000
Escalante River near Escalante	320	1.27	0.004
Pine Creek near Escalante	68.1	0.48	0.007
Panguitch Creek near Panguitch	97	2.4	0.025
Little Creek near Oaragonah	15.8	0.45	0.028
Summit Creek near Summit	24	0.89	0.037
East Fork Sevier River near Ruby's Inn	71.6	3.7	0.052
Mammoth Creek above West Hatch ditch, near Hatch	105	8.28	0.079
Ashdown Creek near Cedar City	80.9	7.18	0.089
North Fork Virgin River near Springdale	344	37.5	0.109
Red Creek near Paragonah	6.3	0.82	0.130
East Fork Virgin River near Glendale	69.2	9.81	0.142
Sevier River at Hatch	340	51.5	0.151
Antimony Creek near Antimony	84	14.4	0.171
Center Creek above Parowan Creek, near Parowan	11.6	3.42	0.295
East Fork Boulder Creek near Boulder	21.4	15.6	0.729

Source: "Hydrology of Area 57, USGS Open File Report 84-068"

The lakes within Dixie National Forest that are named with the UWQS are all protected for cold water species of game fish; with the exception of Jacob's Valley Reservoir (Escalante Ranger District), which is protected for non-game fish and waterfowl. All the lakes are protected for boating and agricultural use. Figure 3-8 shows water resources including streams, lakes, wetlands, and riparian areas and Figure 3-9 illustrates sensitive aquifers and municipal watersheds within the Dixie National Forest.

Water quality monitoring within the Forest has been conducted since Forest Plan implementation in 1987. In general, State water quality standards have been met with several exceptions:

- The maximum water temperature for a cold water fishery has been exceeded in the East Fork of the Sevier River and its tributaries.
- Panguitch Lake has excessive phosphorus loading.
- Occasional measurements that do not meet standards
  - High pH in East Fork of Sevier River and in Donkey Reservoir



- Low pH in Fish Creek
- High phosphate in Donkey Reservoir and Pleasant Creek
- Low dissolved oxygen in Tropic Reservoir
- High turbidity in East Fork of the Sevier River.

The Utah Division of Water Quality has implemented a monitoring program at Panguitch Lake. Erosion control and stream stabilization measures on private lands have also been implemented to address the phosphate problem. The Forest Service has planned installation of a remote temperature monitoring station for the East Fork of the Sevier River to further study the apparent temperature problem.

Water quality data collected from selected stations in or at the boundary of the Dixie National Forest are shown in Table 3-11.

Sampling of public water supplies within the Forest has been conducted since 1987. No violations of primary maximum contaminant levels have been found. The State of Utah Nonpoint Source Management Plan (1988) lists the East Fork Sevier River (Antimony) watershed as a High Priority Nonpoint Source watershed for total phosphorus, nitrogen, total dissolved solids, sodium, and turbidity. Similarly, the Grover (Upper Fremont River basin) watershed is listed as a High Priority Nonpoint Source watershed for total phosphorus, dissolved oxygen, total dissolved solids, sodium, and manganese.

In general, the surface water quality within the study area varies primarily in total dissolved solids (TDS). The TDS in the surface waters at the headwaters of streams generally have low TDS concentrations. Within the study area, many of the high elevation streams cross outcrops of either the Tropic Shale or Carmel Formation geologic formation. The soils and rocks of these formations contain readily dissolvable gypsum and mirabilite. Downstream of these formations the TDS concentration in the streams is markedly higher. These geologic formations intersect the headwaters of the North and east Forks of the Virgin River, Kanab Creek, the Paria River, and the wester tributaries of the headwaters of the Escalante River.

In general, the lake water quality is above average for the state and meets the standards for most uses. However, Panguitch Lake water quality is significantly less than the other lakes near the study area. The relatively low quality is attributable to the high nutrient levels in the lake provided by heavy grazing within the watershed and rapid development of recreational facilities and summer homes. The nutrients have been carried to the lake by sediments eroded from upstream streambanks.

The surface water draining from the Markagunt Plateau is particularly sensitive to contamination. The primary source for surface water in this area is precipitation transmitted through underground channels in the limestone formation underlying the surface volcanics. There is little soil to attenuate contaminants, and little opportunity for remediation of a spill in this area prior to the rapid transmission, over a wide area of contaminants to surface streams. As noted above, rainfall over a small area near Navajo Lake can be transmitted via these underground channels across the divide of major river basins. In addition, the high quality waters from this area are used downstream of the Forest for irrigation, domestic, and industrial purposes.

## **Sediment**

Sediment loading in the area streams is largely connected to local geology. Streams arising in well vegetated watersheds overlying extrusive igneous rock, sandstone, and limestone have relatively low sediment concentrations. These watersheds include; Mammoth Creek, Panguitch Creek, and Ash Creek. Streams from less vegetated watersheds overlying shale and siltstone have higher sediment concentrations. These streams include; North and East Forks of the Virgin River, the higher watersheds and most western



Table 3-11  
Water Quality Data Collected From Stations In or Near The Dixie National Forest

Parameter	Mean of Standard	Mean of All Samples										
		Pine Valley Reservoir	South Ash Creek	Center Creek @ Forest Boundary	Mammoth Creek at crossing on Mammoth Creek Road	Tommy Creek at Forest Boundary	East Fork Sevier River at USGS Sta 10183900 at Tropic Reservoir	East Fork Sevier River near Sieler Creek	Lake Creek at Hells Backbone Road Crossing	Pine Creek at Cowpuncher Guard Station	Pleasant Creek near Campground on Boulder Road	Pine Creek near boundary (NW Boulder Mountain)
<b>Class 1C</b>												
pH, S.U.	6.5 - 9.0	8.5000										8.4000
Arsenic (mg/1)	0.0500	<0.0050										<0.0050
Barium (mg/1)	1.0000	<0.0050										<0.0050
Cadmium (mg/1)	0.0100	<0.0010										<0.0010
Chromium (Tri)(mg/1)	0.0500	<0.0050										<0.0050
Lead (mg/1)	0.0500	<0.0030										<0.0030
Mercury (mg/1)	0.0020	<0.0002										<0.0002
Selenium (mg/1)	0.0100	<0.0020										<0.0020
Silver (mg/1)	0.0500	<0.0020										<0.0020
<b>Class 2B</b>												
pH, S.U.	6.5 - 9.0											
Total Phosphorus (mg/1)	0.0500											
<b>Class 3A</b>												
Maximum Temperature (C)	20.0000	10.0000	14.0000	9.0000	6.0500	7.0000	13.5000	8.0000	10.3500	10.4000	8.5500	10.7000
pH, S.U.	6.5 - 9.0	8.5000	8.6000	8.6000	8.7000	8.7000	8.2667	7.9000	8.4500	8.5500	8.5500	8.4000
Minimum D.O. (mg/1)	6.5000						8.7250					
Ammonia as N (un-ionized)	1.5399-2.2222						<0.0500		<0.0500	<0.0500	<0.0500	
Total Phosphorus (mg/1)	0.0500	0.0380	0.0500	0.2870	0.0415	0.0380	<0.0131	0.0205	0.0540	0.0580	0.0535	0.0535
Arsenic (mg/1)	0.3600	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	0.0025		<0.0050	<0.0050	<0.0050	<0.0050
Cadmium (mg/1)	0.0007-0.0117	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010		<0.0010	<0.0010	<0.0010	<0.0010
Chromium (Tri)(mg/1)	0.5025-3.8445	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050		<0.0050	<0.0050	<0.0050	<0.0050
Copper (mg/1)	0.0043-0.0405	<0.0300	<0.0300	<0.0200	<0.0200	<0.0200	<0.0200		<0.0200	<0.0200	<0.0200	<0.0200
Iron (mg/1)	1.0000	<0.0470	<0.0300	<0.0300	<0.0300	<0.0300	<0.0675		<0.0630	<0.0570	<0.0330	0.0330
Lead (mg/1)	0.0119-0.2808	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0050		<0.0030	<0.0030	<0.0030	<0.0030
Mercury (mg/1)	0.0024	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0001		<0.0002	<0.0002	<0.0002	<0.0002
Selenium (mg/1)	0.0200	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0005		<0.0020	<0.0020	<0.0020	<0.0020
Silver (mg/1)	0.0003-0.0215	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020		<0.0020	<0.0020	<0.0020	<0.0020
Zinc (mg/1)	0.0324-0.2458	<0.0300	<0.0300	<0.0300	<0.0300	<0.0300	<0.0175		0.0530	<0.0390	<0.0300	<0.0300
Diss. Nitrate, mg/1	4.0000						0.0500					

*Rounding*



Table 3-11  
Water Quality Data Collected From Stations In or Near The Dixie National Forest (cont.)

Parameter	Mean of Standard	Mean of All Samples										
		Pine Valley Reservoir	South Ash Creek	Center Creek @ Forest Boundary	Mammoth Creek at roading crossing on Mammoth Creek Road	Tommy Creek at Forest Boundary	East Fork Sevier River at USGS Sta 10183900 at Tropic Reservoir	East Fork Sevier River near Sieler Creek	Lake Creek at Hells Backbone Road Crossing	Pine Creek at Cowpuncher Guard Station	Pleasant Creek near Campground on Boulder Road	Pine Creek near Forest boundary (NW Boulder Mountain)
<b>Class 3C</b>												
Maximum Temperature (C)	27.0000											
pH, S.U.	6.5 - 9.0											
Arsenic (mg/1)	0.3600											
Cadmium (mg/1)	0.0090											
Chromium (Tri)(mg/1)	0.5942											
Copper (mg/1)	0.0052											
Iron (mg/1)	1.0000											
Lead (mg/1)	0.0154											
Mercury (mg/1)	0.0024											
Selenium (mg/1)	0.0200											
Silver (mg/1)	0.0004											
Zinc (mg/1)	0.0386											
<b>Class 4</b>												
pH, S.U.	6.5 - 9.0	8.5000	8.6000	8.6000	8.7000	8.7000	8.2667	7.9000	8.4500	8.5500	8.4000	
Total Dissolved Solids	1200.0000	53.0000	94.0000	164.0000	103.0000	132.0000	232.0000	236.0000	81.0000	155.0000	81.0000	
Arsenic (mg/1)	0.1000	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	0.0025	<0.0010	0.0050	<0.0050	<0.0050	
Cadmium (mg/1)	0.0100	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	
Chromium (Tri)(mg/1)	0.1000	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	
Copper (mg/1)	0.2000	<0.0300	<0.0300	<0.0200	<0.0200	<0.0200	<0.0200	<0.0200	<0.0200	<0.0200	<0.0200	
Lead (mg/1)	0.1000	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0050	<0.0050	<0.0030	<0.0030	<0.0030	
Selenium (mg/1)	0.0500	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0005	<0.0005	<0.0020	<0.0020	<0.0020	
		Cells with heavy outlines show exceedances of water quality standards										



tributaries of the Escalante River, and the headwaters of streams arising along the Hurricane Cliffs in eastern Iron County (Coal Creek, Summit Creek). In general, the sediment load increases exponentially with flowrate. Maximum sediment loads carried by high snowmelt or floodwaters is several magnitudes higher than those carried by low flows, so that sediment concentration varies greatly with the seasons, and recent precipitation.

Sediment related water quality is of mixed quality ranging from poor to excellent across the Forest depending on the geology and the amount of disturbance from roads, timber harvest, off-highway vehicle use, livestock grazing, and other ground disturbing activities. The East Fork of the Sevier River is listed within the State of Utah Nonpoint Source (NPS) Management Plan (1988) as a High Priority NPS watershed for turbidity, as indirect indicator of excess sediment load. Further indication of sediment problems is provided by measurements in 1982 and 1985 which indicated that less than 40 percent of the stream banks within this drainage were stable, which is less than the Forest Plan standard of 50 percent.

## Groundwater

The geologic units in the study area generally contain ground water. The source of the ground water is primarily recharge from infiltration and snowmelt in the higher elevations where the precipitation is highest. Depth to the regional groundwater table varies from near the ground surface at lower elevations to several hundred feet to a thousand feet below the plateaus of the study area. On the plateaus, however, perched water tables exist, which provide the sources for the many springs that emerge. Figure 3-9 shows the location and extent of sensitive aquifers on the Forest.

In the High Plateaus area of the Dixie National Forest (Powell and Escalante Districts), there are a series of geologic formations which determine the surface water and groundwater patterns of the region. They are:

- Mesozoic Sandstones and Shales. These sedimentary formations generally occur below the plateau escarpments on steep erosional lands. These formations generally form good aquifers. Two of the aquifers derived from these formations are the Straight Cliffs Aquifer (made up of the Straight Cliffs, Wahweap, and Kaiparowits Formations) and the Navajo Aquifer (made up of Navajo Sandstone). The Straight Cliffs Aquifer varies in thickness from less than 100 feet in the vicinity of outcrop areas to over 2000 feet to the north. The Navajo Aquifer similarly varies in thickness from 50 to 100 feet in outcrop areas to over 2000 feet to the north. The Straight Cliffs Formation overlies the Navajo Sandstone and is separated hydrologically from the Navajo Sandstone by the Tropic Shale.
- Tertiary Sediments. These occur on the surface of the plateaus and include the Wasatch limestone. The formation is not permeable when intact, but solution channels can develop along fractures that pass water readily. The formation has little storage and is not a feasible site for water supply wells.
- Tertiary and Quaternary Igneous Extrusives and Igneous Sediments. These thick formations cover a large portion of the surface of the Sevier, Markagunt, and Aquarius plateaus. The formations contain dense and impermeable rocks, but are fractured and readily transmit water.
- Stratified Recent Sediments. These shallow formations are stream deposits or glacial outwash, and are present in small, isolated areas within the plateaus. Shallow wells in these deposits can yield water sufficient for domestic or livestock use.



For most of the High Plateau area, the surface of the high plateaus is largely the igneous extrusives or tertiary sediments, neither of which store much water, but which can transmit water via infiltration to the lower Mesozoic sandstones. In the area of Navajo Lake, the surface water drainages have been blocked by igneous formations, so that rainfall generally enters solution channels in the surface formation and emerges in springs in the lower sandstone (the solution channels cross topographic divides so that water from Navajo Lake watershed can emerge in either the Sevier River or Virgin River watershed). In other areas storm water collects and drains in surface water channels that pass over a series of benches to the major stream valleys. The streams lose water as they cross the outcrop areas of the Mesozoic sandstones. Lower in the watersheds, where the streams have eroded below the water table in the outcrops, the streams receive water from the sandstone formations.

East of the Hurricane Fault, the outcrops of the Navajo Sandstone occur well south of the Forest boundary. The outcrops of the Straight Cliffs Aquifer generally begin just to the south of the Powell District boundary, and extend well into the Paunsagaunt Plateau within Escalante District.

West of the Hurricane Fault, the outcrops of the Navajo Sandstone occur near the headwaters of the watersheds within the Pine Valley District east of Gunlock, including the headwaters of watersheds flowing into Ash Creek. In this region, streams within Forest boundaries contribute significant recharge to the regional aquifer.

On the Sevier Plateau (northern Powell District), the surface is largely igneous, with little soil and sediment, so that few sites exist for shallow wells.

On the Markagunt Plateau (Cedar District), the southern end includes the blocked surface drainages in the vicinity of Navajo Lake (discussed above). The upper Markagunt also is characterized by sinks (solution channels, fractured rock) and springs. Spring flow varies directly with precipitation, indicating moderate storage. The larger creeks (Asay, Mammoth, and Bear Valley Creek) have alluvial deposits. Because streambed erosion is not deep, considerable water is likely to be contained in these deposits.

On the Aquarius Plateau (Escalante and Teasdale Districts), the surface igneous rocks are highly transmissive, so that most of the precipitation leaves the plateau as ground water. This water re-emerges in springs, some on and some below Forest land. Some isolated alluvial sediment deposits occur along stream channels, but arroyo cutting into these sediments generally drains them.

The estimated potential yield for wells within the study area (6 inch diameter, 1000 feet deep) is 5 to 50 gallons per minute (gpm) over most of the Forest area. Areas along the stream bottoms of the East Fork of the Sevier River and main branch of the Sevier River have estimated yields up to 500 gpm, while the Cedar Valley and Parawan Valley have yields up to 1000 gpm.

There are several hundred springs in the study area fed by the regional or perched groundwater table. The major springs (discharge of 1 cfs or more) in or near the Dixie National Forest affected by ground water include those presented in Table 3-12. Three of the springs are connected to Navajo Lake: Duck Creek and Lower Asay (which drain into the Sevier River basin), and Cascade Spring (which drains into the Virgin River basin). Navajo Lake is a natural lake formed by a lava flow that cut off natural surface drainage into the Sevier River Basin. The flows that feed the springs escape from the lake via a sink area in the eastern end of the lake. The eastern end of the lake has been separated from three-quarters of the lake by a dike, so that flow into the springs is partially influenced by uncontrolled discharges over or controlled discharges through the dike.

Ground-water quality varies with geologic unit. A recent study of aquifers in western Kane County (east of the Hurricane Fault) found the water in the Navajo aquifer to have dissolved-solids concentrations



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**TABLE 3-12**  
**Selected Major Springs In or Near The Dixie National Forest**

Spring	Watershed	Approximate Total Dissolved Solids (TDS) (ppm)	Discharge (cfs)
Blue Springs	Sevier River	135	10
Mammoth Spring	Sevier River	105	1.8 - 3.14
Brian Head Spring	Cedar Canyon	-	2
Upper Asay Spring	Sevier River	210 - 220	8
Lower Asay spring		150 - 220	28 - 35
Duck Creek Spring	Sevier River	115 - 140	9.3 - 25
Cascade Spring	North Fork Virgin River	100 - 160	0 - 30
East Branch Spring	East Fork Virgin River	-	1

Source: "Non-thermal Springs of Utah", Water Resources Bulletin 16, USGS and UGMS, 1971

varying between 102 to 3,100 mg/l with a median of 230 mg/l. The water in the Straight Cliffs aquifer was found to have dissolved-solids concentrations varying between 139 to 1,250 mg/l with a median of 330 mg/l. The water in alluvial aquifers was found to have dissolved-solids concentrations varying between 283 to 3,500 mg/l with a median of 838 mg/l. Concentrations of selected trace metals, organic chemicals, and radionuclides in all the aquifers met Utah established ground water quality standards. The study concluded that most water in these aquifers can be classified as Pristine, Irreplaceable, Ecologically Important, or Drinking-Water Quality.

A similar recent study of the Navajo aquifer in Washington County (west of the Hurricane Fault), found the water in the Navajo aquifer to have dissolved-solids concentrations that are generally less than 1,500 mg/l, with about 70 percent of the samples analyzed containing less than 500 mg/l dissolved-solids. Concentrations of selected trace metals, organic chemicals, and radionuclides (with one exception, not repeated in later samples) in the aquifer met Utah established ground water quality standards. The study concluded that although sufficient data has not been collected to date for a formal classification, based on the data available most water in the aquifer can be classified as Pristine, Irreplaceable, Ecologically Important, or Drinking-Water Quality. The most vulnerable areas for contamination to enter the sandstone aquifers would be at outcrop locations crossed by roads.

Any surface alluvial aquifer within the study is highly sensitive to contamination. A contaminant spill on one of these small aquifers would lead, (due to the high permeability of these aquifers), to rapid contamination of the entire aquifer.

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## AIR QUALITY

This section addresses:

- Issue 5**      The effects of oil and gas leasing and possible subsequent exploration and development activities on established National Parks, National Monuments and Wildernesses, in particular, Class I airsheds which exist over the National Parks and Monuments.

The management direction contained in the "Land and Resource Management Plan for the Dixie National Forest" include compliance with State and Federal Air Quality Standards. The potentially applicable Air Quality Standards 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 (NSPS)
- National Prevention of Significant Deterioration Standards (PSD)
- National Emissions Standards for Hazardous Air Pollutants (NESHAP).

Further, it is the policy of the State 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 has promulgated a comprehensive set of rules, regulations, standards, and policies that are implemented by the Utah Department of Environmental Quality, Division of Air Quality (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 U.S. 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.

With very few exceptions, "all persons planning to construct a new installation that will or might reasonably be expected to be a source of air pollution must submit a Notice Of Intent (NOI) and receive an Approval Order (AO) prior to initiation of construction" (Utah Air Conservation Rules, pp R307-1-1). 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.

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.

The air quality in the Dixie National Forest is generally considered to be very good and currently meets all NAAQS.

All areas of the State have been designated as either Class I or Class II. Pursuant to the Federal Clean Air Act, the National Parks (including Bryce Canyon, Capital Reef, and Zion) are mandatory Class I. The rest of the study area has been designated 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 are allowed very small increases in pollution, while facilities that impact only Class



II areas are allowed somewhat larger increases. In no case, however, may pollution increases cause a violation of the NAAQS.

Table 3-13 shows the allowable increases of pollution to the ambient air environment of Class I and II areas.

**TABLE 3-13**  
**Allowable Pollutant Increases in Class I and II Areas**

Pollutant	Period	Class I	Class II
		Increment	Increment
<i>Sulfur Dioxide</i>	<i>3-hour</i>	<i>25 ug/m<sup>3</sup></i>	<i>512 ug/m<sup>3</sup></i>
	<i>24-hour</i>	<i>5 ug/m<sup>3</sup></i>	<i>91 ug/m<sup>3</sup></i>
	<i>Annual</i>	<i>2 ug/m<sup>3</sup></i>	<i>20 ug/m<sup>3</sup></i>
<i>Nitrogen Dioxide</i>	<i>Annual</i>	<i>2.5 ug/m<sup>3</sup></i>	<i>25 ug/m<sup>3</sup></i>
<i>Particulate Matter</i>	<i>24-hour</i>	<i>10 ug/m<sup>3</sup></i>	<i>37 ug/m<sup>3</sup></i>
	<i>Annual</i>	<i>5 ug/m<sup>3</sup></i>	<i>19 ug/m<sup>3</sup></i>

ug/m<sup>3</sup> = micrograms per cubic meter

One critical issue that must be resolved before a new installation is granted an AO is obtaining concurrence from the Federal Land Manager that the emissions will not have an adverse impact on Air Quality Related Values (AQRVs), including visibility, in any Class I area. Operators of oil and gas facilities are also be required to demonstrate that the activities will not cause a violation of the NAAQS or exceed the maximum allowable increases in the ambient concentrations of sulfur dioxide, nitrogen dioxide, or particulate matter.

All new installations in the State are required to implement Best Available Control Technology (BACT) to mitigate pollution of the air environment. The BACT requirements include dust abatement practices, restriction of sulfur content in fuels, and other requirements.

Major sources of pollution are subject to additional requirements, including ambient air monitoring, dispersion modeling, emissions monitoring, pollution "offsets," periodic emissions reporting, emergency episode contingency planning, and additional permits (Title V).

The State and Federal Air Quality Standards, and associated regulations, include the requirements necessary to fully protect the air quality in the study area. Compliance with these standards is the responsibility of the owner or operator of oil and gas facilities. Under the UDAQ permitting and control requirements, there is negligible potential for deterioration of air quality from implementation of any of the oil and gas lease alternatives.



## SOILS/GEOMORPHOLOGY

This section addresses the soils portion of:

- Issue 3**      The effects of oil and gas leasing and possible subsequent exploration and development activities on water, soils, and riparian values.

### Overview

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.

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 while the remaining portions of the Dixie National Forest located in the Colorado Plateau province. The Colorado Plateau province consists of a series of plateaus, mesas, and buttes formed from horizontal to gently dipping strata with major faults, monoclinical 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 (Murphy 1993). Alpine glaciation has occurred in a few of the highest areas such as around Boulder Mountain and Aquarius Plateau on the Teasdale/Escalante Ranger Districts and in the Brianhead area on the Cedar City Ranger District (Swenson and Bayer 1990; USDA Forest Service 1986a).

Soils on the Dixie National Forest are diverse and are a reflection of soil parent material, landform processes, and a mountainous, continental climate characterized by variable precipitation and temperature extremes. Because of this diversity, it is difficult to generalize about soils forest-wide.

Landtype associations and associated soils for the Dixie National Forest are presented and discussed by Ranger District. Figure 3-10 shows the landtype association units for each Ranger District. The categories are based on descriptions of landtype associations developed by the Dixie National Forest for the Forest Plan (Forest Plan) for all but the Powell Ranger District. For the Powell Ranger District, the general soil map units described in the *Soil Survey for the Panguitch Area of Utah* (Swenson and Bayer 1990) were used as a foundation. Information provided by the on-going forest wide soil survey and personal communications with Jim Bayer, Forest Soil Scientist, was also incorporated.

The landtype associations represent broad areas that have distinctive patterns of landforms, geology, and soil. Other characteristics include slope steepness, drainage, soil stability and broad vegetation communities. The landtype association units are unique and discrete for each Ranger District. The association types are labeled with a Roman numeral and are coded for each Ranger District (e.g. PV-1 = Pine Valley-1 Rocky Sideslopes and Canyons) The remainder of this section presents a description of the landtype associations by Ranger District. The supporting tables present the total acres for each landtype association broken down by oil and gas potential area.



## Landtype Associations and Associated Soils by Ranger District

### **Pine Valley Ranger District (PV)**

The Pine Valley Ranger District falls within three different areas for oil and gas potential. The areas are shown on the Oil and Gas Potential Map (Figure 2-2 in Chapter 2). The West and North Bull Valley Mountains areas have a moderate potential for oil and gas including carbon dioxide accumulations. The South Bull Valley Mountains and North Pine Valley Mountain/Harmony Mountain areas have a low potential for oil and gas accumulations. The South and Central Pine Valley Mountains area has a moderate potential for oil and gas accumulations. Twelve landtype associations were identified. Table 3-14 summarizes the acreage for each landtype as they occur within each oil and gas potential area.

PV - I Rocky Sideslopes and Canyons: This unit is characterized by steep, rugged topography with extensive rock outcrops occurring between 4,800 and 7,800 feet. Parent materials include undifferentiated volcanics (rhyolite, latite, tuff and breccia). Soils are derived from residuum (parent materials weathered in place) and colluvium (deposited parent materials moved by gravity). They are generally shallow to moderately deep cobbly loams and cobbly clay loams. Vegetation includes oak and pinyon/juniper with sagebrush and scattered ponderosa pine.

This unit occurs in the southwest and central portions of the district. Over half of the unit has slopes over 40% and/or soils with a high erosion potential; no areas of marginally stable, marginally unstable, or unstable lands were identified. Limitations include steep slopes, rock outcrop, short growing-season and low to moderately low precipitation.

PV - II Benchlands: This unit is characterized by gently sloping alluvial bottoms, moderately steep benches and low rolling hills occurring between 5,500 and 6,200 feet. Parent materials are a mix of geologic types including volcanics, sandstones and siltstones. Soils are derived from alluvium (deposited parent materials moved by streams and overland flow) and some residuum. They are generally moderately deep to gravelly clay loams. There are areas of shallow, gravelly loams. Vegetation includes pinyon/juniper with sagebrush.

This unit occurs in the western third of the district. Slopes over 40% occur as a very minor inclusion. No areas of high erosion potential, marginally stable, marginally unstable, or unstable lands were identified. Limitations include shallow soils, some rock outcrop, and low precipitation.

PV - III Steep Sideslopes: This unit is characterized by steep slopes and extensive rock outcrop and occurs between 5,500 and 7,400 feet. A few, small alluvial valleys are included. Parent materials are primarily volcanics. Soils are derived from colluvium and some residuum. They vary from shallow gravelly loams to 'heavy' clay loams depending on material composition and landscape position. Vegetation is dominated by pinyon/juniper with black sagebrush.

This unit occurs in the northern portion of the district. Slopes over 40% comprise <20% of the unit. No areas of high erosion potential, marginally stable, marginally unstable, or unstable lands were identified. Limitations include steep slopes, rock outcrop, and low precipitation.

PV - IV Mesas and Toeslopes: This unit is characterized by unique topographic features such as cinder cones, mesas, basalt flows, colluvial slopes and graded valleys. It occurs between 4,800 and 7,400 feet. Parent materials are primarily basalt. Soils are derived from colluvium and residuum. On sideslopes, they are moderately deep to deep cobbly clay loams. Deep fine-textured soils occur in the valleys. Basalt boulders are scattered on the soil surface in a few areas. Vegetation is dominated by pinyon/juniper at lower elevations with oakbrush and black sagebrush at higher elevations.



**TABLE 3-14**  
**Pine Valley Ranger District Landtype Association Acreage by Oil and Gas Potential Area**

Map Unit Label	Landtype Association	Total Acres	West/North Bull Valley Mtn. Mod O&G	Percent of Total	South Bull Valley/North Pine Valley Mtn. Low O&G	Percent of Total	South/Central Pine Valley Mtn. Mod O&G	Percent of Total
PV - I	Rocky Sideslopes and Canyons	81,673	15,092	13	66,581	32	0	0
PV - II	Benchlands	35,409	35,409	30	0	0	0	0
PV - III	Steep Sideslopes	61,035	27,389	23	33,348	16	298	0
PV - IV	Mesas and Toeslopes	54,007	20,618	18	14,513	7	18,876	14
PV - V	Dissected Slopes	15,887	3,870	3	12,017	6	0	0
PV - VI	Rolling Hills and Swales	21,864	15,221	13	6,643	3	0	0
PV - VII	Steep Sideslopes and Rockland	45,728	0	0	35,365	17	10,363	8
PV - VIII	Fans and Valley Bottoms	26,618	0	0	23,501	11	3,117	2
PV - IX	Complex Sideslopes and Benches	9,352	0	0	9,352	5	0	0
PV - X	Pine Valley Mountain Foothills	35,537	0	0	0	0	35,537	26
PV - XI	Canyons, Benches, Rolling Hills	25,992	0	0	0	0	25,992	19
PV - XII	Pine Valley Mtn. & Escarpment	49,060	0	0	6,428	3	42,632	31
<b>Totals</b>		<b>462,162</b>	<b>117,599</b>		<b>207,748</b>		<b>136,815</b>	

This unit occurs as several delineations in the western two-thirds of the district. Slopes over 40% comprise a small percentage of the unit. No areas of high erosion potential, marginally stable, marginally unstable, or unstable lands were identified. Limitations include steep slopes, stony surface soils, and low precipitation.

P- V Dissected Slopes: This unit is characterized by moderately steep and steep slopes which are dissected by numerous small channels and gullies. It occurs between 4800 and 7000 feet. Parent materials are old terrace gravels, volcanics, and limestones. Soils are derived from colluvium and alluvium. They vary from moderately deep to deep silt loams, loams, and silty clay loams. Vegetation is dominated by pinyon/juniper and oakbrush/serviceberry.



This unit occurs in the extreme western portion of the district. Slopes over 40% comprise a very minor part of the unit. No areas of high erosion potential, marginally stable, marginally unstable, or unstable lands were identified. However, this unit is described as one of the highest sediment producers despite the lack of steeper slopes. Limitations include moderately steep slopes, high erodability, and moderately low precipitation.

PV - VI Rolling Hills and Swales: This unit is characterized by alluvial bottoms, low benchlands, and rolling hills. It occurs between 5,200 and 6,200 feet. Parent materials are recent alluvium and volcanics including some basalt. Soils are derived from alluvium primarily. They vary from deep clay loams in the valleys to moderately deep and deep gravelly loams and clay loams on the hills. Vegetation is dominated by scattered pinyon/juniper and oakbrush/serviceberry. Grasses and forbs occur in the valleys and a few areas are farmed.

This unit occurs in the north-central portion of the district. Slopes over 40% comprise a very minor part of the unit. No areas of high erosion potential, marginally stable, marginally unstable, or unstable lands were identified. Limitations include localized steep slopes with overland flow and deposition typically resulting from intense storms.

PV - VII Steep Sideslopes and Rockland: This unit is characterized by benchlands with steep slopes and extensive rock outcrop and occurs between 6,000 and 8,000 feet. Parent materials are primarily highly weathered intrusives but limestones, sandstones, conglomerates and volcanics also occur. Soils are derived from colluvium and residuum. Shallow, gravelly sandy loams and loams are interspersed among outcrops. Moderately deep to deep gravelly clay loams occur elsewhere. Vegetation is dominated by pinyon/juniper with oakbrush/serviceberry on deeper soils at higher elevations.

This unit occurs in the northeastern portion of the district. Slopes over 40% comprise 30-40% of the unit. About 10% of the unit has high erosion potential. No areas of marginally stable, marginally unstable, or unstable lands were identified. Limitations include steep slopes, extensive rock outcrop, and shallow soils. Also, the growing season is short at the higher elevations.

PV - VIII Fans and Valley Bottoms: This unit is characterized by open coalescing alluvial fans and broad floodplains. Low dissected hills also occur to a limited extent. The unit occurs between 5,600 and 6,800 feet. Parent materials are alluvium derived from a mixture of rocktypes. Soils range from deep loams and clay loams in the valleys to moderately deep soils on some of the low dissected hills. Vegetation is sparse and includes pinyon/juniper and sagebrush. Some areas have been converted to grass. Wet sedge/grass meadows occur locally.

This unit occurs in the northeastern portion of the district. Slopes over 40% comprise very little of the unit. No areas of high erosion potential, marginally stable, marginally unstable, or unstable lands were identified. Limitations include localized flooding potential and imperfectly drained soils.

PV - IX Complex Sideslopes and Benches: This unit is characterized by dissected benchlands and complex sideslopes occurs between 6,000 and 8,000 feet. Because of faulting, parent materials are composed of limestones, conglomerates and volcanics in close association. Soils are derived from colluvium and residuum. Soils range from deep loams and clay loams on benches to moderately deep cobbly clay loams on complex sideslopes. Vegetation is sparse and composed of pinyon/juniper and oakbrush/serviceberry. Aspen groves are scattered throughout where seeps are present.

This unit occurs in the extreme northeastern portion of the district. Slopes over 40% comprise 10-15% of the unit. No areas of high erosion potential, marginally stable, marginally unstable, or unstable lands were identified. However, landtype association descriptions have identified that small mass failures are common



in the association especially where soil moisture is high or concentrated. Limitations include steep slopes, high run-off and erosion potential in some areas and locally high potential for small mass failures. Also, the growing season is short at the higher elevations.

PV - X Pine Valley Mountain Foothills: This unit is characterized by rock canyons, steep sideslopes, mesas, and gullied alluvial bottoms. Parent materials are composed of sandstone/shale units. Sandstone outcrops are common. Soils are derived from colluvium and residuum. Soils range from sandy loams on the sideslopes and mesas to deep loamy or clayey soils in the valleys. Vegetation is sparse and composed of pinyon/juniper and oakbrush.

This unit occurs in the southeastern portion of the district. Slopes over 40% comprise 10-15% of the unit. No areas of high erosion potential, marginally stable, marginally unstable, or unstable lands were identified. However, gullies and overland flow are evident. Limitations include steep slopes, gullies, rock outcrop, local areas of high run-off and flooding potential, and some salt-affected areas.

PV - XI Canyon, Benches and Rolling Hills Complex: This unit is characterized by rugged topography including a complex of deep, rocky canyons, small mesas, low rolling hills and benchlands. Also included are some open meadows and farmlands. Parent materials are composed of sandstone/shale units with inclusions of volcanics. Soils are derived from colluvium and residuum. Soils range from shallow, gravelly sandy loams to moderately deep cobbly loams and clay loams. Boulders and cobbles on the soils surface are common. Vegetation is sparse and composed of scattered ponderosa pine, pinyon/juniper and brush. Some areas have been converted to grass and forb.

This unit occurs in the extreme southeastern portion of the district. Slopes over 40% comprise 40-50% of the unit. As much as 40-50% of the unit is high erosion potential. No areas of marginally stable, marginally unstable, or unstable lands were identified. However, stability problems are noted in landtype descriptions and may be locally important. Limitations include steep slopes including dissected topography and deep canyons, shallow soils, stony surface soils, and low precipitation.

PV - XII Pine Valley Mountain and Escarpment: This unit is characterized by rugged mountain terrain, well-defined drainages, high mountain meadows, extensive rock outcrop, and the steeply rising eastern escarpment of the Pine Valley Mountains. Parent materials are composed of coarse-grained intrusive igneous rocks. Soils are derived primarily from colluvium and residuum. Soils in the high mountain meadows are derived from alluvium. Soils range from shallow, gravelly sandy loams and loams to moderately deep gravelly loams and clay loams. Soil in the meadows are deep to very deep clay loams. Vegetation consists of mixed coniferous forest with open grassy meadows. Much of the area however, is sparsely vegetated.

This unit occurs in the eastern portion of the district. Slopes over 40% comprise 70-80% of the unit. About 20-30% of the unit is high erosion potential, most of which corresponds to slopes >40% including the eastern escarpment. No areas of marginally stable, marginally unstable, or unstable lands were identified. Limitations include steep slopes, rugged terrain, extensive rock outcrop and cliffs, and shallow soils.

### **Cedar City Ranger District (CC)**

All of the Cedar City Ranger District falls within a area of moderate oil and gas potential. Eleven landtype associations were identified. Table 3-15 summarizes the acreage for each landtype as they occur within each oil and gas potential area.



**TABLE 3-15**  
**Cedar City Ranger District**  
**Landtype Association Acreage**

Map Unit Label	Landtype Association	Total Acres	Percent of Total
CC - I	Open Valleys	6,265	2
CC - II	Low Hills	32,310	9
CC - III	Rocky Hills	29,535	8
CC - IV	Steep Sideslopes	41,081	11
CC - V	Rolling Hills and Valleys	34,279	10
CC - VI	Rocklands	44,392	12
CC - VII	Dissected Hills and Valleys	76,970	22
CC - VIII	Faultlands	22,107	6
CC - IX	Rimlands	32,310	9
CC - X	Glaciated Headslopes	13,515	4
CC - XI	Mesas and Valleys	25,013	7
	Total	357,777	

CC - I Open Valleys Association: This unit is characterized by gently sloping valley floors and long coalescing alluvial fans. The unit is bounded by rocky fault scarp faces. Parent materials are composed of mixed volcanic alluvium. Soils are generally loams and clay loams with low rock fragment content. Poorly drained soils occur in the valley bottoms. Vegetation consists of sagebrush/grassland with sedges and grasses in the bottoms.

This unit occurs in the northern portion of the district. Slopes over 40% comprise a very minor proportion of the unit. No areas of high erosion potential, marginally stable, marginally unstable, or unstable lands were identified. Limitations include areas of poorly drained soils and moderately low precipitation.

CC - II Low Hills Association: This unit is characterized by rocky low hills, graded toeslopes, and included valleys. Rock outcrops are a minor component. Parent materials are composed of mixed volcanic colluvium with some limestone and shale. Soils range from shallow to deep gravelly loams and clay loams with high rock fragment contents. Vegetation consists of pinyon/juniper with sagebrush/grassland.

This unit occurs in the eastern and western slopes along the northern end of the district. Slopes over 40% comprise about 10% of the unit. A small acreage of marginally stable land occurs on the western edge of the district. No areas of high erosion potential, marginally unstable, or unstable lands were identified. Limitations include areas some steep slopes; some rock outcrop and associated shallow soils; and rocky soils.

CC - III Rocky Hills Association: This unit is characterized by steep rocky hillsides and rock outcrops. Parent materials are composed of mixed volcanic residuum and colluvium. Soils are moderately deep gravelly loams and gravelly clay loams. Vegetation is sparse and consists of brush with scattered pockets of fir and aspen.



This unit occurs on the northern end of the district. Slopes over 40% comprise about 35-45% of the unit. No areas of high erosion potential, marginally stable, marginally unstable, or unstable lands were identified. Limitations include areas of steep slopes, rock outcrop, and shallow soils.

CC - IV Steep Sideslopes Association: This unit is characterized by steep rocky hillsides with some open valleys. Rock outcrop is common, especially where faulting has occurred. Parent materials are composed of mixed volcanic residuum and colluvium on the slopes and volcanic alluvium in the valleys. Soils range from shallow, gravelly loams on rocky slopes to deep clay loams in the valleys. Vegetation is spruce/fir with aspen pockets. Silver sage is common in the valleys.

This unit occurs on the west-central portion of the district. Slopes over 40% comprise <10% of the unit. A small area of high erosion potential occurs near Mammoth Summit. Marginally stable land occurs along Clear Creek. Marginally unstable lands occur along the middle reaches of Deer, Bunker, and Mammoth Creeks. No unstable lands were identified. Limitations include steep slopes, rock outcrop, shallow soils, some areas of marginally unstable lands, and a short growing season.

CC - V Rolling Hills and Valleys Association: This unit is characterized by long open ridges, rolling hills, and steep sideslopes and included small valleys. Rock outcrop is common on the ridges. Parent materials are composed of mixed volcanic residuum and colluvium. Soils are shallow to moderately deep gravelly loams and gravelly clay loams. Deeper loamy soils occur in the valleys. Vegetation consists of sagebrush on the ridges, silver sage in the higher valleys, and areas of mixed conifer and aspen.

This unit occurs on the east-central portion of the district. Slopes over 40% comprise <10% of the unit. No areas of high erosion potential, marginally stable, marginally unstable, or unstable lands were identified. Limitations include areas steep slopes, rock outcrop, shallow soils, and moderately high runoff potential.

CC - VI Rocklands Association: This unit is characterized by cinder cones, lava flows, and benchlands. Exposed bedrock is common. Parent materials are composed of basalt residuum and colluvium. Soils are non-existent where basalt flows are recent. In other areas, soils are moderately deep to deep loams and clay loams. Large boulders are common in the soil profile and on the surface. Vegetation is sparse on the lava beds. Mixed conifer and aspen occur elsewhere.

This unit occurs on the central portion of the district. Slopes over 40% comprise a minor portion of the unit. Marginally unstable lands occur south of Houston Mountain. No areas of high erosion potential, marginally stable, or unstable lands were identified. Limitations include areas of steep slopes near cinder cones, exposed bedrock, and bouldery surface.

CC - VII Dissected Hills and Valleys Association: This unit is characterized by steep dissected sideslopes surrounding long narrow valleys. Parent materials are composed of limestone and shale residuum and colluvium on the slopes and mixed alluvium in the valleys. Soils range from deep clay loams and clays in the valleys to moderately deep soils on the sideslopes. Vegetation consists of oakbrush, grasslands, pinyon/juniper, and ponderosa pine on the steeper sideslopes.

This unit occurs on the southwest portion of the district. Slopes over 40% comprise 25-35% of the unit. Areas of high erosion potential cover about 15-25% of the unit and are associated with exposed parent material. Marginally stable land occurs in the Shingle Mill, Dairy, and Stout Canyon area. No marginally unstable, or unstable lands were identified. Limitations include steep, strongly dissected slopes, high potential erosion rates, and poorly drained soils in the valley bottoms.

CC - VIII Faultlands Association: This unit is characterized by headlands with undulating benchlands as a result of faulting. Lower slopes are highly dissected with steep narrow canyon bottoms. Parent materials



of the upper slopes are composed of volcanic colluvium and the lower slopes are composed of a mix of residuum and colluvium from limestone, conglomerate and shale. Soils range from deep cobbly loams and clay loams on the upper slopes to moderately deep, eroded silt loams and clay loams on the lower slopes. Vegetation is spruce/fir and aspen at the upper elevations and ponderosa pine and pinyon/juniper at the lower elevations.

This unit occurs on the west-central edge of the district. Slopes over 40% comprise 35-45% of the unit. Marginally unstable lands comprise a significant portion of the unit (35-40%). Areas of high erosion potential and marginally stable lands also occur. No unstable lands were identified. Limitations include areas of steep erodible slopes, mass failure potential where soils are clayey and wet, and locally rugged inaccessible terrain.

CC - IX Rimlands Association: This unit is characterized by the distinctive barren pink rimlands typical of Bryce Canyon and the Cedar Breaks. Steep, dissected rimlands and the ridges and benches beneath the plateau rim are included in the unit. Parent materials include residuum and colluvium from sedimentary strata of limestone, sandstone, and shale. Soils are absent from the barren rimlands. On the benches and ridges below the rim they are deep, gravelly silty clay loams and clay loams. Where it occurs, vegetation is mixed conifer with aspen and oakbrush.

This unit occurs along the southwestern and southern edge of the district. Slopes over 40% comprise 70-80% of the unit. Marginally stable lands comprise a significant portion of the unit (50-60%). Areas of high erosion potential are less extensive. No marginally unstable or unstable lands were identified. Limitations include areas of steep, dissected slopes, high erosion potential, and some shallow, rocky soils.

CC - X Glaciated Headslopes Association: This unit is characterized by open valleys and low hills with an undulating topography resulting from weakly expressed glaciation. Parent materials include colluvium from volcanic rocks and limestone. Soils are deep, gravelly clay loams and clay loams. Cobbles and boulders occur on the surface where glaciation was most active. Vegetation is variable with open meadows of sagebrush and grass and spruce/fir with aspen elsewhere.

This unit occurs along the west-central portion of the district, east of Cedar Breaks. Slopes over 40% are a very minor component of the unit. No areas of high erosion potential, marginally stable, marginally unstable, or unstable lands were identified. Limitations include stony soil surface, rocky soils, and a very short growing-season.

CC - XI Mesas and Valleys Association: This unit is characterized by gently sloping mesa tops and shallow open valleys. Parent materials include residuum and colluvium from limestone and shale and mixed alluvium in the valleys. Basalt caps the limestone formations in some places. Soils range from deep, silty clay loams in the valleys to shallow soils on the valley rims and benches to moderately deep, gravelly clay loams on the mesas. Vegetation is mixed conifer on the slopes and sagebrush/grassland in the valley bottoms.

This unit occurs along the southwestern and southern edge of the district. Slopes over 40% comprise <10% of the unit. No areas of high erosion potential, marginally stable, marginally unstable, or unstable lands were identified. Limitations include moderately steep slopes, locally shallow, rocky soils, and a short growing season at the upper elevations.



## Powell Ranger District (P)

All of the Powell Ranger District falls within a area of moderate oil and gas potential. Seven landtype associations were identified. Table 3-16 summarizes the acreage for each landtype as they occur within each oil and gas potential area.

**TABLE 3-16**  
**Powell Ranger District Landtype Acreage**  
**(all Moderate Potential for Oil and Gas)**

Map Unit Label	Landtype Association	Total Acres	Percent of Total
P - I	Alluvial Fans, Benches, and Hillsides	60,403	16
P - II	Mountainsides & Rock Outcrop/Cliffs	94,813	25
P - III	Mountainsides and Ridgetops	38,018	10
P - IV	Dissected Pediments & Mtn. Meadows	19,703	5
P - V	Plateau Mountainsides, Mesas, Cliffs	44,215	12
P - VI	Badland/Rock Outcrop	38,480	10
P - VII	Mesas, Hillslopes, and Badlands	84,360	22
	Total	379,992	

P - I Alluvial Fans, Benches, and Hillsides Association: This unit is characterized by a variety of landforms associated with erosional and depositional processes including along coalescing alluvial fans, fan terraces, benches, hillsides, and mountainsides. Slopes range from gentle to steep. Some alluvial fan areas are highly dissected. The unit occurs between 6,500 and 8,500 feet. Parent materials are alluvium derived from a variety of igneous rocks. Soils include gravelly loams, sandy clay loams, and clay loams. Substratum materials tend to be very gravelly or cobbly loams, sandy loams, and loamy sands. Vegetation consists of pinyon/juniper with sagebrush/grasslands at lower elevations.

This unit occurs around the perimeter of the northern portion of the district. Slopes over 40% comprise about 10% of the unit and occur mostly in the northeast corner of the district. No areas of high erosion potential, marginally stable, marginally unstable, or unstable lands were identified. Limitations include some areas steep slopes, dissected areas with high runoff/sediment delivery potential, and low precipitation.

P - II - Mountainsides and Rock Outcrop/Cliff Association: This unit is characterized by moderately steep to steep hillsides and mountainsides. The unit occurs between 7,300 and 9,600 feet. Parent materials are residuum, colluvium, and alluvium all derived from igneous rocks. Vertical cliffs and ledges of volcanic rocks comprise about 30% of the unit. Soils are loams, clay loams, and some clays. A common feature



is high rock content throughout the soil. Soils range from very gravelly and cobbly to extremely gravelly and cobbly. Vegetation consists of pinyon/juniper and sagebrush.

This unit occurs in the northern portion of the district. Slopes over 40% comprise about 55-65% of the unit. Areas of marginally unstable lands comprise about 15% of the unit and are associated with escarpments, primarily in the west-central area of the north half of the district. A few minor areas of high erosion potential were identified. No areas of marginally stable, or unstable lands were identified (Dixie National Forest 1993 GIS maps). Limitations include steep slopes, rock outcrop, marginally unstable lands, and short growing season.

P - III Mountainsides and Ridgetops Association: This unit is characterized by moderately steep to very steep hillsides, mountainsides, and gently rolling ridgetops. The unit occurs between 8,200 and 10,500 feet. Parent materials are predominantly residuum and colluvium derived from igneous rocks. Soils are very cobbly and extremely cobbly loams and clay loams. Vegetation consists of mixed coniferous forest and mountain shrub.

This unit occurs in the central portion of the north half of the district. Slopes over 40% comprise about 35-45% of the unit. Areas of marginally unstable lands comprise about 5% of the unit. No areas of high erosion potential were identified. Limitations include steep slopes, a very short growing season, and a few areas of marginally unstable lands.

P - IV Dissected Pediments and Mountain Meadows Association: This unit is characterized by moderately steep dissected pediments (eroded mountain footslopes) and mountain meadows. The unit occurs between 8,500 and 10,500 feet. Parent materials are alluvium derived from igneous rocks. Soils are very deep and well drained. They include gravelly silt loams and loams and cobbly clay loams and sandy clay loams. Vegetation consists primarily of sagebrush/grassland and grass/forb meadows.

This unit occurs in the north-central portion of the district. Slopes over 40% comprise about 20-30% of the unit. Areas of marginally unstable lands comprise a minor portion of the unit. No areas of high erosion potential or, marginally stable lands were identified. Limitations include some steep slopes, a very short growing season, and a small area of marginally unstable lands.

P - V Plateau Mountainsides, Mesas, and Cliff Association: This unit is characterized by moderately steep to very steep rugged terrain of hillsides, mountainsides, ridges, and mesas. Vertical limestone cliffs comprise about 20% of the unit. The unit occurs between 7300 and 9600 feet. Parent materials are residuum and colluvium derived from limestone, sandstone, and shale. Soils are loams, clay loams, and some clays. A common feature is high rock content throughout the soil. Soils are very gravelly and cobbly to extremely gravelly and cobbly. Vegetation consists of pinyon/juniper at lower elevations and mixed conifer at higher elevations.

This unit occurs along the southern perimeter of the district. Slopes over 40% comprise about 70-80% of the unit. Areas of marginally stable lands comprise about 35-45% of the unit and are primarily associated with sandstone parent materials. Areas of high erosion potential comprise about 10% of the unit and area associated with the shale parent materials. Limitations include rugged terrain, steep slopes, cliffs, marginally stable lands, areas of high erosion potential, and short growing season.

P - VI Badland/Rock Outcrop Association: This unit is characterized by steep to very strongly dissected plateau slopes with v-shaped valleys and sharp divides. Rock outcrops of interbedded limestone, sandstone, and shale form spectacular columns, spires, pinnacles and shear walls. The unit occurs between 7,300 and 8,500 feet. Parent materials are residuum and colluvium derived from limestone, sandstone, and shale. Includes soils are clays formed in the shale and gravelly and cobbly loams and



sandy loams formed in the other sedimentary parent materials. Much of the unit is barren. Where vegetation occurs it is sparse shrublands with small inclusions of pinyon/juniper and ponderosa pine.

This unit occurs in the west-central portion of the district. Slopes over 40% comprise about 10-15% of the unit. Areas of high erosion potential comprise about 10% of the unit and are associated with badlands. No areas of marginally stable, marginally unstable, or unstable lands were identified. Limitations include rugged terrain, steep slopes, shallow soils, cliffs, areas of very high erosion potential, and short growing season.

P - VII Mesa, Hillslope, and Badland Association: This unit is characterized by highly dissected shale badlands, gently sloping benches and mesas, and steep to very steep hillsides. The unit occurs between 7100 and 9600 feet. Parent materials are residuum and colluvium derived primarily from limestone. Soils are moderately deep and well drained. Typically they are gravelly to extremely cobbly loams and silt loams. The shale badlands are barren. Elsewhere, vegetation is predominantly mixed conifer and mountain shrub.

This unit occurs in the south-central portion of the district. Slopes over 40% comprise about 10-15% of the unit. Areas of high erosion potential comprise about 10-15% of the unit and are associated with badlands. Marginally stable lands comprise about 15-20% of the unit and are associated with the major drainageways. No areas of marginally unstable or unstable lands were identified. Limitations include rugged terrain, steep slopes, some shallow soils, areas of very high erosion potential, marginally stable lands along major drainages, and very short growing season.

### **Escalante and Teasdale Ranger Districts (ET)**

The Escalante and Teasdale Ranger Districts fall within five different areas for oil and gas potential. The areas are shown on the Oil and Gas Potential Map (Figure 2-2). The Aquarius Plateau, northern Escalante Mountains, and Boulder Mountain area occurs on both ranger districts and has a high potential for carbon dioxide accumulations and a moderate potential for oil and gas accumulations. The Southern Escalante Mountains, Table Cliffs, Plateau, Kaiparowits Plateau/Escalante Benches area occurs in the southern portion of the Escalante Ranger District and has a moderate potential for oil and gas including carbon dioxide accumulations. The Eastern End of the Boulder Mountain area has a low potential for oil and gas accumulations. The Escalante anticline area has a high potential for carbon dioxide and moderate potential for oil and gas. The area between the Escalante anticline and the East End of Boulder Mountain has a moderate potential for oil and gas including carbon dioxide accumulations. Eight landtype associations were identified. Table 3-17 summarizes the acreage for each landtype as they occur within each oil and gas potential area.

ET - I Alluvial Floor, Toeslopes, and Canyons Association: This unit is characterized by a variety of landforms associated with erosional and depositional processes including steep incised canyons, dissected alluvial floors, graded toeslopes and benches. Rocky hillslopes and ledges in the canyons are common. Slopes range from gentle to steep. Parent materials are alluvium and colluvium derived from a variety of igneous and sedimentary rocks. Soils are highly variable depending on position on the landscape. Soils range from deep in the valleys to shallow on benches and hills. Soil textures are variable but are generally rocky throughout. Vegetation is generally sparse. Where it occurs it consists of pinyon/juniper with sagebrush or rabbitbrush/grasslands. Ponderosa pine also occurs to a limited extent.



**TABLE 3-17**  
**Escalante/Teasdale Ranger Districts**  
**Landtype Association Acreage by Oil and Gas Potential Area**

Map Unit Label	Landtype Association	Total Acres	Aquarius Plateau N. Escal. Mtn. Mod O&G High CO <sub>2</sub>	Percent of Total	S. Escal. Mtn. Table Cliff/ Kaiparowits Mod O&G	Percent of Total	East End Boulder Mtn.	Percent of Total	Escalante anticline Mod O&G High CO <sub>2</sub>	Percent of Total	Area Between Escal. Anticline/ Boulder Mtn. Mod O&G	Percent of Total
ET - I	Alluvial Floor, Toeslopes, Canyons	58,359	25,174	9	33,185	17	0	0	0	0	0	0
ET - II	Badlands	1,717	0	0	1,717	1	0	0	0	0	0	0
ET - III	Table Cliff Plateau, Rim & Sideslopes	60,968	3,250	1	57,718	29	0	0	0	0	0	0
ET - IV	Canyonlands and Mesas	164,707	0	0	50,050	26	28,469	94	41,309	53	44,879	39
ET - V	Plateau	113,741	79,550	30	20,574	10	0	0	13,616	18	0	0
ET - VI	High Elevation Glaciated Plateau	51,790	45,725	17	0	0	0	0	3,776	5	2,289	2
ET - VII	High Elev., Gently Sloping Benchlands	30,391	30,391	11	0	0	0	0	0	0	0	0
ET - VIII	Glaciated Rimlands and Benchlands	204,500	84,698	32	32,703	17	1,782	6	18,995	24	66,322	59
	Totals	686,173	268,790		195,947		30,251		77,698		113,490	



This unit occurs along the western portion of the district. Slopes over 40% comprise about 10% of the unit and occur mostly in the Aquarius Plateau portion. An area of high erosion potential and a few small marginally unstable areas were identified in the northwest corner of the district. No areas of marginally stable or unstable lands were identified. Limitations include some areas of steep slopes; dissected areas with high runoff/sediment delivery potential; some rock outcrop; and low precipitation.

ET - II Badlands Association: This unit is characterized by steep, strongly dissected and severely eroded sideslopes and canyon floors. Rocky hillslopes and ledges in the canyons are common. Parent materials are alluvium and colluvium derived from limestone, sandstone, and shale. Soils range from shallow to deep and have silty clay loam and clayey textures. Vegetation is sparse. Scattered pinyon/juniper with sagebrush and some ponderosa pine occurs.

This unit occurs along the southwestern edge of the district. Slopes over 40% comprise about 80-90% of the unit. Areas of high erosion potential cover as much as 40% of the unit. No areas of marginally stable, marginally unstable, or unstable lands were identified. Limitations include steep slopes, dissected areas with high runoff/sediment delivery potential, and low precipitation.

ET - III Table Cliff Plateau, Rim, and Sideslopes Association: This unit is characterized by rolling plateau and ridges, steep, strongly dissected and eroded sideslopes and benches. Cliffs and ledges along the escarpment are common. Parent materials are residuum and colluvium derived from sedimentary and igneous rocks. Soils are variable depending on landscape position and parent material mix. Vegetation included ponderosa pine and spruce/fir at middle to higher elevations and pinyon/juniper at lower elevations.

This unit occurs in the south-central portion of the district. Slopes over 40% comprise about 35-45% of the unit. Areas of high erosion potential cover as much as 40% of the unit and are generally associated with the slopes over 40%. Areas of marginally unstable lands occur around Barney Top. No areas of marginally stable or unstable lands were identified. Limitations include steep slopes, areas of marginally unstable land, high erosion potential especially when rock pavement is disturbed, some cliff areas, and short growing season.

ET - IV Canyonlands and Mesas Association: This unit is characterized by rocky canyons, steep sideslopes, mesas, and meadows. Inclusions of rolling hills, benchlands, and meadows also occur. Sandstone rock outcrops are common in the canyons. Dissected and gullied areas are common on sideslopes and alluvial bottoms. Parent materials are residuum and colluvium derived from sandstone and shale with some areas of volcanics. Soils are variable and range from shallow to deep. Soil textures range from sandy loams to loams and clays. In many areas cobbles and boulders partially cover the soil surface. Some soils have high lime content. Vegetation included ponderosa pine and mountain shrub at higher elevations and pinyon/juniper with sagebrush at lower elevations.

This unit occurs along the entire eastern boundary of the districts. Slopes over 40% comprise about 30-40% of the unit. Areas identified as having high erosion potential cover a very minor portion of the unit. Areas of marginally unstable or marginally stable lands occur to a very minor extent as well. No areas of unstable lands were identified. Limitations include rugged inaccessible terrain, rock outcrops and cliffs, steep slopes, some areas with mass stability problems, and low precipitation.

ET - V Plateau Association: This unit is characterized by low rolling hills and swales with some areas of steeper sideslopes. Parent materials are residuum and alluvium derived from volcanics. Soils are moderately deep to deep very gravelly and cobbly loams, silt loams and clay loams. Stony and bouldery surfaces are common. Vegetation is spruce/fir forest with aspen groves. Open meadows are dominated by silver sagebrush and grass.



This unit occurs along the entire eastern boundary of the districts. Slopes over 40% comprise about 5% of the unit. Areas identified as having high erosion potential cover a minor portion of the unit. Areas of marginally unstable or marginally stable lands also occur to a minor extent and are often associated with the steep slopes. No areas of unstable lands were identified. Limitations include a short growing season and some areas of shallow soils, rock outcrop, stony surfaces, or steep slopes.

ET - VI High Elevation Glaciated Plateau Association: This unit is characterized by a broad plateau with rough undulating slopes, low rolling hills, and swales. Numerous small perennial and ephemeral lakes also occur. The unit occurs between 10,500 and 11,300 feet. Parent materials are primarily residuum derived from volcanics. Alluvium occurs in the swales. Soils are shallow and rocky. Stony and bouldery surfaces are common. Vegetation is dominated by spruce/fir forest and open meadows with grasses, sedges, and forbs.

This unit occurs in the northeast portion of the Teasdale Ranger District. Slopes over 40% comprise an extremely minor part of the unit. Areas of marginally unstable or marginally stable lands also occur to a very minor extent. No areas of high erosion potential or unstable lands were identified. Limitations include an extremely short growing season; shallow soils; wet areas; low-relief rock outcrop; and stony surfaces.

ET - VII High Elevation, Gently Sloping Benchlands Association: This unit is characterized by long, smooth, gently sloping benchlands. The unit occurs between 8,500 and 9,500 feet. Parent materials are primarily residuum derived from volcanics. Soils are deep and very rocky, often with limy substratum. Cobbly surfaces are common. Vegetation is dominated by sagebrush/rabbitbrush and grasslands. Pockets of aspen occur at the higher elevations.

This unit occurs in the northwestern boundary of the ranger districts, extending from the Aquarius Plateau benchlands and gently dropping northward. Slopes over 40% and areas of high erosion potential comprise a very minor part of the unit. A small area of marginally unstable lands occurs near Pine Creek Reservoir. No areas of marginally stable or unstable lands were identified. Limitations include a very short growing season, rocky soils, and low precipitation.

ET - VIII Glaciated Rimlands and Benchlands Association: This unit is characterized by undulating slopes, benchlands, and moderately sloping toeslopes below the Aquarius Plateau and Boulder Mountain. Extensive areas of unstable lands ranging from small slope failures to large block slides occur below the rims. Much of the unit exhibits glaciated features such as talus slopes, moraines, and headwalls. The unit occurs between 7,500 and 10,500 feet. Parent materials are primarily colluvium and glacial drift from a variety of rock types. Soils are shallow to deep and generally rocky. Clayey soils with high shrink-swell characteristics, wet and imperfectly drained soils, and cobbly and bouldery surfaces are common. Vegetation includes spruce/fir forests with aspen groves and scattered meadows at higher elevations, mixed coniferous forest at mid-elevations and oak/ponderosa pine at lower elevations.

This unit occurs in a band circling the Aquarius Plateau and Boulder Mountain. Slopes over 40% comprise about 10-15% of the unit. Marginally unstable lands comprise about 15-20% of the unit. Marginally stable lands comprise about 35-45% of the unit. Two areas of unstable lands were identified. One area is small and is located near Barker Reservoir. The other covers about two square miles between Lost Lake and Flatiron Lakes. Limitations include a very short growing season at the higher elevations; extensive areas of poor soil/slope stability; soils with high shrink-swell potentials; rocky surfaces; wet and imperfectly drained soils; some steep slopes; and low precipitation at lower elevations.



## RECREATION

This section describes the recreation opportunities and experiences on the Dixie National Forest which would be affected by potential oil and gas leasing and subsequent activities, and addresses the following issues:

- Issue 4**            The effects of oil and gas leasing and possible subsequent exploration and development activities on visual and recreation resources.
- Issue 5**            The effects of oil and gas leasing and possible subsequent exploration and development activities on established National Parks, National Monuments, and Wilderness.

A detailed recreation resource inventory in terms of the Recreation Opportunity Spectrum (ROS), recreation sites and places, major recreation activities, and estimates of user volume for the study area was compiled using the methodologies and guidelines of the Forest Service ROS (Forest Service 1974) and through interviews with the Forest Service recreation specialist. The purpose of this inventory was to establish and document the existing recreation qualities of the Dixie National Forest in order to assess the potential effects of proposed oil and gas leasing with potential oil and gas exploration and development on recreation experiences and opportunities.

### Recreation Opportunity Spectrum

The ROS is composed of six classes describing possible combinations of activities, settings, and probable recreation experience opportunities. This system was developed by the Forest Service to analyze both the physical setting and the recreation use/experience as factors that affect the availability and quality of recreation opportunities (Forest Service, 1974).

The ROS system defines recreation opportunities as:

- Primitive
- Semi-primitive non-motorized
- Semi-primitive motorized
- Roaded natural
- Rural
- Urban

The six classes provide a framework for defining outdoor recreation opportunity environment. For the purposes of this analysis the ROS classification of urban was not discussed as there are no urban areas in the Dixie National Forest Study Area. ROS is an analytical tool used by the Forest Service for measuring recreation opportunities. These opportunities vary from primitive wilderness areas with only minimal modifications to the environment to highly developed sites, greatly modifying the physical environment.

Key recreation resource features are illustrated in Figure 3-11 at the end of this chapter, including areas of semi-primitive non-motorized recreation opportunities, developed recreation sites, and "high recreation" areas. Table 3-18 shows the acres of each ROS class by Ranger District.



**TABLE 3-18**  
**Acres of Recreation Opportunity Spectrum Classes by Ranger District**

Ranger District	Oil and Gas Potential	Private Land	Primitive	Roaded Natural	Semi-primitive Motorized	Semi-primitive Non-Motorized	Rural
Cedar City	Moderate	49,540	6,527	76,660	210,735	58,335	2,430
Escalante & Teasdale	Moderate (High CO <sub>2</sub> )	1,276	29,250	40,008	264,098	8,297	0
Escalante	Moderate	1,972	0	70,987	97,582	34,910	0
Pine Valley	Low	10,216	9,460	28,065	74,211	89,380	0
Pine Valley	Moderate	8,321	38,990	27,418	82,161	109,491	3,207
Powell	Moderate	9,271	0	124,173	53,882	201,182	0
Teasdale & Escalante	Moderate	2,846	1,289	24,575	76,035	7,146	0
Teasdale	Low	0	0	0	29,959	0	0

**Primitive (P)** - A natural, unmodified environment with characteristics found in designated Wilderness. Users will rarely encounter other people or evidence of human activity. The area offers a high degree of challenge and risk. There may be trails, but few structures. Motorized travel is prohibited.

The areas classified as primitive are found in three locations and are designated Wilderness. The Pine Valley Mountain Wilderness is located on the southeast side of Pine Valley Ranger District along the Pine Valley Mountains. The Ashdown Gorge Wilderness Area is located on the Cedar City District bounded to the east by the Cedar Breaks National Monument and to the west by the district boundary. The Box-Death Wilderness area is located in the Escalante District between Hells Backbone road and the southern district boundary.

**Semi-primitive Non-motorized (SPNM)** - 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 wandering through the area. Motorized travel is prohibited.

Areas that are classified as SPNM are dispersed throughout the study area and generally occur where no roads exist.

**Semi-primitive Motorized (SPM)** - 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 are dispersed throughout the study area and usually occur at a distance greater than one half mile from highly modified, constructed roads. The SPM areas also generally exist where primitive roads and trails are located.

**Roaded Natural (RN)** - 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.

Roaded Natural 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.

Corridors along the state highways and secondary roads in the study area are classified as RN, these roads include: Forest Service Road 006 to Honeycomb Campground, Highway 18, Forest Service Road No. 035 to Pine Valley Recreation Area, Scenic Byway 143, 148, 14, 12, and State Highway 63.

Most of the constructed gravel roads in the study area are classified as RN. Some of the gravel/dirt roads are connector roads to the secondary roads, however, many of these roads provide access to numerous recreation sites, recreation areas, and private residences.

Not all Forest Service primitive roads in the study area are classified as RN, however, in areas of popular and commonly used developed recreation sites and dispersed areas the primitive roads are considered to be RN within the ROS classification.

**Rural (R)** - Area is characterized by a substantially modified natural environment. Resource modifications enhance specific recreation activities and some of the facilities are designed for a large number of people. Sights and sounds of humans are readily evident, and user interaction is moderate to high. Facilities are also provided for intensified motorized use and parking.

Areas classified as Rural occur on the Pine Valley Ranger District in the Pine Valley Recreation Area and in the Cedar City Ranger District surrounding Panguitch Lake.

**Urban (U)** - Areas substantially characterized by an urbanized environment. The background elements may appear to be natural, however the vegetation is often exotic or manicured. Large numbers of users can be expected on-site and nearby with predominant sights and sounds of humans. Modifications are done to enhance specific recreation activities. Facilities for highly intensified motor use and parking are available with forms of mass transit often available. There are no areas classified as Urban in the study area.

### **Major Recreation Activities**

The major recreational uses that occur in the Dixie National Forest Study Area are: camping, picnicking, viewing scenery, automobile travel, viewing interpretive signs, hiking, horse back riding, downhill skiing, cross country skiing, snowmobiling, staying at resorts, big game hunting, and cold water fishing. Table 3-19 shows a listing of recreation activity summaries by Ranger District.



**TABLE 3-19**  
**Recreation Activity Summaries by Ranger District**

Activity Grouping	Recreation Visitor Days (in thousands)	Percent of Total
<b>Pine Valley Ranger District</b>		
camping, picnicking, swimming	133	43
mechanized travel, viewing scenery	39	12
hiking, horseback riding, water travel	41	13
winter sports	11	3
resorts, cabins, organized camps	16	5
hunting	18	6
fishing	11	4
nonconsumptive fish & wildlife use	5	2
other recreation activities	36	12
<b>District Total</b>	<b>310</b>	<b>100</b>
<b>Cedar City Ranger District</b>		
camping, picnicking, swimming	547	45
mechanized travel, viewing scenery	196	16
hiking, horseback riding, water travel	36	3
winter sports	165	14
resorts, cabins, organized camps	58	5
hunting	89	7
fishing	38	3
nonconsumptive fish & wildlife use	4	<1
other recreation activities	74	6
<b>District Total</b>	<b>1,207</b>	<b>100</b>



**TABLE 3-19**  
**Recreation Activity Summaries by Ranger District (cont.)**

Activity Grouping	Recreation Visitor Days (in thousands)	Percent of Total
<b>Powell Ranger District</b>		
camping, picnicking, swimming	85	8
mechanized travel and viewing scenery	759	72
hiking, horseback riding, water travel	26	2
winter sports	4	<1
resorts, cabins organized camps	0	0
hunting	17	2
fishing	15	1
nonconsumptive fish & wildlife use	0.5	<1
other recreation activities	148	14
<b>District Total</b>	<b>1,054</b>	<b>100</b>
<b>Escalante Ranger District</b>		
camping, picnicking, swimming	155	5
mechanized travel, viewing scenery	2,550	90
hiking, horseback riding, water travel	17	<1
winter sports	4	<1
resorts, cabins, organized camps	20	1
hunting	24	1
fishing	35	1
nonconsumptive fish & wildlife uses	2	<1
other recreation activities	36	1
<b>District Total</b>	<b>2,840</b>	<b>100</b>



**TABLE 3-19**  
**Recreation Activity Summaries by Ranger District (cont.)**

Activity Grouping	Recreation Visitor Days (in thousands)	Percent of Total
<b>Teasdale Ranger District</b>		
camping, picnicking, swimming	65	18
mechanized travel, viewing scenery	80	22
hiking, horseback riding, water travel	29	8
winter sports	0	0
resorts cabins, organized camps	15	4
hunting	58	16
fishing	41	11
nonconsumptive fish & wildlife use	8	2
other recreation activities	70	19
<b>District Total</b>	<b>365</b>	<b>100</b>



Big game hunting is a popular and major recreation activity for residents and nonresidents in the Dixie National Forest. Rifle hunting for mule deer is the most common event, however, permits for elk and pronghorn antelope are allowed. Rifle hunting is a major event and crowding on opening weekend of the rifle season is a problem. Utah Division of Wildlife Resources makes changes each year to the hunting permits, regulations, and seasons to accommodate changes in wildlife populations and the numbers of people hunting, as well as when and where people are hunting.

## Recreation Sites and Places

### **Developed Sites**

Developed recreation sites that occur within the Dixie National Forest Study Area are interspersed throughout the Forest. Table 3-20 provides a detailed list of developed recreation sites in each Ranger District.

A majority of the developed recreation sites within the Pine Valley Ranger District occur within the Pine Valley Recreation Area including six campgrounds, one trailhead, and an overlook. Two other developed recreation sites (campgrounds) occur at the Enterprise Reservoir in this district. Three Points of Interest are also located in the Pine Valley District. The Points of Interest include: Old Iron Town on private land with access by Forest Service Road 012, Mountain Meadow Monument along Utah State Highway 18, and the Whipple trail head in the Pine Valley Recreation Area.

The following developed recreation sites are also located on the Pine Valley Ranger District under a special use permit. These sites are operated by private concessionaires and include: Blue Spring, Juniper Park, and Pines Campgrounds, Lower Pines group area, Upper Pines group camping area, Ponderosa Group area, West Ponderosa group area, and the Lions Club Lodge.

Cedar City Ranger District developed recreation sites which include campgrounds, Points of Interest, boat ramps, and snowmobile trail heads occur along Scenic Byway 143 and Panguitch Lake, at Brian Head Ski Resort, and along Scenic Highway 14. Four Points of Interest are located in the Cedar City District, they include: The Brian Head Observation Point near Brian Head Ski area, Zion Overlook along Scenic Highway 14, 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 058.

The following developed recreation sites are also located within the Cedar City Ranger District under a special use permit. These sites are operated by private concessionaires and include: Duck Creek, Navajo Lake, Spruces, Te-ah, Panguitch Lake North, Panguitch Lake South, White Bridge, Vermillion Castle, Cedar Canyon, Deer Haven Campgrounds, Navajo Lake Lodge, Behmer Lodge and Landing, Lake View Resort, and Brian Head Ski Area.

The Powell Ranger District contains only two developed recreation sites: Red Canyon Campground along Scenic Byway 12 and King Creek Campground along the East Fork of the Sevier Scenic Backway. The Powell District has two Points of Interest including: Red Canyon viewing area along Scenic Byway 12 and Pink Cliffs viewing area with trail access from Forest Service Road No. 209.

The Escalante Ranger District has four developed recreation sites (campgrounds) interspersed throughout the district. Three of the four campgrounds are located near water (Pine Lake, Baker Reservoir, and Posey Lake). The Escalante District has two Points of Interest including: Powell Point viewing area with trail



**TABLE 3-20  
Developed Recreation Sites**

<b>District</b>	<b>Recreation Site</b>	<b>Activities/Facilities</b>	<b>Operator</b>
<b>Pine Valley District</b>	Pine Park	tent camping	Forest Service
	Honeycomb Rocks	camping, fishing, swimming	Forest Service
	Ponderosa	picnicking, fishing, hiking	Concessionaire
	Lower Pines	picnicking, fishing, hiking	Concessionaire
	Upper Pines	camping, fishing, hiking	Concessionaire
	Pines	camping, picnicking, fishing, hiking	Concessionaire
	Blue Springs	camping, fishing, hiking	Concessionaire
	Juniper Park	camping, fishing, hiking	Concessionaire
	Oak Grove	tent camping, hiking	Forest Service
<b>Cedar City District</b>	Vermillion Castle	camping, picnicking	Concessionaire
	White Bridge	camping, fishing	Concessionaire
	Panguitch Lake North	camping, ranger station	Concessionaire
	Panguitch Lake South	camping	Concessionaire
	Mammoth Spring	tent camping, fishing	Forest Service
	Cedar Canyon	camping	Concessionaire
	Deer Haven	camping	Concessionaire
	Te-ah	camping, fishing	Concessionaire
	Navajo Lake	camping, fishing	Concessionaire
	Spruces	camping, fishing, boat ramp	Concessionaire
	Duck Creek	camping, fishing, ranger station	Concessionaire
	Kolob Canyon Road Terminus	picnicking	Forest Service
<b>Powell District</b>	Red Canyon	camping, picnicking, hiking, view area	Forest Service
	King Creek	camping, fishing, picnicking,	Forest Service
<b>Escalante District</b>	Barker Reservoir	tent camping, fishing, picnicking, hiking, horseback riding, boating	Forest Service
	Posey Lake	camping, fishing, hiking, boating	Forest Service
	Blue Spruce	tent camping, fishing, hiking	Forest Service
	Pine Lake	camping, fishing, hiking, boat ramp, boating, swimming	Forest Service
<b>Teasdale District</b>	Oak Creek	camping, hiking	Forest Service
	Pleasant Creek	camping, fishing, hiking	Forest Service
	Lower Bown	tent camping, fishing, picnicking, hiking, boating, swimming	Forest Service
	Singletree	camping, fishing, hiking	Forest Service



access from Forest Service Road 091 and Roger Peak viewing area with access from Forest Service Road 153 (Hells Backbone road).

Developed recreation sites (campgrounds) on the Teasdale District are located along the Boulder-Grover Road, a Scenic Byway (Highway 12), and at the Lower Bown Reservoir. Three Points of Interest in the Teasdale District include: Steep Creek viewing area and Keller Ridge viewing area along Scenic Highway 12, and Bluebell Knoll (the highest point on the Dixie National Forest) with access from Forest Service Road 178.

### **Dispersed Recreation Areas**

The Dixie National Forest receives an immense (approximately 5,776,000 recreation visitor days per year) amount of recreational use. This use not only occurs in developed recreation sites, but in areas that are not developed throughout the forest. The following is a list of popular dispersed recreation areas on each district.

Areas most commonly used areas for dispersed recreation on the Pine Valley Ranger District largely occur in the Pine Valley Recreation Area, Cottonwood Road (Forest Service Roads 031 and 033), Forest Service Road 011 following the Pinto Creek South Fork, and near the trailheads at Pinto Creek, Comanche Spring, and Bench Spring.

Commonly used dispersed recreation areas in the Cedar City District occur in the area of Bear Valley, Brian Head Ski Area, the area surrounding the 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.

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 at the Podunk Forest Service Guard Station.

Commonly used dispersed recreation areas in the Escalante District occur in the vicinity of Barker Reservoir, Lower Barker Reservoir, and the 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.

Commonly used dispersed recreation areas in the Teasdale District occurs in the area of Row Lakes Purple Lake, Halfmoon Lake, Horseshoe Lake, Round Lake, Scout Lake, Lower Brown Reservoir, Fish Creek Lake, Blind Lake, Donkey Reservoir, Lower Bowns Reservoir, Round Lake, and Lost Lake.

### **Wilderness Areas**

There are three established Wilderness Areas in the Dixie National Forest Study Area, Pine Valley Mountain Wilderness Area located on the east side of Pine Valley District, Ashdown Gorge Wilderness Area located on the Cedar City District and is adjacent to the west boundary of Cedar Breaks National Monument, and the Box-Death Hollow Wilderness Area is located on the Escalante District on the south side of Hells Backbone Road. Established Wilderness Areas are not available to oil and gas leasing except by prior existing rights. The Wilderness Areas are accessible by numerous trails (refer to section on Wilderness)



## Trails

The Dixie National Forest maintains approximately 1,009 miles of trail. Currently, new trails are being developed and constructed. The Forest maintains sections of trails of national significance, the Great Western Trail and the American Discovery Trail. The Great Western Trail travels in a north-south between Mexico and Canada and the American Discovery Trail travels in a east-west direction. Many other trails are dispersed throughout the study area providing access to many recreation sites and areas.

## Outfitters

The Dixie National Forest has issued 21 special use permits for recreation in the study area. These permits are held by operations that outfit and guide for deer, bear, antelope, elk, and mountain lion hunting, trail rides and overnight pack trips, snowmobiling, horse back riding, fly fishing, ATV rides, experiences for troubled and defiant youth, and cattle round-ups.

## Scenic Byways and Scenic Backways

Scenic Byways are state highways that have been designated as significantly scenic, culturally, or historically unique with road conditions that standard vehicles can travel on. Scenic Backways are also designated by the state as significantly scenic, culturally, or historically unique, however, the road is not necessarily paved or open year round. It may not be possible for a standard vehicle to travel the backways.

Throughout the Dixie National Forest several roads designated as Scenic Byways and Scenic Backways travel through breathtaking scenery and lead to numerous developed recreation sites within the boundaries of Dixie National Forest and beyond the forest to private, city, county, state, and other public recreation locations.

*Brian Head-Panguitch Lake Scenic Byway U-143* - climbs southeast from Parowan, past the Vermillion Cliffs to the 9,800 foot-high town of Brian Head, and Brian Head Ski Resort. Scenic Byway 143 turns east, crossing alpine stretches of the Dixie National Forest to Panguitch Lake, a year-round fishing and recreation area. The byway continues 17 miles northeast of the lake to the town of Panguitch.

*Markagunt Scenic Byway U-14* - A steep climb from Cedar City on the Scenic Byway, Utah State Highway 14, leads into the Dixie National Forest. Fifteen miles east of Cedar City, Scenic Byway Utah State Highway 148 heads north from Utah State Highway 14 for six miles to Cedar Breaks National Monument. At the 10,000 foot summit of Cedar Mountain, Zion Overlook offers a panoramic view of Kolob Terrace and the distant buttes of Zion National Park. Along this byway, ancient lava flows and extinct volcanoes reveal the geology. Continuing east on the byway, is Navajo Lake, Scenic Byway Utah State Highway 14 ends at the intersection of US Highway 89.

*Kanab Scenic Byway US-89* - This byway is one of Utah's most popular drives and goes between Panguitch and Kanab. A small portion of the byway passes through the southeast corner of the Cedar City District, however, the byway mainly occurs between the Dixie National Forest's Cedar City District and the Powell District. The portion of the byway occurring in the Cedar City District travels through a forested mountain valley with views of the Navajo Lime Stone formations, similar to those found in Bryce Canyon National Park from US Highway 89 on the south to Utah State Highway 24 on the north.



*Highway 12 Scenic Byway* - This byway starts from US Highway 89, south of Panguitch, and guides the visitor through the fascinating Red Canyon on the Dixie National Forest and continues to rise in elevation to the spectacular spires of Bryce Canyon National Park. The park is accessible on Utah State Highway 63 from Utah State Highway 12. East of Bryce Canyon National Park, Scenic Byway 12 passes through small communities and scenic attractions outside of the Dixie National Forest boundary ending near the entrance to Capitol Reef National Park.

*Loa to Hanksville Scenic Byway U-24* - This byway passes outside the northern boundary of the Teasdale District of the Dixie National Forest. The byway begins in Loa passing through farming communities and Capitol Reef National Park to Hanksville and continues north to US Interstate 70.

*Dry Lakes/Summit Canyon* - This backway is a dry-weather dirt and gravel road (closed in the winter) between Interstate 15 and Scenic Byway 143. This backway features views of Cedar Canyon, Cedar Breaks National Monument, Ashdown Gorge Wilderness Area and Sugarloaf Mountain.

*Kolob Reservoir Road* - A paved, gravel and dirt road (closed in winter) features hikes through meadows, views of Zion National Park, Kolob Reservoir, Kolob Terrace, and Kolob Canyons. This backway travels between Scenic Byway 14 and Scenic Byway 9 passing through a portion of Zion National Park.

*East Fork of the Sevier* - A double and single lane gravel road off of Scenic Byway 12 extending south and traveling parallel to Bryce Canyon National Park. Feature views of the East Fork of the Sevier River, Tropic Reservoir, Podunk Guard Station, and a broad forested valley with red rock formations within the Dixie National Forest. The backway becomes a primitive road and then turns into a trail.

*Griffin Road* - A narrow single lane dirt and gravel road (closed in winter) mainly occurring on the Escalante Ranger District on the Dixie National Forest. The backway begins in Escalante off of Scenic Byway 12, and intersects with Posey Road Scenic Backway. This backway features views from a high plateau and excellent wildlife viewing within Dixie National Forest.

*Posey Lake Road* - A single lane dirt road and gravel road (closed in winter) between Scenic Byway 24 and Scenic Byway 12. The backway occurs mainly on the Dixie National Forest and features access to Posey Lake, wildlife viewing, camping and fishing. Sunrises and sunsets from the nearby plateaus and magnificent.

*Burr Trail* - A hard surfaced, graded dirt and gravel road originating near the town of Boulder in the Escalante Ranger District of the Dixie National Forest, crosses Capitol Reef National Park's Waterpocket Fold to Lake Powell.

## **VISUAL RESOURCES**

This section describes the visual resources on the Dixie National Forest which may be affected by the potential oil and gas leasing, subsequent activities and addresses;

- Issue 4**      The effects of oil and gas leasing and possible subsequent exploration and development activities on visual and recreation resources.



## **Background**

A visual resource inventory of variety Class, visual sensitivity, distance zone (visibility), and visual quality objectives for the study area was conducted using the methodologies and guidelines of the Forest Service Visual Management System (VMS) (Forest Service 1974). The purpose of this inventory was to establish and document the existing visual qualities of the Dixie National Forest in order to assess the potential visual effects of proposed oil and gas leasing with potential exploration and development.

## **Visual Resource Management System**

In the Visual Resource Management System (VMS), all National Forest system lands can be described by the character of their landscape. This characteristic landscape is the naturally established landscape, which visually represents the basic patterns of land, rock, water, and vegetation which are common to the scene being viewed. For visual management purposes, these visual patterns (land, rock, water, and vegetation) are being evaluated in the context of their form, line, color, and texture.

The greater the variety of form, line, color, and texture the greater the potential for high scenic quality. All lands have value, but classifying landscapes into variety class units identifies those landscapes which are most diverse in form, line, color, and texture and therefore have a higher scenic value and those landscapes which are of less scenic value. Smaller units of physiographic and visual characteristics define the boundaries between variety class units. There are three variety class designations that describe the scenic quality of the landscape:

- Class A - Distinctive
- Class B - Common
- Class C - Minimal

Sensitivity levels refer to the degree of the visitors concern for or expectation of the landscape. Sensitivity levels are rated from one to three, with one being the most sensitive and three being the least sensitive. Viewers in the study area are most likely to be recreation users. Recreation users typically have a high sensitivity (sensitivity level I) of the visual environment.

Distance zones are divisions of the particular landscape being viewed, denoted by specific distances from the observer. Distance zones are important frames of reference for discussing changes in the characteristic landscape because the greater the distance between the viewer and a management activity, the less noticeable are the details and, consequently, the impact of the activity on the characteristic landscape. There are three distance zones:

- Foreground (fg)      0 - 1/2 mile
- Middleground (mg)    1/2 to 3 - 5 miles
- Background (bg)      3 - 5 to 10 miles and beyond.

To evaluate the relative value of visual resources, a visual resource inventory of characteristic landscapes is necessary. This value is measured as a composite of two factors: a physical component (variety class) that measures the landscape's inherent visual quality and a social component (sensitivity level) that measures people's concern for its scenic value. These two components are combined with a third element, distance zone, to develop visual quality objectives.

Visual Quality Objectives (VQOs) have been established for determining the amount of alteration a given landscape can sustain without jeopardizing its visual quality. VQOs are determined from the composite



values of variety classes, sensitivity levels, and distance zones. There are five VQOs: Preservation, Retention, Partial Retention, Modification, and Maximum Modification.

Except for VQO of Preservation, which allows only ecological changes, each describes a different degree of alteration acceptable in the characteristic landscape based on its aesthetic value. The degree of alteration is measured in the context of its visual contrast in form, line, color, and texture with the characteristic landscape.

### Variety Class

For the Dixie National Forest study area, Class A (distinctive) landscapes occur in high alpine areas with abundant spruce and fir trees, meadows and wildflowers. Distinctive landscapes also occur in areas with unique volcanic intrusions occur, and deep eroded and colorful canyons.

These distinctive areas classified as Class A include the Pine Valley Recreation Area which encompasses the Pine Valley Mountain Wilderness (Pine Valley District), Cedar Breaks National Monument and extends beyond the boundaries of the monument to the southwest, the Yankee Reservoir including Brian Head Ski Area, Navajo Lake and Dry Valley area (Cedar City District), the Red Canyon and Pink Cliffs area (Powell District), and the basin area below the rim throughout the Escalante and Teasdale Districts.

The remainder of the study area is inventoried as Class B, with small areas of Class C interspersed throughout the Dixie National Forest (the variety class inventory map is included in the project files).

### Sensitivity Level/Distance Zone

The study area is approximately 2 million acres and numerous Level I and Level II viewpoints are identified within the study area. However, because of the numerous viewpoints, the Dixie National Forest Landscape Architect has chosen the most critical viewpoints for the oil and gas leasing analysis.

A majority of the viewpoints within the study area are located on mountain summits, along mountain trails, or are located along highways in high alpine areas. These viewpoints view the full spectrum of the defined distance zones (fg, mg, bg). Many of the viewpoints have panoramic views into other districts, far beyond 10 miles.

Specific viewpoints identified in the study area include:

*Pine Valley Recreation Area* - the campground and trailheads located in a cluster along and at the end of Forest Service Road 035 in the Pine Valley Recreation Area. These recreation sites are Level I viewpoints.

*Brian Head Observation Point* is a Level I viewpoint and is located at the top of Brian Head Mountain (11,307 feet). Powell Point (Escalante District) is visible from this viewpoint.

*Panguitch Lake* is a Level I viewpoint and is located along Scenic Byway - Utah State Highway 143. Panguitch Lake is a popular year-round fishing and recreation area.

*Jones Corral* and a viewpoint from Forest Service Road 125 are Level II viewpoints and are located in the northern portion of the Powell District.

*Deer Creek Trailhead* is a Level I viewpoint and is located along Scenic Byway - Utah State Highway 12 near the Forest Service boundary, by Capitol Reef National Park.



*Bryce Canyon National Park* has approximately 47 viewpoints located along Scenic Byway - Utah State Highway 63 at all points where a park visitor may see Forest Service land, along trails, at all scenic overlooks. These viewpoints are all identified as Level I sensitivity.

*Powell Point Viewing Area* is a Level I viewpoint and is located in the southwest corner of the Escalante District. Access to the Summit of Powell Point is by trail.

*Intersection of Griffin Road and Forest Highway 17* is a Level I viewpoint and is located in the southwest area of the Escalante District. Griffin Road is a Scenic Byway.

*Viewpoint along Scenic Backway - Griffin Road* - is located on the Griffin Road near Iron Spring on the west side of the Escalante District and is a Level I viewpoint.

*Trail Point* is a Level I viewpoint and is located on the boundary between the Teasdale and Escalante District. Access to Trail Point is by trail. This area is a popular dispersed recreation area.

*Steep Creek Viewing Area* is a Level I viewpoint and is located along Scenic Byway - Utah State Highway 12 on the east side of the Teasdale District.

*Bowns Point* is a Level I viewpoint and is located on the east side of the Teasdale District. Access to Bowns Point Summit is by trail.

*Lower Bown Campground* is a Level I viewpoint and is located along the southwest shores of Lower Bown Reservoir (Teasdale District). Access to the campground is from Scenic Byway - Utah State Highway 12 and Forest Service road 181.

*Keller Ridge Viewing Area* is a Level I viewpoint located along Scenic Byway - Utah State Highway 12 on the east side of the Teasdale District.

*Chokecherry Point* - is a Level I viewpoint and is located on the east side of the Teasdale District. Access to Chokecherry Point is by trail only.

### **Visual Quality Objectives**

The VQO inventory results were derived and provided by the Dixie National Forest from the Forest data base. Areas of VQO Retention and Partial Retention are illustrated on Figure 3-12.

The Forest Service Geographic Information System (GIS) was used to determine these portions of the land seen from sensitivity level I and II travel routes, use areas, and water bodies. The topographic information used was obtained from maps available from the United States Geological Survey accurate to 30 meters horizontally and 50 meters vertically. Only landform screening was used in the preparation of the maps. Many of the areas shown, as visible on the VQO maps may not be seen because of vegetation, which would screen it from the view of the forest uses. Also, large sections of the forest are reported to be visible and contain a Partial Retention VQO. Many of these are visible from high points on the forest some distance from the lands being viewed. The diverse variety contained in the landscape on the Dixie will facilitate a high degree of alterations before middle ground or background Partial Retention VQOs are not achievable. This decision will be determined on a individual case as projects are proposed. At this level of planning we feel it is sufficient to determine those areas that are visible. Identifying areas needing further investigation before more specific activities may be permitted.



**Preservation** - The Dixie National Forest contains three designated Wilderness areas (approximately 83,000 acres): The Pine Valley Mountain Wilderness is located on the southeast side of Pine Valley Ranger District following the Pine Valley Mountains. The Ashdown Gorge Wilderness Area is located on the Cedar City District bounded to the east by the Cedar Breaks National Monument and to the west by the district boundary. The Box-Death Wilderness area is located in the Escalante District between Hells Backbone road and the southern district boundary.

**Retention** - Provides for management activities that are not "visually evident" within the characteristic landscape. Under VQO Retention, activities may only repeat form, line, color, and texture found frequently in the characteristic landscape.

Areas parallel to paved highways, dirt/gravel Forest Service roads, local roads, and areas that encompass sensitivity level I recreation areas and viewpoints are typically VQO Retention.

Areas of VQO Retention in the Pine Valley Ranger District include: areas parallel to 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 road number 031 and 033), and Forest Service Road 032 to Oak Grove Campground.

Areas of VQO Retention in the Cedar City Ranger District include: areas parallel to Scenic Byways 143, 148, 14, and 89, Forest Service Road 064 and 068 (between Scenic Byways 143 and 14), Forest Service Road 053 (road along south side of Navajo Lake), Forest Service Road 049 to Yankee Meadow Reservoir, Forest Service Road 058 to Strawberry Creek Point, Forest Service Road 060 adjacent to Swains Creek and dispersed recreation areas around Brian Head Ski Area and areas surrounding the Ashdown Gorge Wilderness.

Areas of VQO Retention in the Powell Ranger District include: areas parallel to 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 (Forest Service Road 087) and dispersed recreation areas beyond the East Fork of the Sevier River Scenic Backway.

Areas of VQO Retention in the Escalante and Teasdale Ranger Districts include: areas parallel to Scenic Byway 12, Forest Service Road 153 (Hells 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), Forest Service Road 168 (Brown Reservoir), popular dispersed recreation areas including the trails and primitive roads and recreation areas including: East Lake, Donkey Reservoir, Lower Reservoir, Round Lake, Blind Lake, Fish Creek Lake, Round Lake, Scout Lake, Green Lake, Deer Creek Lake, Chriss Lake, Horse Shoe Lake, Halfmoon Lake, Crescent Lake, Row Lake, Blue Lake, Purple Lake, and Lake McGath.

**Partial Retention** - Provides for management activities that are visually subordinate within the characteristic landscape. Under partial retention, activities may repeat form, line, color, and texture found in the characteristic landscape. Activities may also introduce form, line, color, and texture found infrequently in the characteristic landscape, but these activities must remain subordinate to the visual strength of the characteristic landscape.

VQO Partial Retention areas occur throughout the study area but are largely found adjacent to areas classified as retention. These areas are viewed in the middleground or background from the level I viewpoints. Other partial retention areas occur parallel to level II sensitivity viewpoints. These areas



include roads, developed and dispersed recreation sites and areas that are used by the public, but are not as popular and commonly used as the level I sensitivity viewpoints.

**Modification** - Provides for management of activities that are visually dominate within the characteristic landscape. Under modification, activities may repeat and introduce form, line, color, and texture found in the characteristic landscape. However, activities of vegetative and landform alteration must borrow from naturally established form, line, color, and texture so completely and at such a scale that their visual characteristics are those of natural occurrences within the characteristic landscape.

VQO modification areas are dispersed throughout the study area. These areas are viewed in the background (3-5 to 10 miles and beyond) from sensitivity level I viewpoints, or in the foreground (0 - 1/2 mile) or middleground (1/2 - 3 to 5 miles) from sensitivity level II viewpoints.

## **SOCIOECONOMICS**

This section addresses:

- Issue 7**            The effects of federal leasing decisions and possible subsequent exploration and development activities on local communities and socioeconomic values.

The potential for socioeconomic impacts (whether beneficial or adverse) resulting from potential oil and gas activities could occur over several different political jurisdictions. Jurisdictions of potential involvement include:

- Counties within the area of the Dixie National Forest
- Communities and localities located within or closely adjacent to major access roads leading to the Dixie National Forest
- Communities (some of which may be included in the above designation) which act as regional centers and as such may be solicited for the provision of goods and services supportive of the proposed action unavailable in the nearer, but small, localities over the area of the Dixie National Forest.

The study area covers the entire Dixie National Forest in Southern Utah and includes Garfield, Iron, Kane, Piute, Washington and Wayne counties.

### **Social Setting**

Many observers regard the area as exceptionally scenic, with high mountain vistas, panoramic views, broad lush meadows, stately stands of timber, and abundant fish and wildlife. The area is used for summer livestock grazing, timber harvesting, and outdoor recreation, including camping, hunting, fishing, hiking, skiing, sight-seeing, and nature study. Portions of the area have potential for yielding oil and gas.

The communities and localities, along with the counties mentioned above would be those most immediately affected should the leasing of oil and gas minerals rights lead to additional exploration and development of petroleum on the Dixie National forest. As such, these counties form the geographic focus and overall study area, or "zone of influence" for the investigation of socioeconomics.



The economic situation of communities particularly those adjacent to the eastern portion of the Dixie National Forest has not been very bright during the past few years. Development of new industry and new job opportunities for local residence has been minimal. Communities within the area are relatively small with limited resources available for large development or industry. For example, housing and water are critical in many southern Utah communities.

Most of the small towns around the Dixie National Forest have very deep traditional values that can be traced back to early pioneers settling periods of Utah. These values dictate many of the local activities and viewpoints.

### **Population**

The Dixie National forest occupies over 1.88 million acres in Garfield, Iron, Kane, Piute, Washington and Wayne Counties in Utah and is an important source of timber, minerals, grazing land, hydropower and recreation, as well as revenues to state and local governments. The six counties enclosing the Dixie National Forest had a population of nearly 82,000 at the 1990 census, representing about 5 percent of the state/s population.

Table 3-21 presents a summary of the population characteristics for the six counties, from the 1990 census. As can be seen, there is considerable variation in population size, ranging from less than 2,000 in Piute County to over 48,560 in Washington County. Some counties experienced little growth during the 1980s while others expanded rapidly. Washington County experienced one of the fastest growth rates in the state, in large part because of the popularity of the St. George area. As a result of Washington County's strong growth, the six-county region's overall population growth rate was more than two and one-half times the statewide average, and accounted for one-half of the state's entire increase in population over the 1980-1990 decade.

The six-county region displays less ethnic diversity than the statewide average. Less than 5 percent of the region's population in 1990 was non-White, compared to the statewide average of over 11 percent. Most of the non-White population is Native American and Hispanic, located mainly in Washington and Iron Counties.

### **Economic Characteristics**

Profiles of income and employment characteristics in the six counties for the year 1991 are presented in Table 3-22. The six-county region accounts for just under 4 percent of the state's total personal income and employment, in contrast to having almost 5 percent of the state population. The lower than proportional shares for personal income and employment reflect the fact that the region has relatively large numbers of retired persons and un- or underemployed working-age persons who rely on state and federal income assistance. The ratio of employed persons to total population in the six-county region in 1991 was 44 percent versus 52 percent statewide. Consequently, per capita incomes and average earnings per employed person were lower in the six-county region than the statewide averages.

Table 3-22 shows that the six-county region accounted for 45 percent of the state's entire share of personal income based on income maintenance, while average per capita income in the region, at \$11,671, was only 80 percent of the statewide average of \$14,588. Average wage and salary earnings per job in the region were \$15,440, only three-fourths of the statewide average of \$20,382. Non-farm proprietors' average earnings, in contrast, were very nearly the same as the statewide average of \$14,685.



**TABLE 3-21**  
**Population Characteristics of Counties in the Dixie National Forest**

Parameter	Garfield	Iron	Kane	Piute	Washington	Wayne	Total 6 Counties	State of Utah Totals	6 Counties as Percent of State
<b>Population</b>									
1980	3,673	17,349	4,024	1,329	26,065	1,911	54,351	1,461,037	3.7%
1990	3,980	20,789	5,169	1,277	48,560	2,177	81,952	1,722,850	4.8%
Change, 1980-1990	307	3,440	1,145	(52)	22,495	266	27,601	54,895	50.3%
Growth Rate (%/year)	0.8%	1.8%	2.5%	(0.4%)	6.4%	1.3%	4.2%	1.7%	252.5%
<b>Racial Origins</b>									
White	3,890	1,992	5,032	1,267	47,202	2,123	61,506	1,615,845	3.8%
Black	1	43	5	0	66	1	116	11,576	1.0%
Native American	73	635	77	9	706	40	1,540	24,283	6.3%
Asian/Pacific Islander	8	98	25	1	290	2	424	33,371	1.3%
Other Races	8	91	30	0	296	11	436	37,775	1.2%
Hispanic (all origins)	35	382	101	15	862	25	1,420	84,597	1.7%
Total Non-White <sup>2</sup>	125	1,249	238	25	2,220	79	3,936	191,602	2.1%
Percent Non-White	3.1%	6.0%	4.6%	2.0%	4.6%	3.6%	4.8%	11.1%	43.2%

Source: Economic Report to the Governor, 1992.

<sup>1</sup> Persons of Hispanic origin may be of any race, including White.

<sup>2</sup> Including Hispanic.

Totals may not add exactly due to rounding.

The three top counties in terms of income per capita and earnings per job were Washington, Iron and Garfield. Garfield County's residents had the highest average per capita income of the six counties, at almost \$12,500, owing to having a higher than average percentage of employed residents (53 percent) but Washington and Iron Counties' average earnings per employed person were higher because there are a higher proportions of workers in non-farming occupations, notably manufacturing, retail trade and government. Because Washington and Iron Counties had higher proportions of lower income persons in their populations than Garfield County, their overall average incomes per person were lower. Kane, Piute and Wayne Counties, being sparsely populated with little commercial or industrial activity, had the lowest levels of employment and income.

Table 3-23 presents data on the levels and composition of employment in each of the six counties and compares the regional totals to the statewide values. With 4 percent of the state's total employment, the region had a significantly higher proportion of workers in the farming sector than statewide. The region's shares of employment in construction, retail trade and state and local government were also higher than the statewide averages, with most of the jobs being located in Washington and Iron Counties. Of particular interest are the number of jobs in the mining and construction sectors, which would be mainly affected by the proposed oil and gas and CO<sub>2</sub> reserve leasing. In 1991 the two sectors employed almost 2,600 persons (full-time equivalent jobs) in the six-county region, with most of the jobs being in construction in



**TABLE 3-22**  
**Economic Profiles of Counties in the Dixie National Forest - 1991**

	Garfield	Iron	Kane	Piute	Washington	Wayne	Total 6 Counties	State of Utah Totals	6 Counties as Percent of State
Total Personal Income (\$000)	50,973	236,220	60,180	14,270	620,730	23,916	1,006,289	25,893,133	3.9%
Nonfarm Personal Income	47,160	226,528	58,514	12,052	616,173	20,095	980,522	25,690,005	3.8%
Farm Income	3,813	9,692	1,666	2,218	4,557	3,821	25,767	203,128	12.7%
Net Earnings <sup>1</sup>	32,697	158,291	36,440	7,600	353,951	14,936	603,915	18,667,332	3.2%
Transfer Payments	10,561	48,605	12,897	4,315	135,791	5,476	217,645	3,937,750	5.5%
Income Maintenance <sup>2</sup>	466	3,330	610	151	6,427	362	11,346	25,340	44.8%
Unemployment Insurance	455	808	314	109	1,664	207	3,557	85,933	4.1%
Retirement and Other	9,640	44,467	11,973	4,055	127,700	4,907	202,742	3,598,417	5.6%
Dividends, Interest, and Rent	7,715	29,324	10,843	2,355	130,988	3,504	184,729	3,288,051	5.6%
Population <sup>3</sup>	4,080	21,499	5,271	1,328	51,852	2,188	86,218	1,775,014	4.9%
Per Capita Personal Income	12,493	10,987	11,417	10,745	11,971	10,931	11,671	14,588	80.0%
Total Earnings (POW, \$000)	33,512	171,205	31,087	6,097	369,367	14,177	625,445	19,812,264	3.2%
Wages and Salaries	24,439	128,813	22,706	3,161	272,365	8,228	459,712	16,338,101	2.8%
Other Labor Income	2,685	13,297	2,176	299	25,291	947	44,695	1,628,863	2.7%
Proprietors' Income	6,388	29,095	6,205	2,637	71,711	5,002	121,038	1,845,300	6.6%
Nonfarm <sup>4</sup>	3,085	21,478	4,670	720	67,579	1,549	99,081	1,692,179	5.9%
Farm	3,303	7,617	1,535	1,917	4,132	3,453	21,957	153,121	14.3%
Total Employment (Full & Part-Time)	2,167	10,205	2,323	439	21,927	1,049	38,110	930,791	4.1%
Wage and Salary Jobs	1,597	8,429	1,734	217	17,193	605	29,775	801,578	3.7%
Number of Proprietors	570	1,776	589	222	4,734	444	8,335	129,213	6.5%
Nonfarm	310	1,395	440	93	4,321	225	6,784	115,230	5.9%
Farm	260	381	149	129	413	219	1,551	13,983	11.1%
Average Earnings per Job (\$)	15,465	16,777	13,382	13,888	16,845	13,515	16,412	21,285	77.1%
Wage & Salary Earnings per Job (\$)	15,303	15,282	13,095	14,567	15,842	13,600	15,440	20,382	75.8%
Average Earnings per Nonfarm Proprietor (\$)	9,952	15,396	10,614	7,742	15,640	6,884	14,605	14,685	99.5%

Source: U.S. Department of Commerce, Bureau of Economic Analysis, REIS (1993)

Footnotes to County Economic Profiles:

- <sup>1</sup> Total earnings less personal contributions for social insurance adjusted to place of residence.
- <sup>2</sup> Includes supplemental security income payments, payments to families with dependent children (AFDC), general assistance payments, food stamp payments, and other assistance payments, including emergency assistance.
- <sup>3</sup> Per Utah Population Estimates Committee.
- <sup>4</sup> Excludes limited partners.



Washington County. This sector would experience most of the impact of oil and gas or CO<sub>2</sub> field exploration and development activities. The mining sector is small, as indicated in Table 3-23. In most of the counties the actual number of mining jobs was suppressed in the data source (REIS) because either there were nine or less jobs, or the number was confidential because there were only one or two mining firms in the county. Thus, any significant expansion of oil or gas or CO<sub>2</sub> production (after the exploration and development phases) would impact mining sector employment.

### **Fiscal Characteristics**

Local governments rely on state and federal revenues for a significant part of their annual general government budgets. According to county financial statements filed with the State of Utah Department of Finance in 1991, transfers of revenues from state and federal sources to the six Dixie National Forest counties amounted to \$11.6 million, which represented almost one-half of all sources of revenue. Table 3-24 presents data for the six counties' 1991 receipts. Most of the intergovernmental transfers are indicated as coming from the state--\$7.2 million versus \$4.3 from the federal government--some of the state revenues are based on federal programs that pay funds to the state government which in turn passes them on to local governments. These indirect payments include a one-fourth share of all revenues earned by the National Forests from uses of their lands for mining, grazing, recreation and other activities (under the Payment Act of May 23, 1908). The Dixie National Forest's 25 percent payments for Fiscal Year 1991-92 to the six counties amounted to \$312,650.<sup>1</sup>

The principal directly-paid federal revenue source for five of the six Dixie National Forest counties is Payments In Lieu of Taxes (PILT), which are intended to compensate local governments for loss of federal lands from the local tax rolls (only Washington County has the majority of its direct federal revenues coming from other sources). The Bureau of Land Management acts as agent for the federal government in Utah to dispense PILT funds to counties. The amounts of PILT take into account other sources of federal fund transfers that are paid indirectly to local governments in the form of funds passed through the state Department of Finance, including the National Forests' 25 percent of receipts payments.

Table 3-25 presents the Dixie National Forest's sources of 25 percent receipts payments for FY 1991-92. In that period the Dixie National Forest received \$1.25 million in revenues from users of the forest's resources, mostly based on timber. About 46 percent (\$571,790) of the receipts came from direct use of resources, of which grazing and recreation-based receipts were the primary sources (\$431,060). Receipts from mineral extraction totalled \$34,187. Receipts based on timber included \$80,940 from direct receipts, \$234,345 for Knutsen-Vandenberg reforestation charges, \$166,667 from timber purchaser road credits, and \$277,781 from timber salvage sales. The 25 percent payments to counties were apportioned on the basis of gross National Forest acreage in each county, and were the equivalent of \$0.17 per acre.

## **MINERALS/GEOLOGY**

This section provides a description of the existing minerals and geology that could be affected by oil and gas leasing, exploration, and/or development within the Dixie National Forest. The information presented addresses:

**Issue 6**            The effects of Federal Leasing decision on the opportunities to explore for and develop oil and gas resources within the analysis area.

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<sup>1</sup>The sub-lines for PILT and the Dixie NF 25% Receipts payments in Table 3-26 are not additive to the numbers for the federal portion of intergovernmental revenues. The table is based on the counties' annual financial reports, which include the indirect payments with the state portion of intergovernmental revenues.



**TABLE 3-23**  
**Employment Profiles of Counties in The Dixie National Forest, 1991**

	Garfield	Iron	Kane	Piute	Washington	Wayne	Total 6 Counties	State of Utah Totals	6 Counties as Percent of State
Total Employment (Place of Work)	2,167	10,205	2,323	439	21,927	1,049	38,110	930,791	4.1%
By Type of Employment:									
Wage and Salary	1,597	8,429	1,734	217	17,193	605	29,775	801,578	3.7%
Proprietors	570	1,776	589	222	4,734	444	8,335	129,213	6.5%
Farm	260	381	149	129	413	219	1,551	13,983	11.1%
Nonfarm <sup>1</sup>	310	1,395	440	93	4,321	225	6,784	115,230	5.9%
By Industry:									
Farm	280	488	163	147	447	241	1,766	17,586	10.0%
Nonfarm	1,887	9,717	2,160	292	21,480	808	36,344	913,205	4.0%
Private	1,410	7,225	1,655	190	18,499	540	29,519	739,554	4.0%
Ag. Serv., For., Fish.	(L)	(D)	(L)	(L)	320	11	331	6,163	5.4%
Mining	(D)	(D)	(D)	(L)	174	10	184	9,381	2.0%
Construction	49	411	120	(L)	1,744	82	2,406	43,956	5.5%
Manufacturing	187	743	72	40	1,537	68	2,647	111,058	2.4%
Transportation and Public Utilities	69	372	56	15	1,054	21	1,587	45,870	3.5%
Wholesale Trade	(D)	215	29	(L)	586	11	841	42,082	2.0%
Retail Trade	298	2,353	595	65	5,277	217	8,805	159,188	5.5%
Finance, Insurance, and Real Estate	66	489	(D)	10	1,787	10	2,362	62,175	3.8%
Services	714	2,440	698	40	6,020	110	10,022	259,681	3.9%
Government and Government Enterprises	477	2,492	505	102	2,981	268	6,825	173,651	3.9%
Federal, Civilian	142	269	54	(L)	303	97	865	38,776	2.2%
Military	30	159	40	(L)	391	17	637	19,631	3.2%
State and Local	305	2,064	411	85	2,287	154	5,306	115,244	4.6%

Source: U.S. Department of Commerce, Bureau of Economic Analysis, REIS (1993)

- <sup>1</sup> Excludes limited partners
- (D) Not shown to avoid disclosure of confidential data.
- (L) Less than 10 jobs. Estimates are included in totals.



**TABLE 3-24**  
**County Government Revenues, 1991, Counties in the Dixie National Forest**

	Garfield	Iron	Kane	Piute	Washington	Wayne	Total 6 Counties
(Amounts in \$'000)							
Revenue Source							
Taxes	802.91	2,453.95	1,013.57	137.36	2,474.14	301.30	7,183.23
Licenses & Permits	8.15	49.89	31.83	0.33	99.67	5.44	195.31
Intergovernmental Revenues	2,602.45	2,376.29	1,117.97	349.09	4,304.85	821.58	11,572.23
State	2,383.45	1,800.30	881.33	231.84	1,265.45	670.09	7,232.46
Federal	219.00	575.99	236.64	117.25	3,039.40	151.49	4,339.77
Of Which: Payments in Lieu of Taxes <sup>1</sup>	199.00	545.17	236.64	54.12	817.00	108.85	1,960.78
Dixie National Forest 25% Receipts Payments <sup>2</sup>	172.97	40.02	20.62	0.35	65.48	13.21	312.65
Charges for Services	379.80	469.97	129.75	44.68	1,325.58	122.53	2,472.31
Fines & Forfeits	62.00	170.09	177.23	17.28	226.22	83.04	735.86
Miscellaneous Revenues	137.08	324.29	177.65	29.34	1,537.42	59.15	2,264.93
<b>TOTALS</b>	<b>3,992.39</b>	<b>5,844.48</b>	<b>2,648.00</b>	<b>578.08</b>	<b>9,967.88</b>	<b>1,393.04</b>	<b>24,423.87</b>
1991 POPULATION	4,080	21,499	5,271	1,328	51,852	2,188	86,218

Sources: Independent Auditors' Reports of General Purpose Financial Statements for Utah Counties, 1992.

U.S. Forest Service, Intermountain Region, Ogden, 1992.

<sup>1</sup> Payments of in lieu of taxes (PILT) for National Forests are paid by Bureau of Land Management.

<sup>2</sup> Data for FY 1991-92 (10/01/91-09/30/92); funds are passed through the Utah Department of Finance to the counties. Totals may not add exactly due to rounding.

### **Physiography and Geologic Setting**

The Dixie National Forest extends from the Nevada border in extreme southwestern Utah to south-central Utah just west of Capital 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 plateaus and sedimentary strata of the Colorado Plateau physiographic province in the east. The boundary between the provinces in southwest Utah generally parallels Interstate Highway 15 between the towns of St. George and Parowan (Hunt 1967).

The Basin and Range province is characterized by steeply-faulted horsts and thick, sediment-filled grabens. The Pine Valley Ranger District is located in the Basin and Range province while the remaining portions of the Dixie National Forest are located in the Colorado Plateau province. The Colorado Plateau province consists of a series of plateaus, mesas, and buttes formed from horizontal to gently dipping strata with major faults, monoclinical folds, anticlines and synclines, domes, and basins. Streams have eroded deep canyons and escarpments in many areas. Extrusive igneous rocks occur around the margins of the province while volcanic cones and flows are common (Doelling and Davis 1989).



**TABLE 3-25**  
**Gross Receipts by Class and County Based on National Forest Acreage and Payments**  
**to Counties Dixie National Forest, Fiscal Year 1992 (10/01/91-09/30/93)**  
**(Receipts and Payments in \$'000)**

	Garfield	Iron	Kane	Piute	Washington	Wayne	Total 6 Counties
National Forest Acreage in County:							
Resource:							
Timber	44.78	10.36	5.34	0.09	16.95	3.42	80.94
Grazing	80.28	18.57	9.57	0.16	30.39	6.13	145.10
Land Uses	7.01	1.62	0.84	0.01	2.65	0.54	12.67
Recreation-Spec. Uses	43.64	10.10	5.20	0.09	16.52	3.33	78.88
Power	7.16	1.66	0.85	0.01	2.71	0.55	12.95
Minerals	18.91	4.38	2.26	0.04	7.16	1.44	34.19
Recreation-User Fees	114.57	26.51	13.66	0.23	43.37	8.75	207.08
Total National Forest	316.35	73.19	37.72	0.63	119.75	24.15	571.79
K-V <sup>1</sup>	129.65	30.00	15.46	0.26	49.08	9.90	234.35
Timber Pur. RD CR <sup>2</sup>	92.21	21.33	10.99	0.18	34.90	7.04	166.67
Salvage Sales	153.68	35.56	18.32	0.31	58.17	11.73	277.78
Total Receipts	691.89	160.09	82.50	1.38	261.90	52.82	1,250.58
Total Payments <sup>3</sup>	172.97	40.02	20.62	0.35	65.48	13.21	312.65

Source: U.S. Forest Service, Intermountain Region, 1993.

Footnotes to Gross National Forest Receipts:

<sup>1</sup> Knutsen-Vandenberg Act revenues, for reforestation.

<sup>2</sup> Timber purchaser road credit.

<sup>3</sup> 25% of total receipts; equivalent to \$0.17 per acre.

Totals may not add exactly due to rounding.

### Seismic and Earthquake Hazards

Southwestern Utah includes part of the southern portion of the Intermountain Seismic Belt, a 60- to 120-mile-wide zone which extends from southern Nevada and northern Arizona to northwestern Montana. The Intermountain Seismic Belt trends northeast-southwest in southwestern Utah, following the tectonic transition between the Basin and Range and the Colorado Plateau provinces. The Intermountain Seismic Belt is a zone of shallow, diffuse seismicity. Many Quaternary-age faults and folds are found in southwestern Utah. These faults are capable of generating Richter magnitude 6.0 to 6.5 or larger earthquakes (Christenson and Nava 1992).

Some major range-front faults such as the Hurricane, Paragonah, and Sevier faults indicate recurrent surface rupture during late Quaternary time. Anticlines, monoclines, tilted stream terraces, and domal uplifts occur in several areas and are usually associated with faults. Historical earthquakes have reached magnitudes of 6 to 6.5, primarily near Richfield and Elsinore. Since many of the larger historical earthquakes occurred in the early 1900s, prior to urbanization, damage was relatively slight. Southwestern Utah has the potential for large, damaging earthquakes. The principal earthquake hazards are ground shaking, surface fault rupture, tectonic subsidence, liquefaction, slope failure, and flooding. Strong ground shaking is the most common and widespread of these hazards (Christenson and Nava 1992). Seismicity



maps of Utah show numerous earthquake localities in the St. George-Kanab-Cedar City area extending northeastward to Richfield and Price, the northward to the Provo-Salt Lake City-Logan area. Several small earthquakes have also been recorded in the eastern part of the Dixie National Forest near the Escalante and Teasdale Ranger Districts. A Richter magnitude 5.8 earthquake occurred near St. George on September 2, 1992. This earthquake caused damage up to 95 miles from the epicenter. Several homes and buildings were destroyed near Springdale and landslides blocked State Route 9 to Zion National Park as well as rupturing buried and above-ground utilities along State Route 9. Southwestern Utah is in the Uniform Building Code seismic zone 2B, an area of moderate earthquake risk (Black and Christenson 1992; Christenson and Nava 1992; Stover and others 1986).

## **Landslide Hazards**

Landslides including rock falls, debris flows and slides, and slump failures are prevalent hazards throughout southwestern Utah. Landslides are common in areas of high precipitation, high elevation, steep slopes, and slide-prone geologic materials. Many of these conditions occur in the mountains and high plateaus of the Basin and Range and Colorado Plateau physiographic provinces, as well as along the canyons and cliffs in the Colorado Plateau (Harty 1992).

Rock falls occur as rock fragments that detach from parent bedrock along joints, bedding planes, or other zones of weakness. These newly detached rock fragments or previously detached rocks on steep hillslopes may fall, roll, or bounce downslope causing damage. Rock falls are abundant in southwestern Utah. In general, rock falls are common in the Navajo Sandstone, the sandstone members of the Kayenta and Moenave formations, and in the upper Cenozoic basalts and rhyolites (Harty 1992).

Debris slides commonly result on steep slopes in the soil mantle or in the weathered bedrock and colluvium that forms a thin cover over the bedrock. The slope failure or debris slide is due to increased pore-water pressure from rainfall, snowmelt, or underlying springs in bedrock.

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. Therefore, they are particularly prone to landsliding where slope angle, precipitation, aspect, and geologic structure are favorable. There are 660 documented landslides in these rock units in southwestern Utah. Identification of past landslides and rockfalls and areas of geologic conditions susceptible to landslides or rockfalls are useful in reducing potential hazards (Harty 1992).

Locations of past landslide and rockfall areas were identified by the Forest Service (1993b) and as shown on Figure 3-13. Areas of active landslide and rockfall were also shown on Figure 3-14 for the Escalante and Teasdale Ranger Districts.

Areas of steep slopes, those exceeding 40 percent, are shown on Figure 3-15. In total, 235,607 acres of the Dixie National Forest have slopes exceeding 40 percent. Table 3-26 displays the acreage distribution of steep slopes, landslides, and rockfall areas by Oil & Gas Potential Area and by Ranger District.

Maps of geologic hazards, Figures 3-13 and 3-14, was also produced by the Forest Service (1993b) showing areas determined to be classified as High Erosion Potential and Marginally Unstable, Landslide Areas, Rockfall Areas, or no hazard (i.e., stable land). High Erosion Potential areas consist of steep slopes with shallow soils, sparse vegetation cover, and are subject to rapid runoff. Areas categorized as Landslide



**TABLE 3-26  
Acres of Steep Slopes, Landslides, and Rockfalls**

Ranger District	Oil & Gas Potential Area	Steep Slopes	Past Landslides	Active Landslides	Rockfalls
Pine Valley	Southern Bull & Northern Pine Valley Mountains	32,481	0	0	0
Pine Valley	South Central Pine Valley Mountains	36,865	0	0	0
Pine Valley	Western & Northern Bull Valley	6,263	0	0	0
Cedar City	Markagunt Plateau	36,915	0	0	0
Powell	Sevier & Paunsagaunt Plateau	58,665	0	0	0
Escalante & Teasdale	Escalante Anticline	11,225	1,318	0	887
Escalante	South Escalante Mountains	25,239	1,484	42	3,256
Escalante & Teasdale	Area East of Boulder Mountains	8,730	944	0	2,327
Escalante & Teasdale	Aquarius Plateau	12,650	4,203	1,003	9,946
Teasdale	East End of Boulder Mountains	6,574	55	0	0
Total Acres		235,607	8,004	1,045	16,416

or Rockfall Areas have evidence of recent mass movement, fresh cracks are discernible, and probabilities of increased additional movements are high. Marginally Unstable areas show discernible evidence of past landslide activity but no recent indication. The overall area is gaining stability but there may be areas subject to reactivation of mass movement. Marginally stable areas show no evidence of past landslide activity but certain land characteristics indicate landslide potential (USDA Forest Service 1993b). Table 3-27 shows the number of acres of geologic hazards by ranger district and oil and gas potential area.

The Pine Valley Ranger District has approximately 35,600 acres with High Erosion Potential. The remainder of the area is considered stable. The Cedar City Ranger District has approximately 12,300 acres with High Erosion Potential, 15,100 acres considered Marginally Unstable, and the remainder of the area is considered stable. The Powell Ranger District has approximately 26,400 acres with High Erosion Potential and about 8,000 acres considered Marginally Unstable. The remainder of this ranger district is considered stable. The Escalante and Teasdale Ranger Districts, within the High CO<sub>2</sub>/Moderate oil and gas potential areas have about 3,900 acres with High Erosion Potential, approximately 20,700 acres considered Marginally Unstable, and the remaining portions considered stable. The Teasdale and Escalante Ranger Districts within the moderate oil and gas potential area have 0 acres with High Erosion Potential and approximately 3,600 acres considered Marginally Unstable. The remaining portions of these ranger districts are considered stable.



**TABLE 3-27**  
**Acres of Geologic Hazards**  
**By Ranger District and Oil and Gas Potential Areas**

Ranger District	Oil & Gas Potential Area	Hazard Classification				
		EH	U	MU	MS	NH
Pine Valley	Southern Bull & Northern Pine Valley Mountains	10,292	0	0	0	21,517
Pine Valley	South Central Pine Valley Mountains	23,547	0	0	0	116,906
Pine Valley	Western & Northern Bull Valley	1,806	0	0	0	127,434
Cedar City	Markagunt Plateau	12,291	0	15,102	25,288	351,584
Powell	Sevier & Paunsagaunt Plateau	26,372	0	8,041	25,073	329,028
Escalante & Teasdale	Escalante Anticline	0	0	4,595	7,311	61,737
Escalante	South Escalante Mountains	19,382	42	9,000	11,676	165,353
Escalante & Teasdale	Area East of Boulder Mountains	0	0	3,622	23,701	84,570
Escalante & Teasdale	Aquarius Plateau	3,858	1,003	16,113	33	215,308
Teasdale	East End of Boulder Mountains	0	0	55	0	29,804
<b>Total Acres</b>		<b>97,548</b>	<b>1,045</b>	<b>56,528</b>	<b>93,082</b>	<b>1,503,241</b>

EH= High Erosion Hazard  
U= Unstable Land  
MU= Marginally Unstable Land

MS = Marginally Stable Land  
NH = No Hazard

### Unique Geologic Features

The Dixie National Forest contains no existing on-site National Natural Landmarks sites. Three Research Natural Areas have been established. Those include the timbered Cinder Cone (640 acres) on the Cedar City Ranger District, Table Cliffs (1,235 acres) on the Escalante Ranger District, and Red Canyon (460 acres) on the Powell Ranger District (USDA Forest Service 1987).

### Mineral Resources

A variety of mineral resources are known to occur within the Dixie National Forest. The most significant known resources are coal, oil, iron, and gravel. Uranium and geothermal resources are considered to have a high potential for discovery.

All minerals owned by the United States and available for exploration and development are classified as locatable, leaseable, or salable. A majority of the mineral substances commonly sought on lands of the United States are subject to mining location under the General Mining Law. Locatable minerals include gold, silver, iron, and other mineral substances, except on acquired lands where they are leaseable. Exceptions are leaseable minerals and salable minerals. Leaseable minerals include coal, oil, gas, oil shale, phosphate, geothermal, and certain sodium and potassium compounds. Salable minerals include common varieties of sand, stone, gravel, pumice, cinders, and clay.



Common variety mineral materials are made available throughout the Dixie National Forest by commercial sales and free use. Many of these material sites are used for Forest Service projects (USDA Forest Service 1987).

Coal resources extend onto portions of Dixie National Forest Service lands. The Kaiparowits Plateau, Alton, and Kolob areas are considered principal coal areas. The quality and quantity of coal is considered generally very good in Kaiparowits and Alton fields. Currently there are several coal leases on the Dixie National Forest.

The Bull Valley area, in the northwestern part of the Pine Valley Ranger District, is an iron-rich area. To the south, near Mineral Mountain and the Bull Valley Mountains, there are precious and base metals such as gold, silver, copper, lead, and zinc (Smith 1987a,b). Active mines near the Pine Valley Ranger District area include Iron Mountain (iron) and Anniversary and Goldstrike (gold and silver) near Mineral Mountain (Utah Geological Survey 1992).

Mineral resources on the Pine Valley District include coal, gold, silver, and oil and gas, on the Cedar City Ranger District mineral resources include coal, oil and gas, all minerals, gold, silver, and geothermal; on the Powell Ranger District mineral resources include coal, oil and gas, and all minerals; and on the Escalante Ranger District mineral resource categories include coal, geothermal, and all minerals. There are no minerals under Federal subsurface ownership on the Teasdale Ranger District.

Figure 3-16 shows mineral ownership within the Dixie National Forest. Approximately 5,000 claims exist for locatable minerals on the Dixie National Forest. Annual assessment work has continued on most of these claims but only minor exploration and development have occurred recently. In 1984, an open pit gypsum mine began operating on the north side of Boulder Mountain, on the Teasdale Ranger District, removing about 20,000 tons per year. A gold strip mine was developed on private land within the Pine Valley Ranger District near New Harmony. Associated with this are 22 lode and placer claims located on adjacent National Forest lands. Also on the Pine Valley Ranger District there are several small alabaster mines in T.41.S, R.14.W and R.15.W near Leeds. On the Teasdale Ranger District, there is an inactive placer gold mine near Pine Creek and a gypsum mine near Bulberry Creek. There is an abandoned gypsum mine along Government Creek. There was some oil and gas test drilling in the early to mid 1980's, but no discoveries were made (USDA Forest Service 1987, 1993b).

### Geothermal Resources

The potential for geothermal resources exists on the west side of the Dixie National Forest near Navajo Lake and in or near portions of the Pine Valley Ranger District. Geothermal resources are concentrated along the Utah hingeline. Three geothermal areas lie within a few miles of the Forest boundary. Geothermal resources occur at the Veyo Hot Springs on the southwestern flank of the Pine Valley Mountains, the Newcastle geothermal area to the north of the Pine Valley Ranger District, and the Pah Tempe Hot Springs along the Hurricane Fault southwest of the Cedar City Ranger District. The geothermal systems in these areas are thought to result from deep circulation of meteoric water along faults and fractures. The Veyo Hot Springs and Pah Temp Hot Springs systems are considered low-temperature resource areas. The Newcastle system, which was recently examined by the Utah Geological and Mineral Survey, is considered a moderate to high temperature system exceeding 130° C. The Veyo and Pah Temp hot springs are developed resort areas, while at Newcastle, geothermal fluids are utilized for space heating of commercial greenhouses and local residences (Blackett and others 1990; Budding and Sommer 1976; Smith 1987a,b).



In southern Utah, only developments in the Roosevelt Hot Springs and Cove Fort-Sulfurdale geothermal areas generate electrical power from geothermal sources. These areas lie north of Cedar City and approximately 50 miles north of the northernmost part of the Forest. No other significant geothermal resources have been discovered on or near the Dixie National Forest and the potential for discovery of additional geothermal resources is low.

### Oil and Gas Exploration and Production History

Three oil fields have been discovered on or near the Dixie National Forest. Table 3-28 provides a summary of these fields. Currently, there are 58 leases on forest lands. Figure 1-2 (at the end of Chapter 1) shows the existing leases on the Dixie National Forest.

The Upper Valley oil field within the Escalante Ranger District is the only field of economic significance.

**TABLE 3-28**  
**Oil Production On and Near The Dixie National Forest**

<b>Field</b>	<b>Formation</b>	<b>Cumulative Production (barrels)</b>
Anderson Junction (1968)	Callville Limestone	2,732 (Smith 1980)
Virgin (1907)	Moenkopi Formation	210,102 (Brandt 1989)
Upper Valley (1964)	All Formations  Production is primarily from Kaibab Limestone; minor production from: Moenkopi-Timpoweap Limestone Redwall Limestone (Petroleum Information 1984)	22,172,159

The Upper Valley field was discovered in 1964. Oil was found, on its southwest flank. The field has approximately 25 producing wells with cumulative production of over 22 million barrels of oil. It is located on the southern plunge of the Upper Valley anticline and produces primarily from the Permian

Kaibab Limestone as well as the Lower Triassic Timpoweap/Sinbad member of the Moenkopi Formation. Sub-commercial oil has also been recovered from the Mississippian Redwall Limestone (Doelling 1975; Petroleum Information 1986; Sharp 1976).

The Anderson Junction Field is located on the east side of the Hurricane Fault only 3 miles east of the Pine Valley Ranger District. Oil accumulated in the Pennsylvanian Callville Limestone. Structural closure occurs on a faulted anticline. Less than 3,000 barrels of oil were produced from this field before it was abandoned in 1971 (Petroleum Information 1984; Smith, 1980).

The Virgin Field is located on the up-thrown side of the Hurricane fault near Zion National Park south of the Markagunt Plateau. Oil seeps at the surface led to its discovery in 1907, the first oil field in Utah. It



has produced a little over 200,000 barrels from the Timpoweap Limestone of the Moenkopi Formation. It is unusually shallow (<1,000 feet) and occurs within the nose of a gently northeast plunging anticline. Erosion depressurized the structure allowing the oil to drain into synclinal pockets on its the nose (Brandt 1989; Heylmun 1961).

### **Carbon Dioxide Discoveries**

Carbon dioxide can play a major role in enhancing recovery of oil fields. Two carbon dioxide discoveries have been made in the eastern part of the Forest. No commercial production has occurred to date. The most significant of these discoveries occurred on the Escalante anticline within the Escalante Ranger District. Carbon dioxide was initially discovered in the Phillip #2 Escalante anticline well completed in 1961. Maximum flow was 23.6 million cubic feet per day from the Permian Toroweap Formation (PI). In 1983 carbon dioxide was discovered in the Midcontinent Charger #1 well. The best actual flow was 39 million cubic feet per day. Two other development wells were drilled. Potentially producing formations at the Escalante anticline include the Triassic Shinarump and Moenkopi and Permian White Rim and Organ Rock formations. Potential flow for individual wells ranges from 3.6 to 8.2 million cubic feet per day. The structure is estimated to contain 1 to 3 trillion cubic feet. Additional drilling will be required to determine the size of the occurrence (Brandt 1989).

A lesser discovery was made within the Teasdale Ranger District. Initial production was 750,000 cubic feet per day (PI), but no commercial production has occurred yet. Approximately 12 miles north of the Teasdale District, a discovery was made on Thousand Lakes Mountain of the Fishlake National Forest.

### **Oil and Gas Potential Areas**

The potential for the occurrence and development of oil and gas for each of the Occurrence Potential Areas of the Dixie National Forest is summarized in Table 2-2 and shown on Figure 2-1 (in Chapter 2). Unless specified otherwise, potential for oil and gas includes hydrocarbons and carbon dioxide. Probability of oil and gas occurrence is described in the Reasonable Foreseeable Development Scenario, Appendix E.

## **TRANSPORTATION SYSTEM**

The roads of the 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 resources. 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.

The transportation system begins at the primary road access provided by the federal and state highway systems.

### **State and Federal Highways**

The following are the federal and state highways that provide access to the Forest (p.II-54, USDA 1986):

- Interstate Highway 15 - St. George to Utah State Highway 20
- Utah State Highway 18 - St. George to Beryl Junction
- Utah State Highway 56 - from Cedar City west to Beryl Junction



- U.S. Highway 89 - from Orderville through Panguitch to Richfield
- Utah State Highway 143 - from Parowan through Cedar Breaks to Panguitch
- Utah State Highway 148 - from Utah State Highway 14 north through Cedar Breaks to Utah State Highway 143
- Utah State Highway 14 - from Cedar City east to U.S. Highway 89 at Long Valley Junction
- Utah State Highway 20 - from I-15, north of Paragonah, east to Utah State Highway 89 at Bear Valley Junction
- Utah State Highway 12 - from U.S. Highway 89 through Red Canyon east to Escalante then north to Torrey
- Utah State Highway 22 - from Otter Creek Reservoir south to Utah State Highway 12
- Utah State Highway 24 - from Loa to Torrey
- Utah State Highway 62 - from U.S. Highway 89 east to Otter Creek Reservoir.

### Existing Forest Transportation System

The Dixie National Forest has over 2,700 miles of Forest Development Roads on inventory. This includes 524 miles of arterial roads, 536 miles of collector roads, and 1,673 miles of local roads. There are other roads that exist and are utilized as a transportation network that are not yet inventoried. Table 3-29 displays the inventoried road miles by type in each Ranger District. Figure 3-17 shows the road network for the Forest and surrounding area.

**TABLE 3-29  
Road Miles by Type and Ranger District**

Ranger District	Arterial Roads	Collector Roads	Local Roads
Pine Valley	120	76	119
Cedar City	140	94	679
Powell	104	194	326
Escalante and Teasdale	160	172	549
Total Miles	524	536	1,673

### Existing Oil and Gas Roads

Most oil and gas roads are not physically closed to the general public and are classed as local roads. Local roads that provide access to the individual

well sites or batteries are managed under the field development plan. None of the roads within the unitized area are managed under special use permits. The oil pipeline and powerlines which extend beyond the unitized area are covered by a special use permit issued to the oil and gas leaseholders.

The roads to the individual well sites or batteries will be reclaimed or managed as intermittent service facility after they are no longer needed for oil and gas activity. Intermittent service roads will be closed to traffic, graded and maintained for drainage, those with native surfacing will be scarified and seeded. Reclaimed oil and gas roads are rehabilitated to near-natural condition.

## **WILD AND SCENIC RIVERS**

This section addresses:

### **Issue 2**

The effects of oil and gas leasing and possible subsequent exploration and development activities on the roadless resource and eligible Wild and Scenic Rivers.



The National Wild and Scenic Rivers System was created by Congress in 1968 (PL 90-542; 16 U.S.C. 1271 et seq.) to preserve certain rivers with outstanding natural, cultural, or recreational features in a free-flowing condition for the enjoyment of present and future generations. Each designated river is administered with the goal of nondegradation and enhancement of the values which caused it to be designated. The Wild and Scenic Rivers Act calls for preparation and maintenance of a comprehensive and continuing inventory of the Nation's significant free flowing streams.

Rivers are classified as wild, scenic, or recreational. The following definitions are provided by the Wild and Scenic Rivers Act:

- *Wild* rivers or sections of rivers that are free of impoundments and generally inaccessible except by trail, with watersheds or shorelines essentially primitive and waters unpolluted. These represent vestiges of primitive America.
- *Scenic* rivers or sections of rivers that are free of impoundments, with shorelines or watersheds still largely undeveloped, but accessible in places by roads.
- *Recreational* rivers or sections of rivers that are readily accessible by road or railroad, that may have some development along their shoreline, and that may have undergone some impoundment diversion in the past.

Four rivers or streams with potential as Wild and Scenic Rivers (PL 90-592) were evaluated by the Forest Service during preparation of the Forest Plan. The streams evaluated included: Deep Creek, Escalante River, North Fork of the Virgin River, and Paria River. The Paria and Escalante Rivers start below the Forest boundary, and a majority of the miles considered for Deep Creek and the North Fork of the Virgin River are on private or BLM lands. As a result no rivers were recommended as meeting the criteria to be eligible for inclusion in the Wild and Scenic Rivers System by the Dixie National Forest (The Dixie National Forest Plan, Final Environmental Impact Statement, 1986, page III-12).

In spring of 1994, the Dixie National Forest reevaluated streams and rivers for eligibility for potential designation as Wild and Scenic Rivers. A list of 18 rivers in southern Utah was compiled by the Dixie National Forest and submitted for review to any interested groups. There was substantial controversy surrounding the list of rivers and currently the situation is unresolved. At present, the Dixie National Forest will adhere to what is stated in the Forest Plan EIS.

During the next Forest Plan revision, the Dixie National Forest will reanalyze potential rivers and streams for inclusion in the Wild and Scenic Rivers System, however, this study will occur statewide with interagency coordination.

## **CULTURAL AND PALEONTOLOGICAL RESOURCES**

### **Cultural Resources**

Cultural Resources are historic and traditional cultural properties that reflect the nation's heritage. Federal regulations define such properties to include prehistoric and historic sites, structures, districts, and objects included in, or eligible for inclusion in the National Register of Historic Places (NRHP), as well as artifacts, records, and remains related to such properties (National Historic Preservation Act Section 305[5]). Traditional cultural properties are rooted in the history of a community and may be eligible for inclusion in the National Register because of their association with the cultural practices or beliefs that are important in maintaining the cultural identity of the community (National Register Bulletin 38).



## **Inventory Results**

To date, 1,647 archaeological sites have been identified within the study area. Many of these sites were identified as a result of the 633 inventory surveys undertaken over the last twenty years, as well as less formal investigations. These surveys, although well distributed throughout the study area, constitute less than eight percent of the land area. While the significance of some of these sites has never been evaluated, approximately forty percent of the sites have been recommended as eligible for listing on the National Register of Historic Places. However, only two sites are currently listed: the location of the Mountain Meadow Massacre and the Long Flat archaeological site.

A variety of archaeological site types, dating from most of the known period of human occupation have been recorded within the study area. These are discussed below.

### **Paleo-Indian (12,000-9000 BP)**

The earliest evidence of human occupation identified in North America is called the Paleo-Indian period, and is generally associated with big game hunting. On the North American High Plains, diagnostic, lanceolate projectile points have been found in association with the bones of extinct megafauna. However, evidence of a Paleo-Indian occupation of the study area, or anywhere in Utah, is poorly represented. Geographically, the closest documentation of this phase is an open site, 42Md300, located on the Sevier River floodplain (Simms and Lindsay 1989). However, surface finds of isolated Paleo-Indian projectile points have been found near the study area in the western Escalante Desert (Amsden 1937; Davenport and Janetski 1983; Keller and Hunt 1967).

Due to the paucity of data, Paleo-Indian subsistence and settlement patterns and other aspects of their lifeways are poorly understood. Madsen (1982) has proposed that there was a dependency on wetland resources during this period, and if this is a correct interpretation than upland bogs and marshes in the study area may have been used. Because of the great age of these sites, they are difficult to recognize. Any actual Paleo-Indian sites identified within the study area would be considered highly significant.

### **Archaic (8500 to 2000 BP)**

During the Archaic stage, aboriginal bands modified their subsistence strategies to a wider ranging hunting and gathering pattern that focused on smaller game and wild plant foods. During this stage, grinding stones, which commonly are taken as evidence for vegetal food processing, became more common, as did roasting pits and residential architecture.

One of the classic ways to define the Archaic stage has been through changes in projectile point technology. This has allowed several substages to be recognized: the Early Archaic (8500-5500 BP), characterized by higher site densities, especially in lacustrine environments; the Middle Archaic (5500-3500 BP), characterized by an increased utilization of upland regions; and the Late Archaic (3500-2000 BP), characterized by increased occupation of upland habitats and the abandonment of many lake-edge cave and shelter sites (Aikens 1970; Madsen and Berry 1975; Simms 1977; Madsen 1982; Madsen 1983).

Sites from each of these periods have been identified within the study area (Moffitt and others 1978; Pratt and Holmer 1983; Janetski and Wilde 1989; Schmidt, personal communication 1993). Some of these sites have been identified on the basis of radiocarbon dates, diagnostic side and corner notched points, basketry, and flat milling stones. In addition, most of the countless undated lithic scatters identified within the study area probably also date to this period, if only because it lasted for so long. Other site types might include stone circles, open camps with hearths, dry rock shelters and quarries, as well as activity areas associated



with hunting and butchering or plant processing. The identification of many Archaic sites can be difficult because they are usually small and often obscured by ground cover.

### **Formative (2000 to 650 BP)**

The Formative occupation of the study area is characterized by a semi-sedentary lifestyle characterized by the construction of relatively permanent residential architecture, corn horticulture, use of the bow and arrow, and the appearance of ceramics. In many cases, especially where prime agricultural soils are present, relatively large village sites developed, recognizable by surface architecture, deep, well developed middens, and subsurface pits. Three relatively distinct Formative cultures occupied portions of the study area.

The Fremont occupation is characterized by painted black-on-gray, black-on-white and applique ceramics as well as unfired clay figurines and unique rock art. Some architectural features were substantial and included surface structures with clay walls, rock-lined semisubterranean pithouses and clay-surface storage features (Marwitt 1970; 1986). Large Fremont villages such as Median Village and the Evans Mound have been identified in the vicinity of Parowan and Cedar City. The study area is considered the extreme southern limit of the Fremont culture which extends north to the Great Salt Lake.

The Virgin Branch of the Anasazi culture was originally identified around the Virgin River drainage of southern Nevada. This occupation is characterized by a series of black-on-gray ceramics, slab lined storage cists, pithouses, and later masonry architecture. Kivas may also be present (Dalley and McFadden 1985; Dalley 1989; Barbara Walling-Frank, personal communication 1990). Major occupations near the study area include Red Cliffs, Little Man, Quail Creek, and Green Springs sites and additional sites can be expected, especially on the Pine Valley Ranger District (Snedeker 1981). This area is probably the northeastern limit of Virgin Anasazi occupation.

Similar to the Virgin Branch, but geographically oriented toward northeast Arizona, is the Kayenta Branch of the Anasazi. The Coombs site (Lister and others, 1960) at the Anasazi Indian Village State Historical Monument in Boulder, Utah appears to be affiliated with this occupation. Additional Kayenta Branch sites can be expected, especially on the lower elevations of the Escalante Ranger District. This area appears to be the extreme northwest limit of the Kayenta Anasazi occupation, and it has been argued that, in this vicinity, at the periphery of their occupation, the sites are virtually indistinguishable from the Virgin Branch sites to the west (Prince personal communication 1993).

While horticultural villages can be expected on the broad floodplains of the larger drainages, Formative period hunting camps and processing locations will also be found at higher elevations. Unless these contain diagnostic artifacts, however, they will be indistinguishable from Archaic or Late Prehistoric sites.

### **Late Prehistoric/Protohistoric (750 BP to present)**

Antecedents to the Southern Paiutes may have arrived in the vicinity of the study area approximately 700-500 BP. These presumed Numic speakers are characterized archaeologically by distinctive ceramics, basketry and Desert Side-notched projectile points. Logistically, these people were more similar to the Archaic cultures than the Formative ones, being mobile, and exploiting a wide range of mostly non-horticultural resources (Kelly and Fowler 1986). Late Prehistoric (Numic) components were, for a while, contemporaneous with Formative sites and the relationship between these two cultures is not well understood. Later Protohistoric sites exhibit culturally diagnostic artifacts which indicate Euro-American contact, such as metal, manufactured goods, glass beads and other trade goods intermixed with aboriginal



artifacts. The location of many protohistoric sites have been determined through archival research or interviews with Native Americans.

### **Historic (AD 1776 to present)**

The historic period within the study area can be divided into three basic stages: exploratory, pioneer, and development (Rose 1981). Spanish exploration began with the Dominguez-Escalante Expedition of 1776 and continued with the Arze-Garcia expedition of 1813 (Bolton 1972). For many years thereafter, Spanish, and later Mexicans utilized the Old Spanish Trail through the Forest on their way from Santa Fe to California (Hafen and Hafen 1954). Later, fur trappers, traders and government explorers all utilized the study area (Cline 1974). However, archaeological evidence of this early period is extremely rare.

The pioneer settlement of the study area was the result of Mormon colonization from the north. Early settlements, beginning in 1851 included Parowan, Cedar City and Panguitch, and soon after, smaller settlements were established at the higher, forested elevations (Arrington 1958; Campbell 1988). During this period, the Spanish Trail continued to be used and in 1857 was the site of the Mountain Meadow Massacre (Brooks 1950). During the development phase, a variety of resources in the forest were developed and the distribution of certain historic site types can be predicted on the basis of the resources they were designed to exploit. Logging camps will be located near large stands of ponderosa pine in accessible areas of moderate to easy terrain. Homesteads will be located near the bottom lands of the major drainages, sheep herding camps near upland meadows, and historic coal and hardrock mines and oil wells will be located near identified deposits (Arrington 1958). In addition, early Forest Reserve and National Forest administrative facilities are still standing within the study area.

### **Cultural Summary**

Estimates on the frequency of various site types within the study area suggest that twenty percent of the sites date to the Archaic period, forty percent to the Formative period, thirty percent to the Late Prehistoric/Protohistoric period, and ten percent to the Historic period (Marian Jacklin, personal communication 1993). These sites have been identified within a variety of environments and landforms. Most are small, being less than 100 meters in diameter, although there are some exceptions. For example, historic transportation corridors and water projects can be many miles in length.

Southern Paiutes, especially from the Cedar City and Shivwits Bands continue to utilize the study area for a variety of collecting and ceremonial tasks and Traditional Cultural Properties (TCPs) are probably present (Stoffle and others 1983). However, when consulted for this study, no specific TCPs were identified.

### **Sensitive Areas**

The available data regarding the distribution of cultural resources within the study area is more a function of where prior surveys have occurred, rather than where sites are actually located. For this reason a model was developed that studies where unrecorded archaeological sites might be expected. This model is not intended to specifically estimate the densities of various types of sites, but rather to provide a more general basis for evaluating the study area from a broad cultural resources perspective.

The model is based on the commonly accepted observations that within the study area archaeological sites are often encountered in higher densities near sources of water and within pinon-juniper vegetation communities. Fewer sites are found in ponderosa pine communities, and even less are found in the



absence of water, on steep slopes, or in spruce-fir communities (Marian Jacklin personal communication 1993.)

For the purposes of this model, a high sensitivity was assigned to those areas of pinon-juniper community (including some lower elevation sagebrush communities) which are located within one-half mile of a water source. Moderate sensitivities were assigned to level areas of unwatered pinon-juniper and to areas of ponderosa pine located near water sources. The remainder of the forest was assigned a low predicted sensitivity for cultural resources (Table 3-30). In terms of site densities, high sensitive areas average about 10 sites per square mile, moderate sensitive areas average about 6 sites per square mile, and low sensitive areas average about 3 sites per square mile. Across the entire forest, sites are expected at a density of 5-6 sites per square mile.

This is only a model, and as a management tool should be utilized with caution. Several inadequacies should be considered. First, since the model predicts sensitivities over broad areas, small, unique microenvironments may be ignored. Second, no distinction is made between areas predicted to have a high sensitivity and unique areas already known to have an extremely high density of archaeological sites. These would include the areas around Mountain Meadows or north of the town of Boulder. Third, high elevation hunting camps are excluded from the model since we are only just beginning to understand how these are distributed across the landscape. Many hunting camps appear to be associated with Alpine meadows, a good example being the Long Flat site west of Cedar Breaks National Monument

**TABLE 3-30  
Predicted Cultural Resource Sensitivity Zone Matrix**

Landform	Vegetation Zone		
	Pinon-Juniper	Ponderosa Pine	Spruce-fir
Slopes > 40%	Low	Low	Low
Slopes < 40%, unwatered	Moderate	Low	Low
Slopes < 40%, watered	High	Moderate	Low

The results are presented in Table 3-30. Areas of high and moderate archaeological sensitivities can be expected in the well-watered lower elevations. These include the southern border of the Escalante Ranger District, the eastern border of the Cedar City Ranger District, and most of the borders of the Powell Ranger District as well as the area along the East Fork of the Sevier River. Most of the Pine Valley Ranger District is in an area of moderate or high sensitivity with the exception of the Pine Valley Mountains.

Areas identified as having a high oil and gas potential are almost entirely within the Teasdale and Escalante Ranger Districts, in areas identified as having a low archaeological potential.

### Paleontological Resources

Paleontological resources occur in various formations throughout the Dixie National Forest. Formations with paleontological sensitivity have been determined by the Paleontology Branch of the Utah Division of State History. Those formations that are known to occur on the Dixie National Forest are presented in Table 3-31 in order of relative sensitivity (USDA Forest Service 1993a).

On the Pine Valley Ranger District, areas with paleontological resources occur near Richie Flat and throughout the Pine Valley Mountains area in the southern part of the district. The Cedar City Ranger District has paleontological resources over many portions of the district. Most of the potential



**TABLE 3-31**  
**Paleontologically Sensitive Formations**

Sensitivity Ranging	Formation Name	Age
<b>Vertebrate Fossil-bearing Bedrock</b>		
1	Green River Fm.	Eocene
2	North Horn FM	Cretaceous and Paleocene
3	Chinle Fm or Gp	Triassic
4	Moenkopi Fm or Gp	Triassic
5	Wasatch Fm or Gp	Eocene
6	Kayenta Fm	Triassic-Jurassic
7	Kaiparowits Fm	Cretaceous
8	Colton Fm	Paleocene-Eocene
9	Brian Head Fm	Eocene
10	Dakota Sandstone	Cretaceous
11	Flagstaff Fm	Paleocene
12	Entrada Fm	Jurassic
13	Wahweap Sandstone	Cretaceous
14	Straight Cliffs Fm	Cretaceous
<b>Invertebrate Fossil-bearing Bedrock</b>		
1	Chinle Shale	Triassic
2	Flagstaff Fm	Paleocene-Eocene
3	Carmel/Twin Creek Fm	Jurassic
4	Dakota Sandstone	Cretaceous
5	Green River Fm	Eocene
6	Tropic Shale	Cretaceous
7	Kaibab Limestone	Permian
<b>Plant Fossil-bearing Bedrock</b>		
1	Green River Fm	Eocene
2	Chinle Shale	Triassic
3	Shinarump/Mossback Fm	Triassic
4	Dakota Sandstone	Cretaceous
<b>Trace Fossil-bearing Bedrock</b>		
1	Green River Fm	Eocene
2	Kayenta Fm	Triassic-Jurassic
3	Moenkopi Fm	Triassic
Formations are in order of sensitivity, 1 being the most sensitive		

paleontological resources occur in the southern portion of the district as well as along many parts of the margins of the district. Nearly all of the Powell Ranger District, except part of the northwestern portion, has potential paleontological resources. Large portions of the Escalante Ranger District, except for part of the central portion, have paleontological resources. The Teasdale Ranger District has paleontological resources along the west, north, and eastern parts of the district (Forest Service 1993a).

Petrified wood is commonly found in several formations in southern Utah. Petrified wood has been collected from all members of the Chinle Formation, in the Kayenta Formation, Morrison Formation, Dakota



Formation, all members of the Straight Cliffs, and Wahweap Sandstones, Kaiparowits Formation, and in the cobbles at the base of the Claron Formation (Doelling and Davis 1989).

The Precambrian rocks of southern Utah have such few outcrops that very little of their fossil record is known. Fossils are usually rare in the Precambrian due to the predominance of highly altered and deformed rocks.

Fossils of the Cambrian include trilobites, brachiopods, echinoderms, sponges, arthropods, gastropods, ostracods, conodonts, pelecypods, and cephalopods. Cambrian-aged Formations occur only at great depth in the Dixie National Forest. The Cambrian formations in southwest Utah crop out in the Beaver Dam Mountains (Hintze 1980, 1988). The Ordovician through early to middle Devonian rocks are absent from southwestern Utah.

Important fossils of the Devonian include brachiopods, corals, crinoids, conodonts, echinoderms, bryozoans, trilobites, stromatoporoids, gastropods, pelecypods, and cephalopods. Formations of the Devonian occur at depth in the Dixie National Forest (Stokes 1986).

Mississippian rocks are rich in fossils primarily due to the relatively stable, quiet, shallow, and warm marine conditions during deposition. Brachiopods, bryozoans, crinoids, and corals are quite common. Gastropods, pelecypods, echinoderms other than crinoids, protozoans, cephalopods, trilobites, and sponges may occur locally but are not abundant. Small tooth-like conodonts are locally abundant.

Mississippian rocks occur at depth beneath the Dixie National Forest (Stokes 1986).

The Pennsylvanian Period was a time of abundant and varied terrestrial and aquatic life. Fusulinids, brachiopods, bryozoans, corals, pelecypods, crinoids, and gastropods were common. Pennsylvanian rocks occur at depth beneath the Dixie National Forest. The Permian Period had a great variety of fossils including invertebrates, vertebrates, and plants. Fusulinids, brachiopods, pelecypods, gastropods, bryozoans, echinoderms (crinoids predominantly), cephalopods, corals, scaphopods, plants, and vertebrates were common. Tracks of amphibians and some reptiles occur in some formations. Rocks of the Permian crop out in eastern and southern Utah but occur at depth under the Dixie National Forest (Stokes 1986).

The Triassic formations have yielded fossils of many significant vertebrates, invertebrates, and plants. Tracks of reptiles and amphibians may be found locally. Footprints have been found in the Moenkopi, Chinle, Shale, Wingate, and Kayenta Formations. Tracks of dinosaurs are found in the Chinle Shale and Kayenta Formation. The Chinle Shale also yields many fossil fish and petrified wood. Triassic formations underlie the Dixie National Forest and crop out extensively in southern Utah (Hintze 1980; Stokes 1986).

Formations of the Jurassic include fossil animal tracks of lizard-like species, several large dinosaurs, as well as several small species. Formations of the later Jurassic in southern Utah crop out in southern portions of the Dixie National Forest.

The Cretaceous formations yield a variety of fossil species including fish, turtles, crocodiles, dinosaurs, various invertebrates, and plants. Formations of the Cretaceous crop out extensively along the southern portion of the Dixie National Forest and to the east in the Kaiparowits Plateau. Recently, areas have been found on the Forest that are abundant with Cretaceous crocodile teeth, mammal teeth, turtles, molluscs, some lower vertebrate material, and a poorly preserved dinosaur (ankylosaur) as well as other dinosaur remains (Doelling 1975; Stokes 1986; USDA 1993a).

The paleontological record of the early Tertiary is rich in plants and animals of lake and river environments but the Tertiary Claron Formation which predominates in the Bryce Canyon National Park area and along the rims of the Paunsagaunt and Markagunt plateaus rarely has fossils. Fossils of the early Tertiary appear



to be limited in the area. Only recently have fossil remains of turtle, rodent teeth, and unidentified bones been found in Tertiary rocks overlying the Claron Formation in an area east of Panguitch (USDA Forest Service 1993a). The remaining part of the Tertiary consists predominantly of volcanic and intrusive rocks. The late Tertiary to Quaternary geologic units consists primarily of basalt flows and cinder cones, some intrusives, landslide deposits, and alluvium. The alluvial deposits may yield mammoth, bison, camels, horse, frogs, muskrat, porcupine, bear, etc. but these have not been reported in the Dixie National Forest at this time (Stokes 1986; USDA 1993a).

The authority to manage paleontologic resources is included under the Federal Land Policy and Management Act of 1976 (FLPMA) and the Organic Acts. Controls are contained in regulations such as, 36 CFR 216 Prohibitions. The identification and protection of paleontological resources may be accomplished by coordination with resource specialists of the Dixie National Forest.

## **SPECIAL AREAS**

This section describes the special areas on the Dixie National Forest including summer homes and recreation residences, administrative sites, Research Natural Areas, Brian Head Ski Area, and "# Management Areas. Figure 3-18 shows the locations of these special areas within the Forest boundary.

### **Summer Homes (on private land)**

There are many parcels of private land within the National Forest boundary. Many of these parcels have been developed for summer homes by people from larger community centers, such as Las Vegas, Nevada and southern California. Mineral ownership under these private lands is also private, therefore restrictions or leases related to these lands are outside of the scope of this analysis. Several of these parcels are quite extensively developed, they are:

- **Pinto Area** developed with summer homes and ranch houses
- **Pine Valley** developed extensively with summer homes
- **Duck Creek** contains commercial facilities, resort lodging and summer home development
- **Swains Creek** area has been developed for summer homes
- **Strawberry Point** area contains summer home development
- **Mammoth Springs** (area below the spring) contains extensive summer home development
- **Panguitch Lake** contains extensive commercial and summer home development
- **Mammoth Creek** (headwaters area) contains extensive summer home development
- **Brian Head** contains extensive commercial facilities and condominium development in conjunction with the ski area facilities



### Recreation Residences (on public land)

There are two recreation residence areas on National Forest System land within the Dixie National Forest. The Pine Valley area contains nine recreation residences and the Navajo Lake area contains 34 recreation residences. All residences are authorized by special use permit and are part of the recreation use of the Dixie National Forest. No new permits have been issued for recreation residences since 1959. Originally, they were used only in the summer. Snowmobiles and four-wheel drive vehicles now make year round access possible. Recreation residences have been operating at their maximum capacity for some time, without expansion there is no accommodation for increased use. On the other hand, residences on private land have increased greatly within and adjacent to the Forest boundary.

### Administrative Sites

There about 25 administrative sites containing 66 buildings used as offices, residences, and warehouses. Most administrative sites and buildings on this Forest are old. Under the provisions of the National Historic Preservation Act of 1966 (36 CFR 800.3), the effects of any program or activity on the existing administrative facilities must be determined for appropriate properties. Appropriate properties are those that are at least 50 years of age and/or represent a Civilian Conservation Corps construction project from the 1930s. As with any cultural resource, the property will be evaluated for eligibility to the National Register of Historic Places (NRHP) before any maintenance or reconstruction takes place. Twenty-five administrative sites are withdrawn from minerals entry, but open to oil and gas leasing.

### Brian Head Ski Area

Brian Head is the largest ski area in southern Utah. The ski area draws users from Nevada, California, and Arizona in addition to Utah. On most weekends during the peak season, the existing ski area nears capacity. Holiday weekends are especially busy.

Most of the base area near Brian Head Resort is privately owned and has large developments which include private residences, condominiums, and commercial facilities. A portion of the federal minerals within the Brian Head Ski Area have been withdrawn.

Brian Head, like most ski areas in Utah, is located up a narrow canyon. Access is often a problem during winter months when the road is snowpacked.

### Research Natural Areas

Three Research Natural Areas (RNA) have been established on the Dixie National Forest, including: the Timbered Cinder Cone (640 acres), Table Cliff (1,300 acres) and Red Canyon (460 acres). These areas are shown as Management Area #10A on the Final Management Area Map for the Forest Plan. There are no existing oil and gas leases within any of the established RNAs. Figure 3-19 illustrates the Dixie National Forest Management Areas.

**Timbered Cinder Cone RNA** The Timbered Cinder Cone RNA was established December 18, 1990. This RNA is an untouched and little-known stand of spruce-fir, representative of managed subalpine forests in the general vicinity, it occupies a small cinder cone on the Markagunt Plateau east of Cedar City, Utah. The Timbered Cinder Cone has been protected from man-caused disturbances and visitation because it is entirely surrounded by a lava field. The rough lava has buffered the Cone from livestock and from all



but the most purposeful human visitors, who must approach on foot. The consequent integrity and isolation of this location suggest an opportunity to recognize its special nature through protective designation. Thus, all of this distinct landform and part of the encircling lava field form the Timbered Cinder Cone RNA.

The major objective of the Timbered Cinder Cone RNA is to preserve in an undisturbed (by man and natural catastrophes) condition a typical, yet uncommon, volcanic landform, a section of associated lava field and commercial forest types. The Timbered Cinder Cone RNA provides a reference site for study, a baseline for assessing long-term ecological changes and a comparison area for determining effects of management techniques and practices applied to similar ecosystems (USDA Forest Service 1990).

**Table Cliff RNA** The Table Cliff RNA is located on the Escalante Ranger District of the Dixie National Forest. The RNA encompasses a portion of the Henderson Creek drainage at the southern end of the Aquarius Plateau. The RNA which is not far from Bryce Canyon National Park, includes subalpine timber, high brilliantly-colored cliffs, several species of rare plants, and dry noncommercial forests. Some of the latter contain unusually diverse tree-species mixtures.

The RNA is practically undisturbed, mainly because the lands within and around it are either very rugged or densely forested. The major features include pristine subalpine forests (primarily of Engelmann spruce and subalpine fir), notably old bristlecone pine groves, extensive mixed-conifer woodlands, and the magnificent cliffs below the Table Cliff Plateau. These cliffs are striking in color, height, and breadth rivaling much of the scenery in Bryce Canyon.

The major objectives of the Table Cliff RNA are to preserve as an undisturbed (by man) condition erosional and depositional landform unique to this part of the Colorado Plateau, scientifically valuable bristlecone pine (*Pinus longaeva*) trees, and commercial and subcommercial forest types. The RNA provides a reference site for study, a baseline for assessing long-term ecological changes, and a comparison for determining effects of management techniques and practices applied to similar ecosystems.

Secondary objectives include protection of several rare plant species (none, however, endemic to the RNA) and preservation of striking and regionally unique landform (USDA Forest Service 1991).

**Red Canyon RNA** The Red Canyon RNA is a small watershed that contains mixed-conifer forests and woodlands on contrasting geologic substrates, plus an unusually rich cluster of endemic plant species, some of which are quite rare.

The Red Canyon RNA encompasses an entire small watershed near the lower western edge of the Paunsagaunt Plateau. Two major geologic types, limestone and basalt, occur in the RNA. These geologic units generally correspond with two different physiographic types. The eastern part of the RNA contains highly dissected terrain formed from limestone. Steep gravelly slopes, hoodoos, low cliffbands, and small washes characterize this part of the site. Some small forested flats occur in the extreme northeast. 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, in contrast with the exposed limestone to the east.

The principal biotic features of the RNA are xeric forests, woodlands and shrublands. Small stands of mixed conifers, primarily ponderosa pine and Douglas-fir, occur on sites where soils and aspect are favorable. The most indicative understory plants are greenleaf manzanita on the limestone, and curleaf mountain mahogany on the basalt. Communities of pinon-juniper, curleaf mountain mahogany and black sagebrush are also present. Much of the eastern part of the tract consists of sparsely-vegetated slopes and outcrops of limestone. These nearly barren habitats support most of the rare plant populations in the RNA. The area contains at least thirteen plant taxa that are endemic or otherwise rare. None of these are



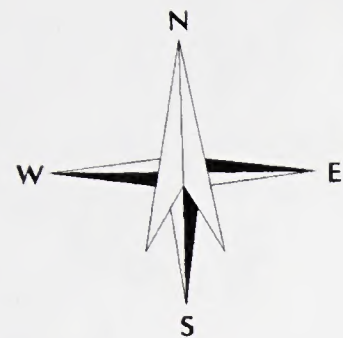
currently listed as Endangered or Threatened, but four are candidates for such listing (USDA Forest Service 1987).

### "#" Management Areas

These Management Areas are designated by a "#" symbol on the Final Management Area Map for the Forest Plan (Figure 3-19) and include parts of seven different Management Areas. These areas were given this designation to preclude surface occupancy for mineral entry. The following is a list of the # Management Areas which are partially included:

- 1A#            Recreation Sites
- 2A#            Semi Primitive Recreation Opportunities
- 2B#            Rural and Roaded Recreation Opportunities
- 4B#            Wildlife Habitat Management (MIS)
- 5A#            Big Game Winter Range (non-forest)
- 10A#          Research Natural Areas
- 10B#          Municipal Supply Watersheds.





# Threatened, Endangered, and Proposed Wildlife Potential Habitat

## DIXIE NATIONAL FOREST



This map shows areas of the Forest that have been identified as potential suitable habitat for threatened, endangered, and proposed wildlife based on this criteria:

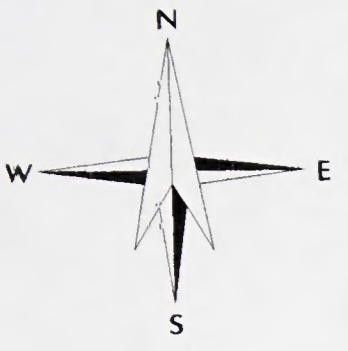
- Utah Prairie Dog: Habitat from State Database
- Bald Eagle: Roost sites digitized from data provided by DNF
- Peregrine Falcon: Slopes > 40 Percent
- Mexican Spotted Owl: Slopes > 40 Percent  
Elevation < 8000 Feet  
Vegetation types Mountain Fir, Pi, Barren, Mountain Shrub,  
Mountain Riparian, Lowland Riparian

Original data was compiled from multiple sources and may not meet the US National Mapping Accuracy Standard. For specific data source dates and/or additional digital info contact the Forest Supervisor, Dixie NF, Cedar City, Utah. This map has no warranties as to its contents or accuracy.

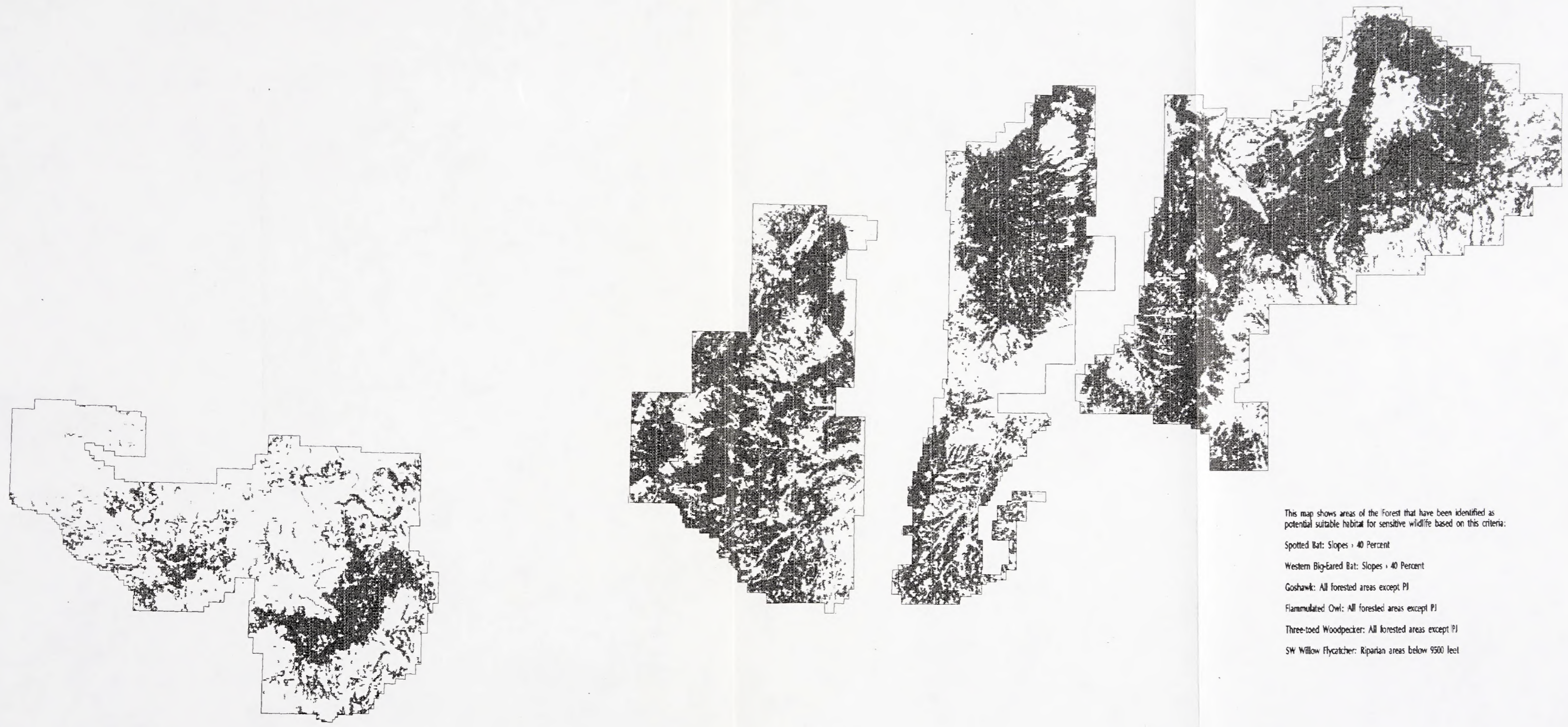








Sensitive Wildlife Potential Habitat  
DIXIE NATIONAL FOREST



This map shows areas of the Forest that have been identified as potential suitable habitat for sensitive wildlife based on this criteria:

- Spotted Bat: Slopes > 40 Percent
- Western Big-Eared Bat: Slopes > 40 Percent
- Goshawk: All forested areas except P1
- Flamulated Owl: All forested areas except P1
- Three-toed Woodpecker: All forested areas except P1
- SW Willow Flycatcher: Riparian areas below 9500 feet

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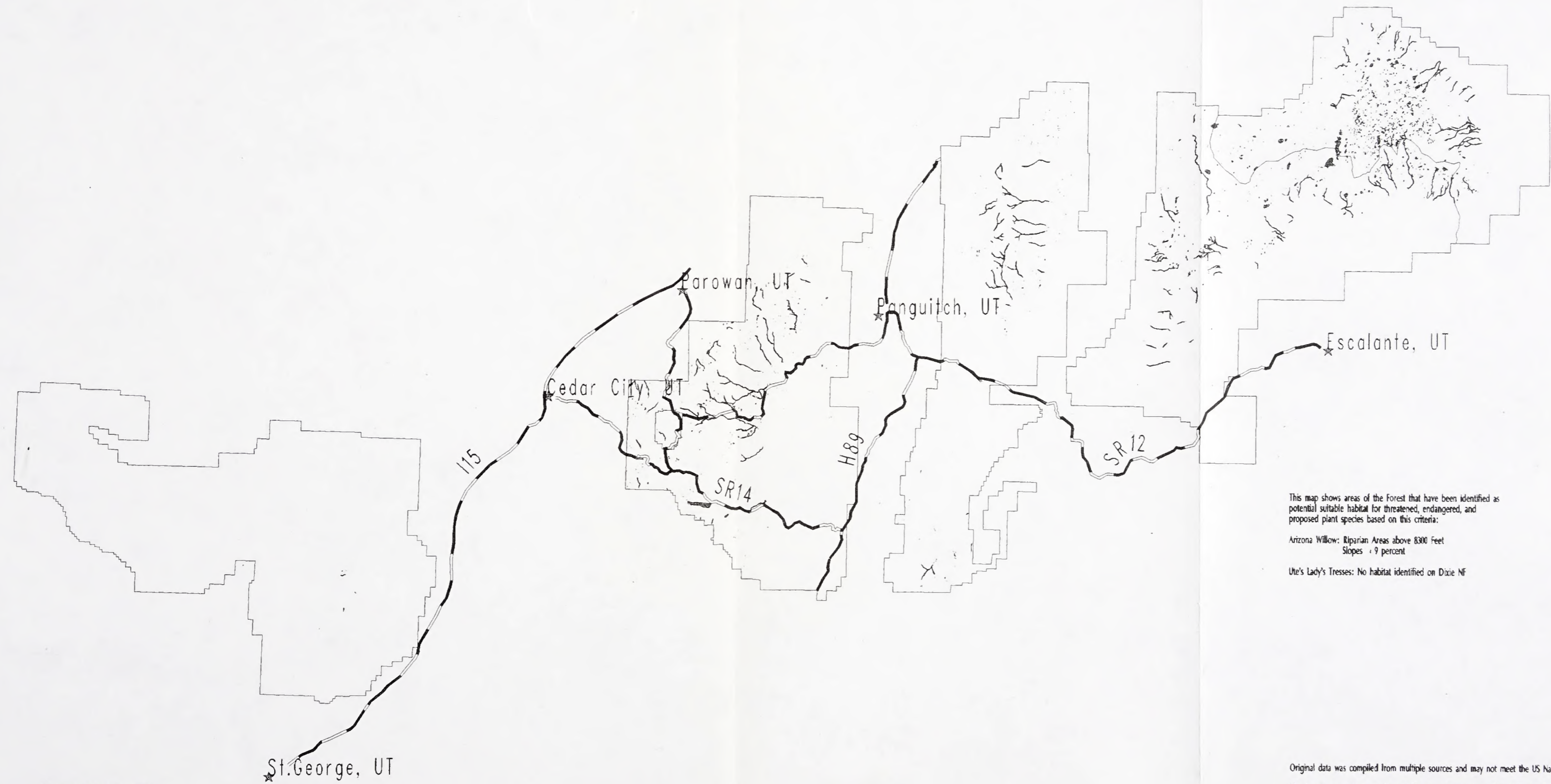








Threatened, Endangered, and Proposed Plant Species Potential Habitat  
DIXIE NATIONAL FOREST



This map shows areas of the Forest that have been identified as potential suitable habitat for threatened, endangered, and proposed plant species based on this criteria:

Arizona Willow: Riparian Areas above 8300 Feet  
Slopes > 9 percent

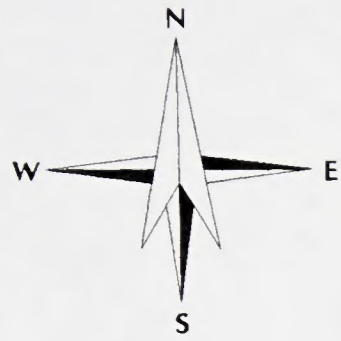
Ute's Lady's Tresses: No habitat identified on Dixie NF

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# Sensitive Plant Species Potential Habitat DIXIE NATIONAL FOREST



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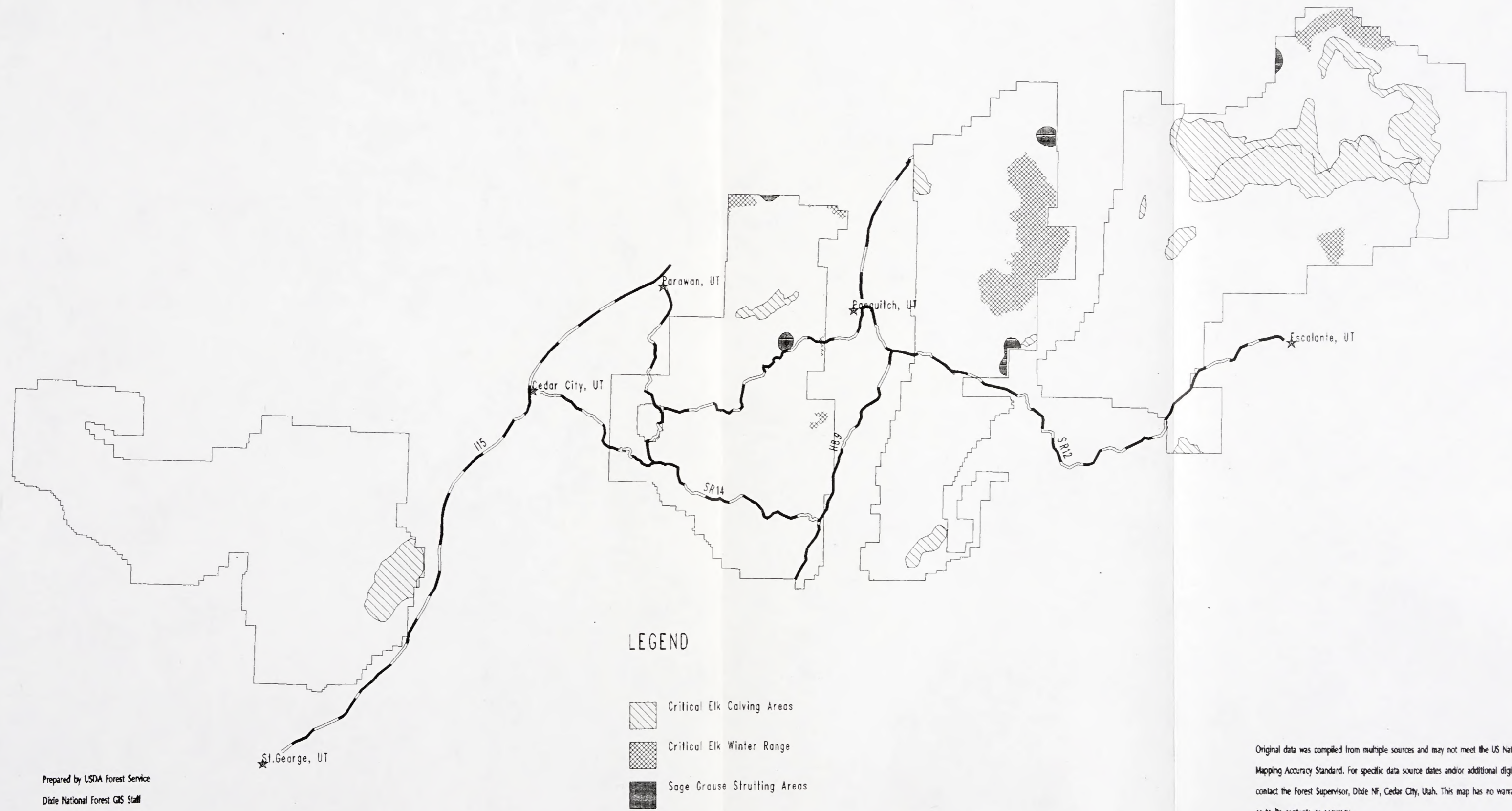
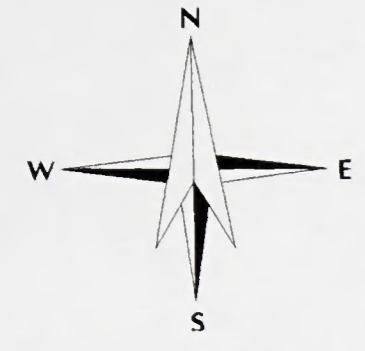











# ELK & SAGE GROUSE CRITICAL HABITAT DIXIE NATIONAL FOREST



### LEGEND

-  Critical Elk Calving Areas
-  Critical Elk Winter Range
-  Sage Grouse Strutting Areas

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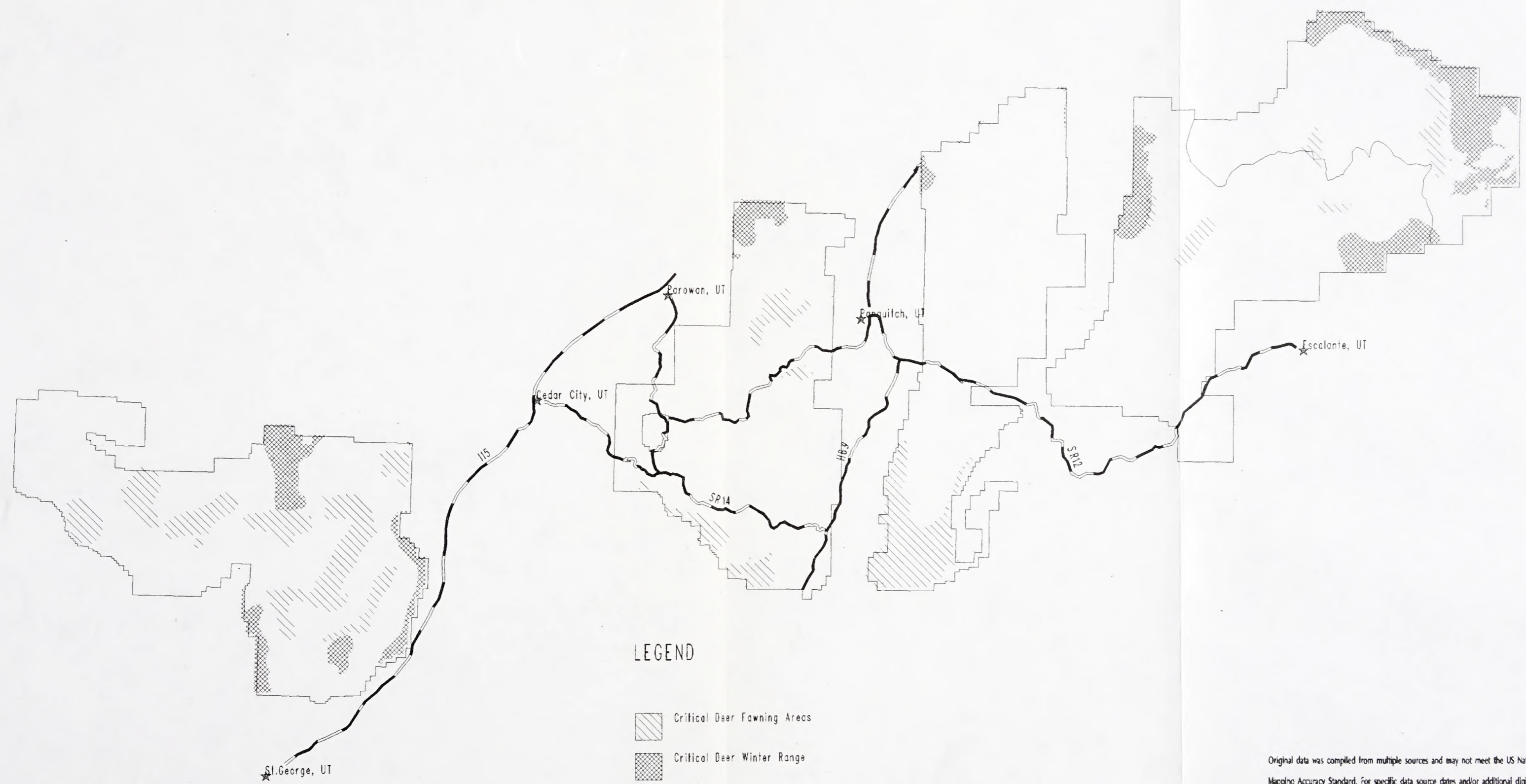










# DEER CRITICAL HABITAT DIXIE NATIONAL FOREST



### LEGEND

-  Critical Deer Fawning Areas
-  Critical Deer Winter Range

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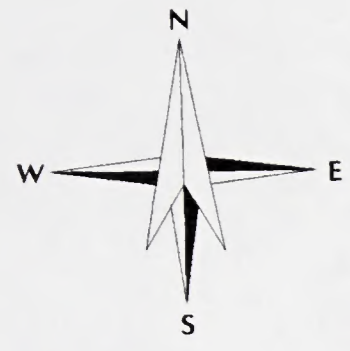










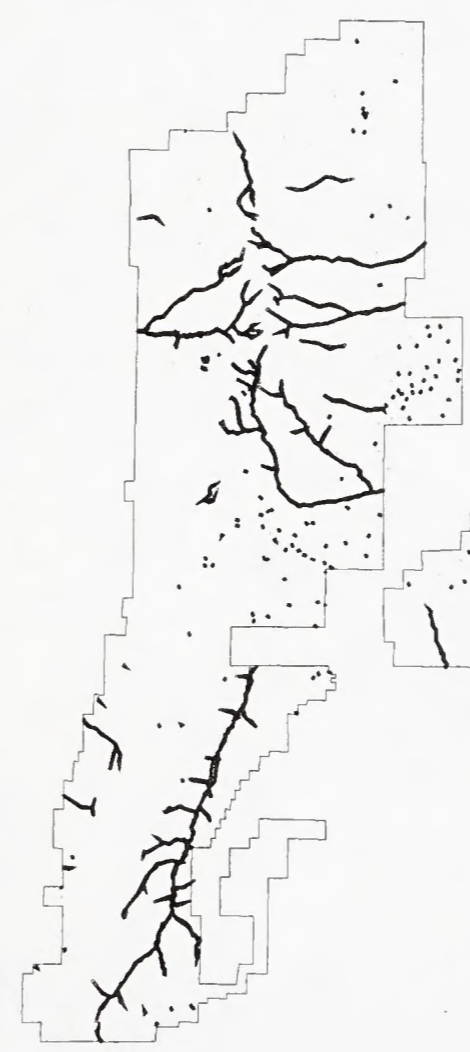
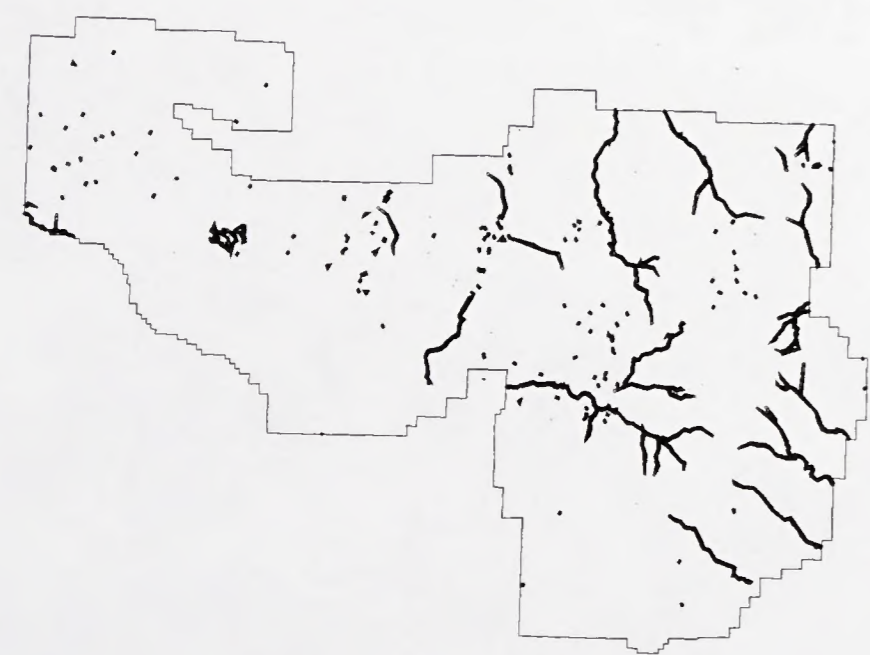


# RIPARIAN AREAS, WETLANDS, STREAMS AND LAKES DIXIE NATIONAL FOREST

## LEGEND

 Riparian Areas and Wetlands\*

\*This layer is derived from a 100ft buffer of lakes, perennial streams and springs.



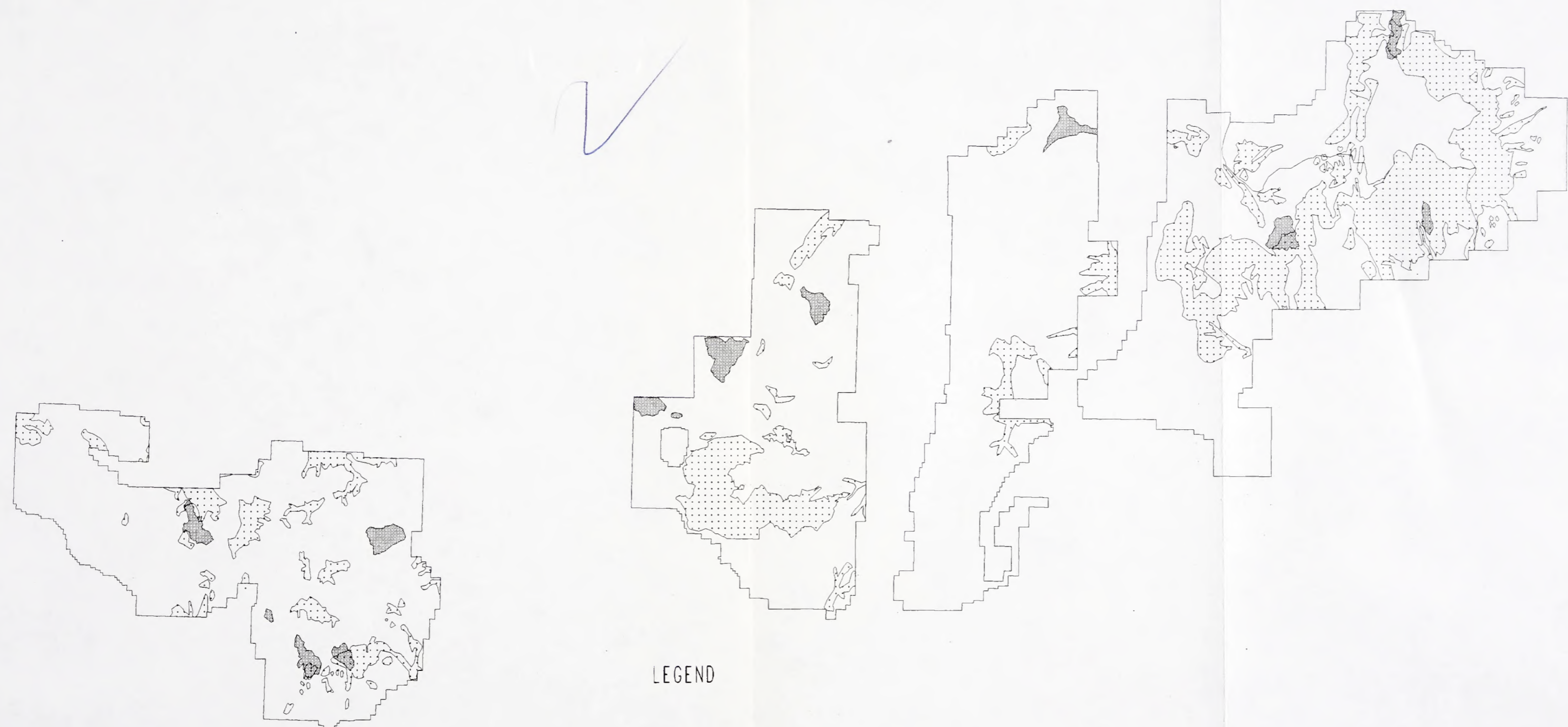
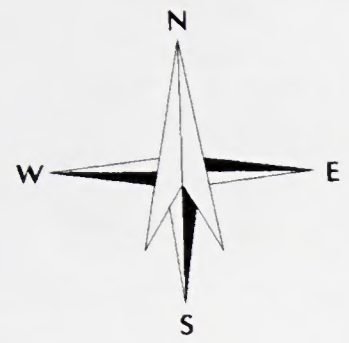










# SENSITIVE AQUIFERS and MUNICIPAL WATERSHEDS DIXIE NATIONAL FOREST



### LEGEND

-  Municipal Watersheds
-  Sensitive Aquifers

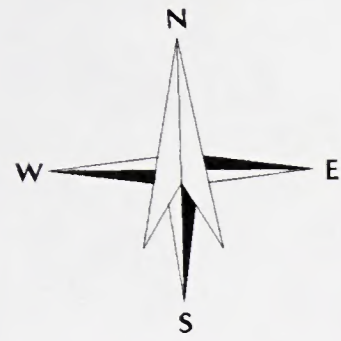
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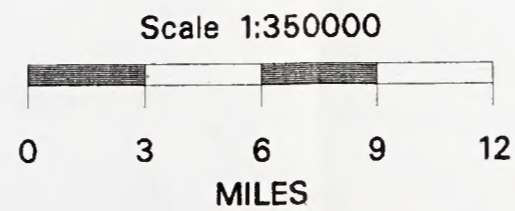
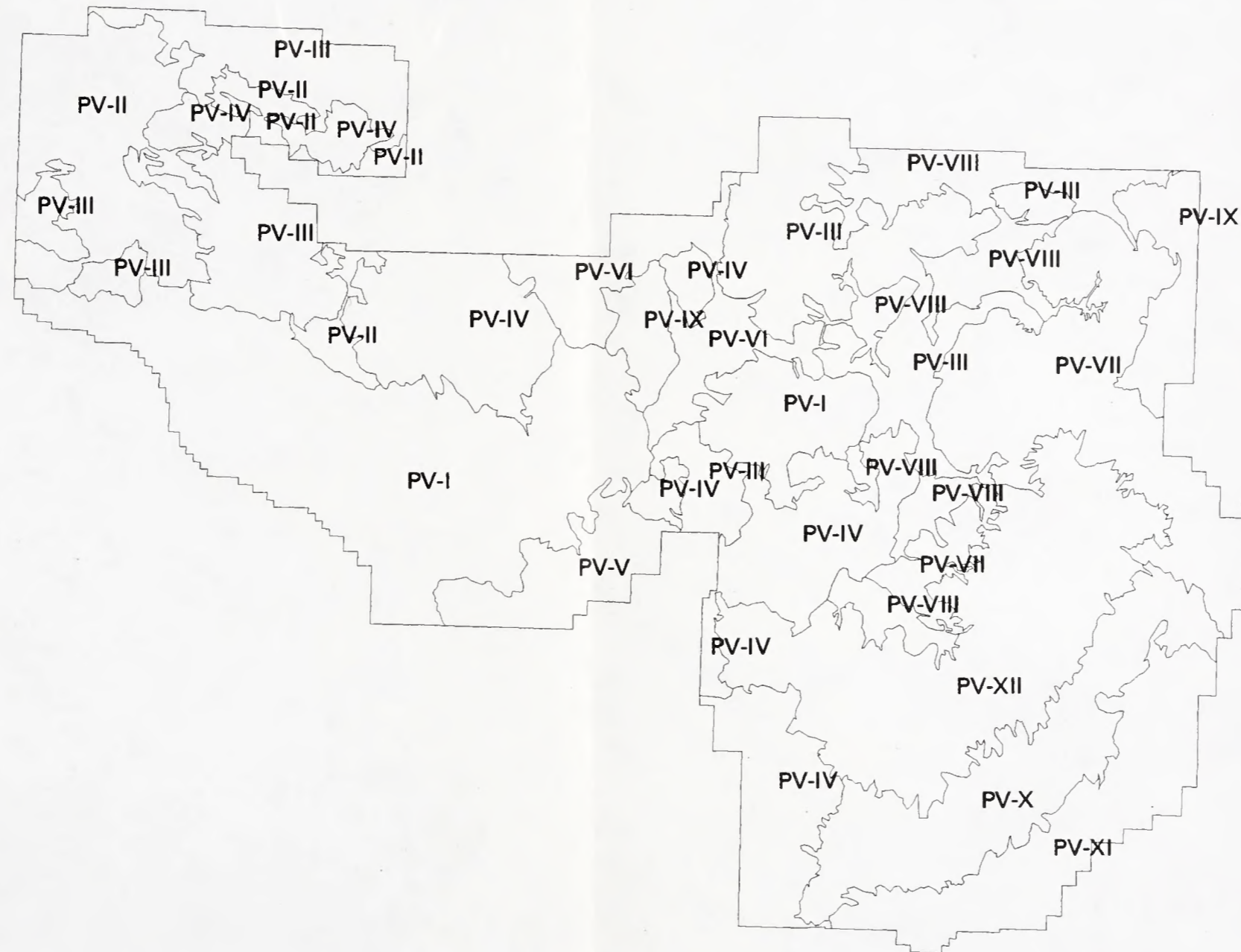








# LANDTYPE ASSOCIATIONS



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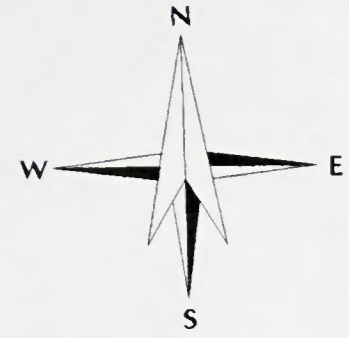


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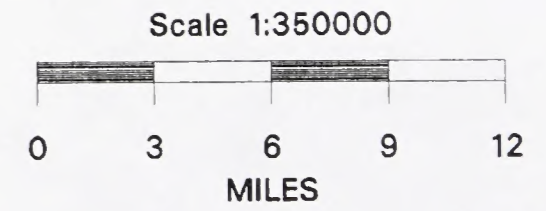
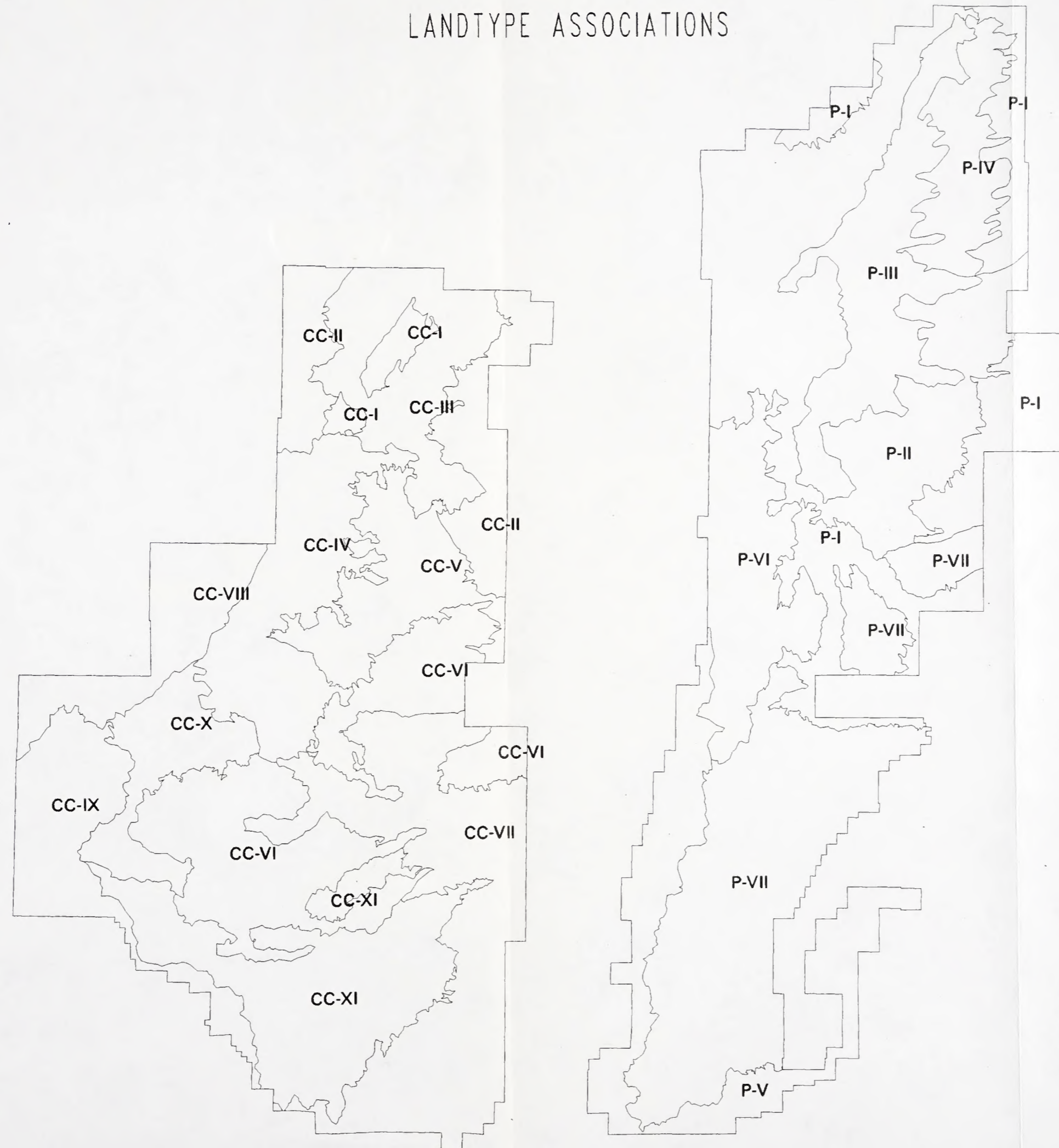








# LANDTYPE ASSOCIATIONS



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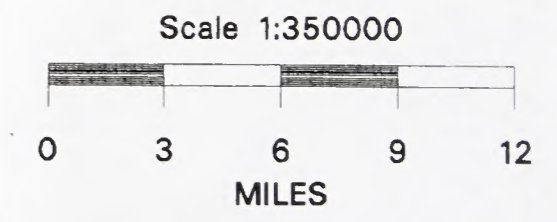
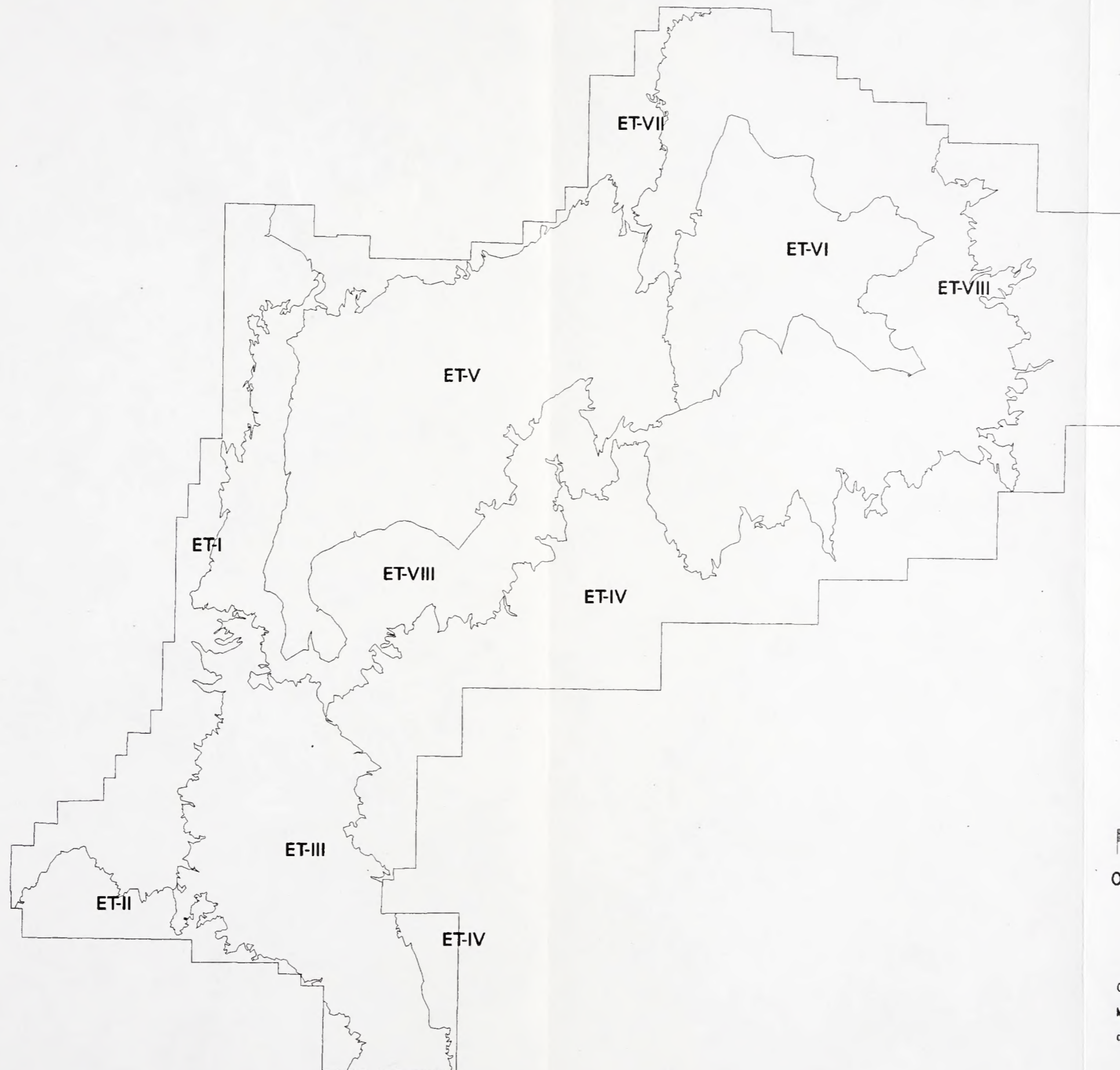
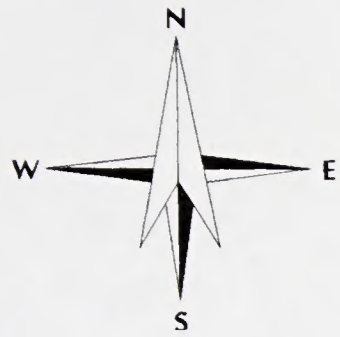








# LANDTYPE ASSOCIATIONS

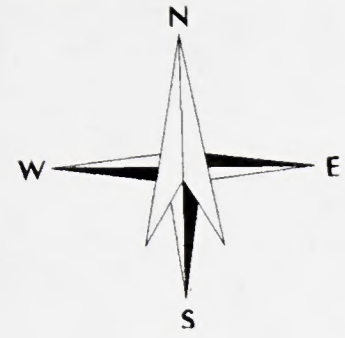


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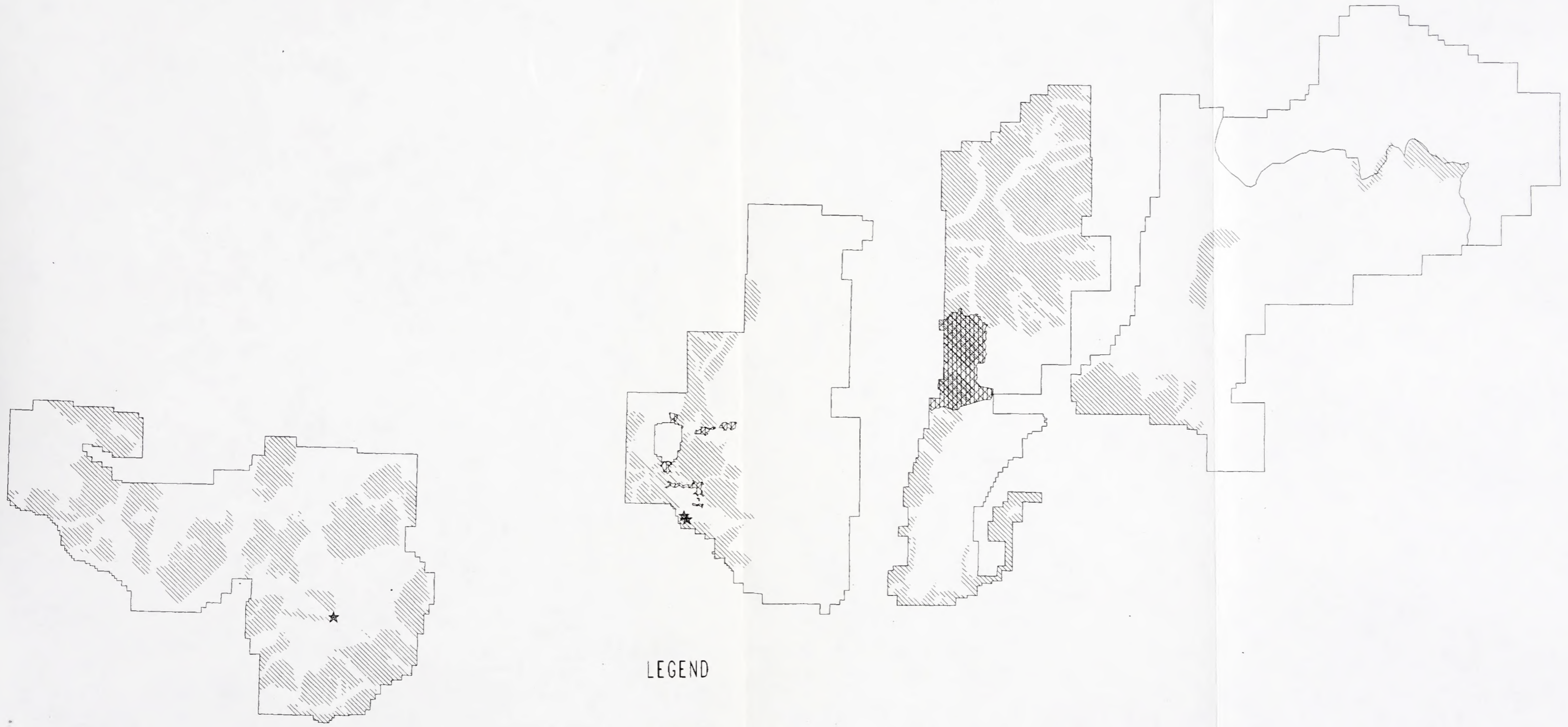











# RECREATION AREAS DIXIE NATIONAL FOREST



## LEGEND

-  High Recreation Areas
-  Semi-Primitive, Non-Motorized Areas
-  Recreation Residence Areas

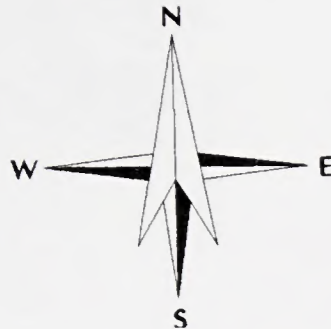










# VISUAL QUALITY OBJECTIVES DIXIE NATIONAL FOREST



## LEGEND

-  Partial Retention
-  Retention

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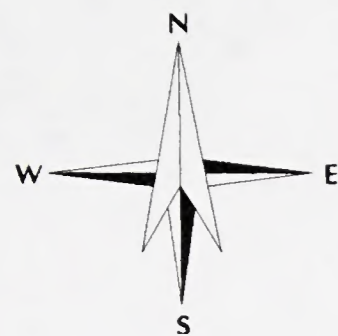










# GEOLOGIC HAZARDS DIXIE NATIONAL FOREST



## LEGEND

-  Marginally Unstable
-  High Erosion Potential

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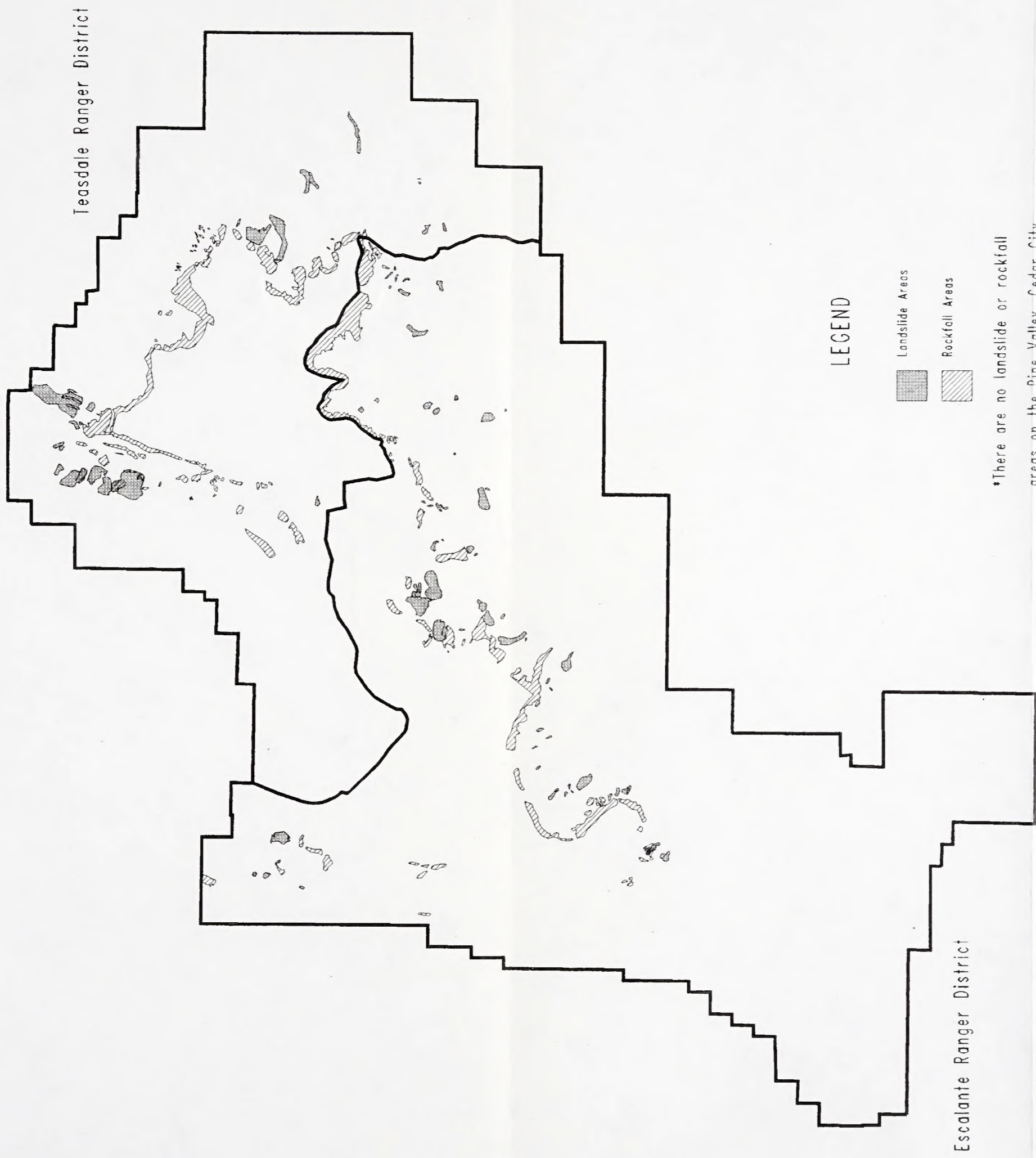
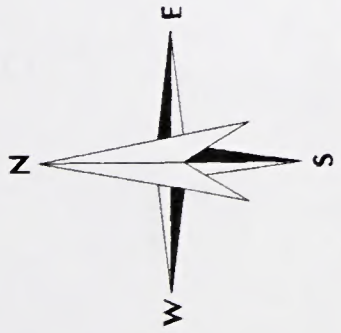
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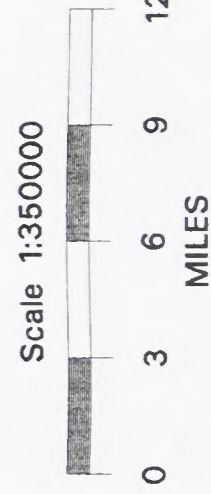
# GEOLOGIC HAZARDS LANDSLIDE AND ROCKFALL AREAS\*



### LEGEND

-  Landslide Areas
-  Rockfall Areas

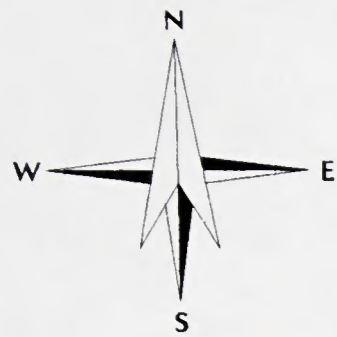
\*There are no landslide or rockfall areas on the Pine Valley, Cedar City or Powell Ranger Districts.











# Slope Exceeds Forty Percent

## DIXIE NATIONAL FOREST



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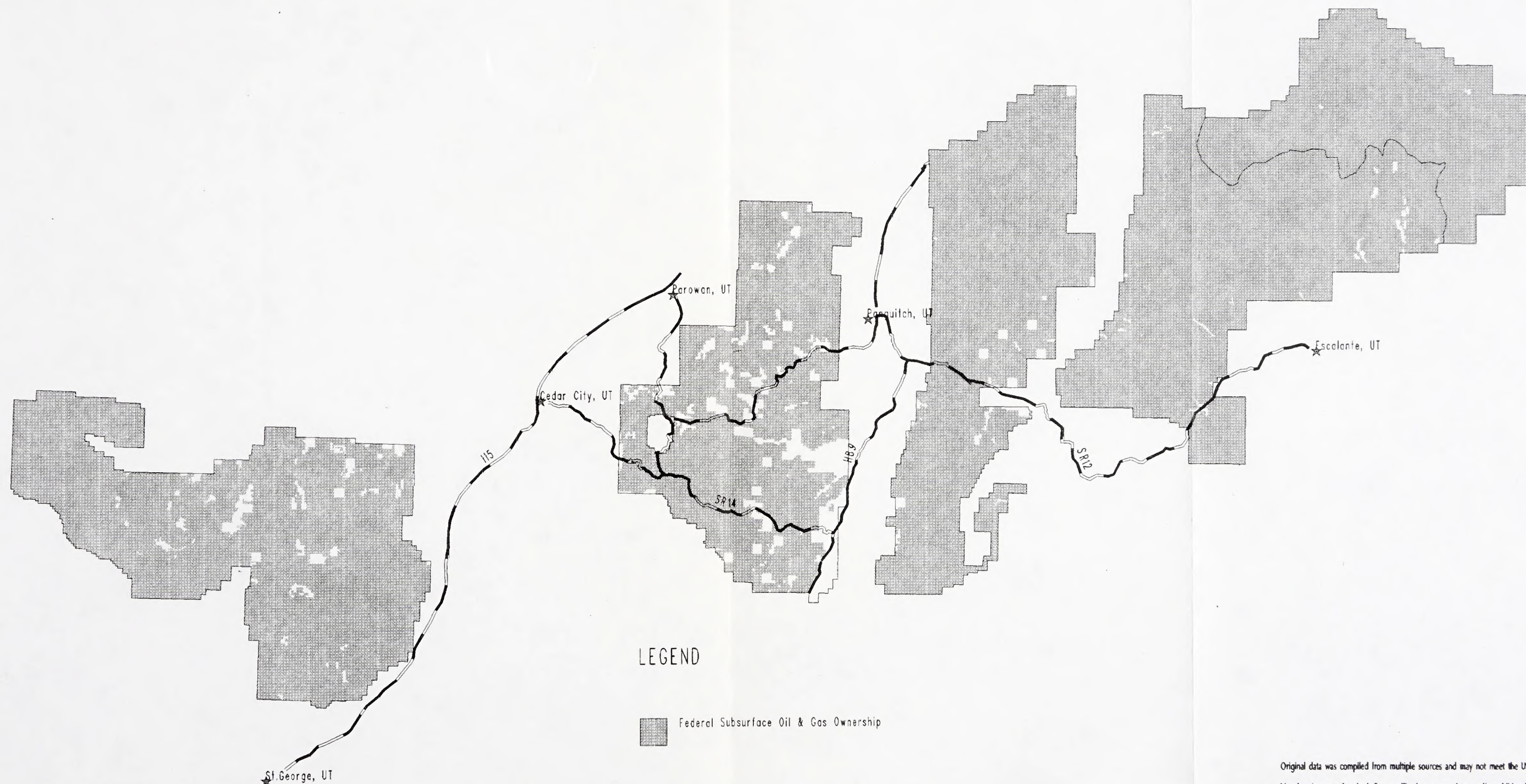
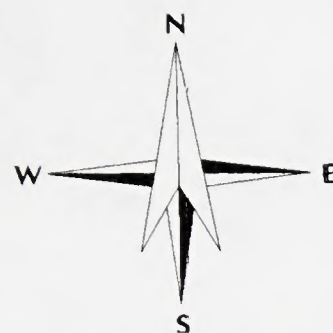









# FEDERAL SUBSURFACE OIL & GAS OWNERSHIP DIXIE NATIONAL FOREST



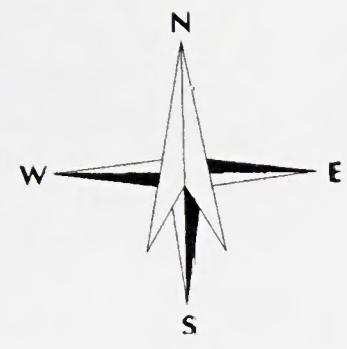
## LEGEND

 Federal Subsurface Oil & Gas Ownership












# ROAD NETWORK DIXIE NATIONAL FOREST

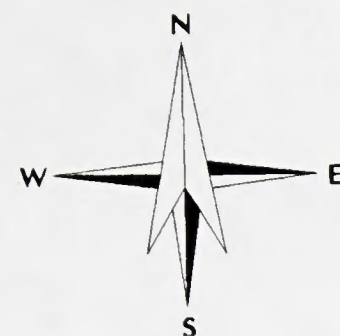


-  Primary Roads & Highways
-  Improved Roads
-  Other Roads & Trails









# SPECIAL AREAS DIXIE NATIONAL FOREST



## LEGEND

-  Ski Area
-  # Management Areas
-  Developed Sites
-  Research Natural Areas

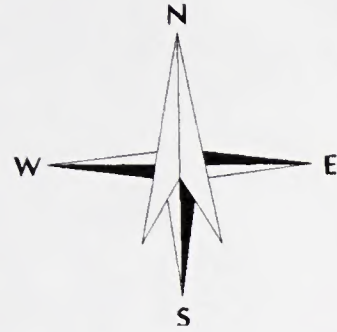
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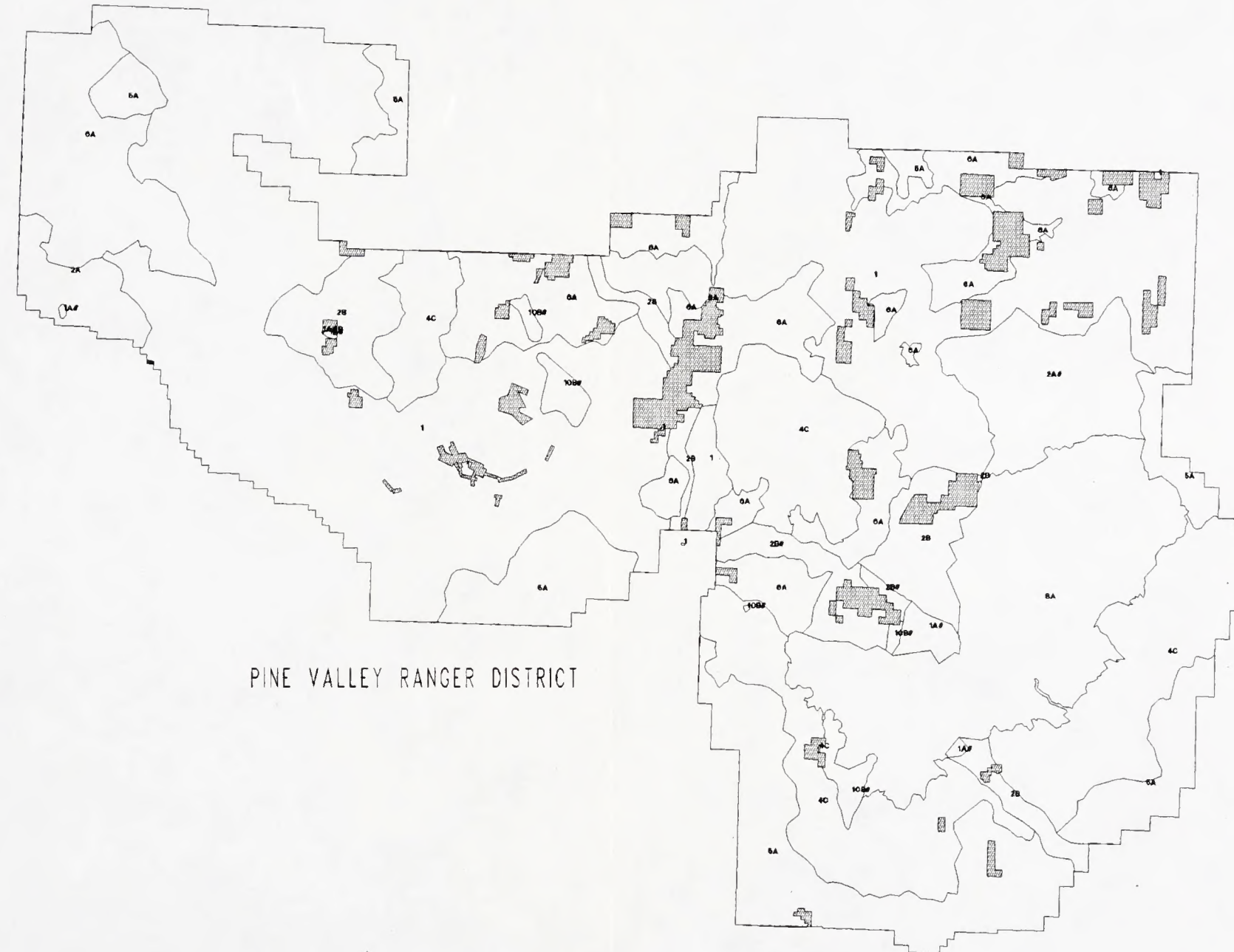




MANAGEMENT AREAS



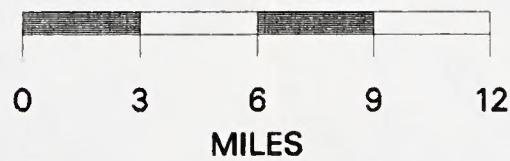
LEGEND



- 1 General Forest Direction
- 1A Recreation Sites
- 1B Winter Sports Sites
- 2A Semi- Primitive Recreation Opportunities
- 2B Rural & Rooded Recreation Opportunities
- 4A Fish Habitat Emphasis
- 4B Wildlife Habitat Management (MIS)
- 4C Wildlife Habitat (Shrub Areas)
- 4D Wildlife Habitat (Aspen Areas)
- 5A Big Game Winter Range (Non Forest)
- 5B Big Game Winter Range (Forest)
- 6A Livestack Grazing
- 7A Timber Management
- 8A Wilderness
- 9A Riparian Management
- 9B Intensive Riparian Management
- 10A Research Natural Areas
- 10B Municipal Supply Watersheds
- # Management Areas marked with # have a no surface occupancy stipulation for mineral entry.
- Private Land

PINE VALLEY RANGER DISTRICT

Scale 1:350000



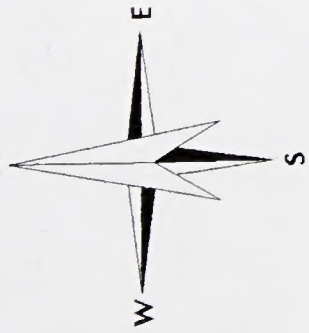








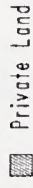
MANAGEMENT AREAS



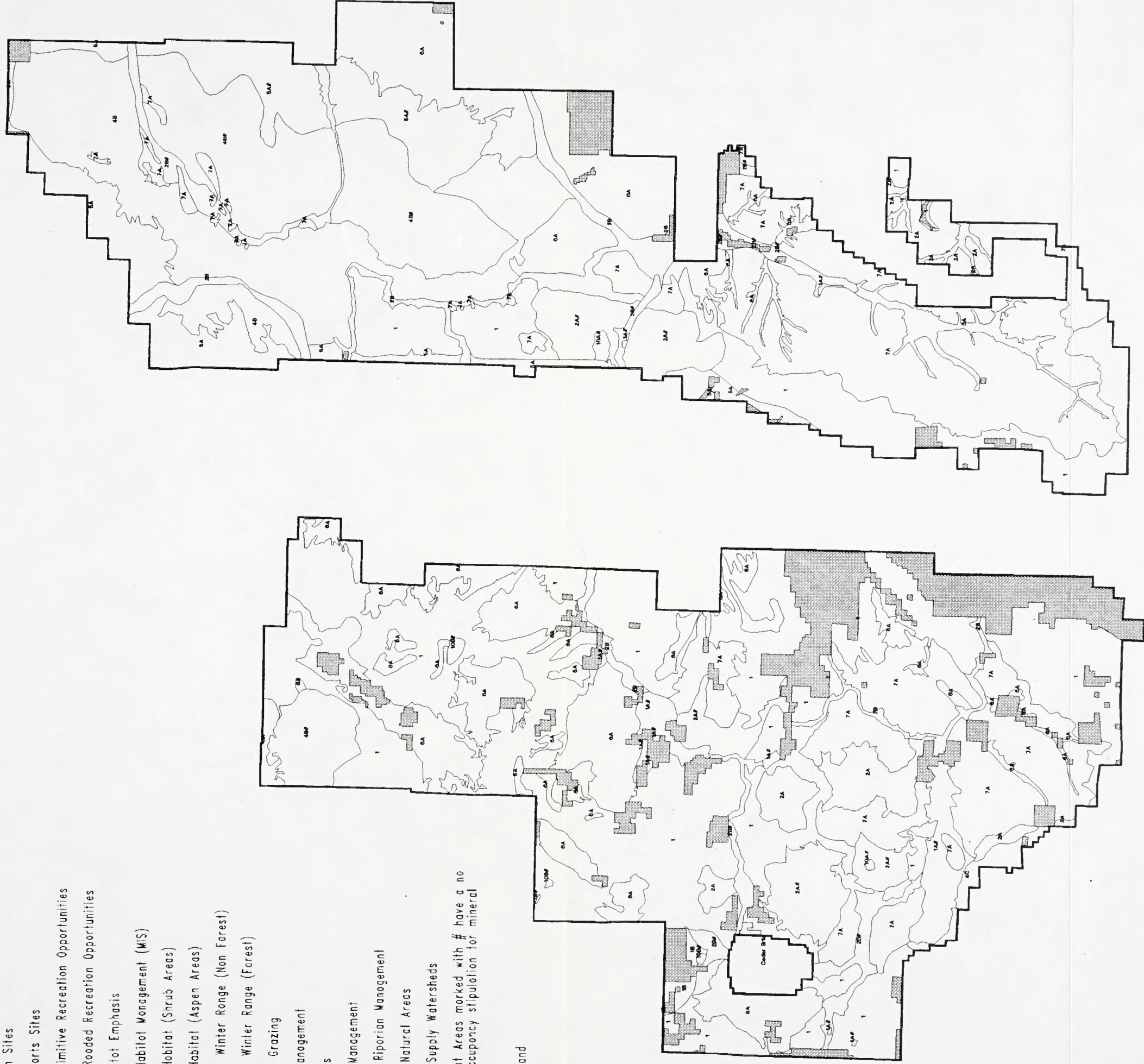
LEGEND

- 1 General Forest Direction
- 1A Recreation Sites
- 1B Winter Sports Sites
- 2A Semi- Primitive Recreation Opportunities
- 2B Rural & Roded Recreation Opportunities
- 4A Fish Habitat Emphasis
- 4B Wildlife Habitat Management (MIS)
- 4C Wildlife Habitat (Shrub Areas)
- 4D Wildlife Habitat (Aspen Areas)
- 5A Big Game Winter Range (Non Forest)
- 5B Big Game Winter Range (Forest)
- 6A Livestock Grazing
- 7A Timber Management
- 8A Wilderness
- 9A Riparian Management
- 9B Intensive Riparian Management
- 10A Research Natural Areas
- 10B Municipal Supply Watersheds

# Management Areas marked with # have a no surface occupancy stipulation for mineral entry.



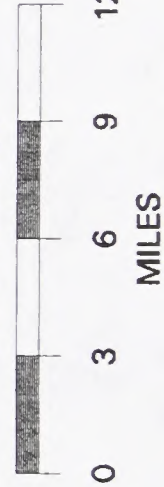
Private Land



Cedar City Ranger District

Powell Ranger District

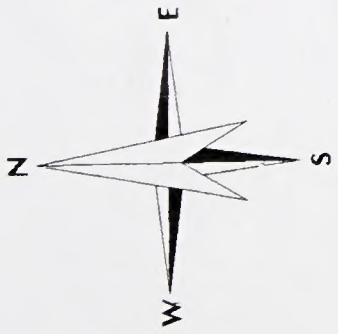
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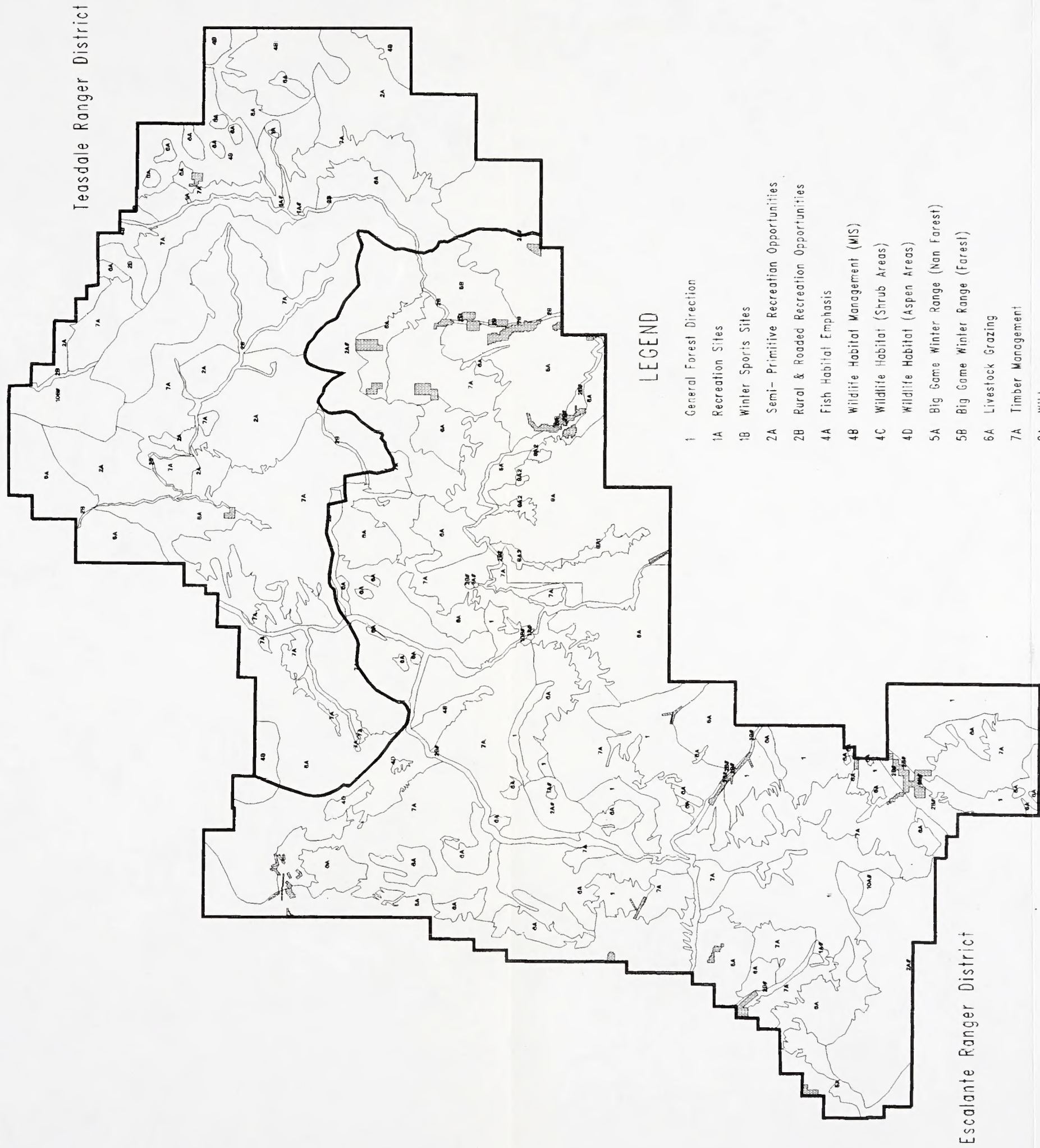








MANAGEMENT AREAS



LEGEND

- 1 General Forest Direction
- 1A Recreation Sites
- 1B Winter Sports Sites
- 2A Semi- Primitive Recreation Opportunities
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- Private Land

Scale 1:350000









## **CHAPTER 4**

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# ***ENVIRONMENTAL CONSEQUENCES***







## CHAPTER 4 - ENVIRONMENTAL CONSEQUENCES

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### INTRODUCTION

This chapter provides a description of the consequences, or potential impacts, to the natural, human, and cultural environments of implementing each alternative in association with potential oil and gas activity. Impacts are defined as modifications to the environment, as it presently exists, that are brought about by an outside action. It should be noted that no ground-disturbing activities will result from the decision made from this document. Rather, any future oil and gas activities resulting in ground-disturbing activities will require further environmental review, in accordance with NEPA, prior to implementing the activities.

Using the information regarding the existing condition of the environment (Chapter 3) and a description of potential oil and gas activities (as detailed in Appendix D and E), the resource specialists identified the types of impacts that each alternative could have on the resources. Impacts can be beneficial (positive) or adverse (negative), and result from the action directly or indirectly. Impacts can be permanent, long-lasting (long term), or temporary (short term). In the case of this analysis, long-term impacts are defined as those that would substantially remain for the life of the project or beyond. Short-term impacts are defined as those changes to the environment during construction that would generally revert to preconstruction conditions at or within a few years of the end of construction. Impacts can vary in significance from no change, or only slightly discernible change, to a full modification or elimination of the environmental condition. Emphasis was placed on stipulations that could be applied to areas sensitive to potential oil and gas activities to mitigate or eliminate impacts. Separate unpublished background reports were prepared for each of the resources addressed in Chapter 3 and Chapter 4, and copies are located in the project files in the Forest Supervisor's Office.

Reference to the maps of the oil and gas potential areas and alternatives at the end of Chapter 2 and the resource maps provided at the end of Chapter 3 will help in understanding the effects discussed in this chapter.

The scope of the analysis includes three types of effects (see 40 CFR 1508.7 and 1508.8):

#### **Direct Effects**

These effects are caused by a specific action or activity at the same time and place. Leasing itself would not cause direct effects though it is reasonable to project effects to result from leasing, i.e. subsequent explorations and developments. These effects on resources were analyzed for the reasonable foreseeable development activities described in Appendix E. Direct effects are described in this chapter.

#### **Indirect Effects**

These effects are caused by a specific action or activity but typically occur later in time or farther in distance. Indirect effects on resources were analyzed for the proposed action and the alternatives. Direct and indirect effects are considered together in the analysis and not specifically identified or disclosed separately.



## Cumulative Effects

These effects result from incremental impacts of the action when added to other past, present, and reasonably foreseeable future actions regardless of what person or agency (Federal or non-Federal) undertakes those actions.

Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time. Reasonably foreseeable actions consist of projects, actions, or developments that can be projected, with a reasonable degree of confidence, to occur within a defined timeframe and that will impact the same or portions of the same resource.

An analysis of cumulative impacts have been performed for each of the resource categories addressed in the Affected Environment and Environmental Consequences chapters of this Environmental Impact Statement (Chapters 3 and 4). The analysis for the cumulative impact assessment generally coincided with the particular area of influence defined for each resource.

Road construction, oil and gas field development, livestock grazing, and recreation use have occurred in and adjacent to the Dixie National Forest. Also, some past activities have occurred and present activities are occurring and are included in the cumulative effects analysis under the appropriate resource headings in this chapter.

## **PLANT AND WILDLIFE THREATENED, ENDANGERED, PROPOSED, AND FOREST SERVICE SENSITIVE SPECIES**

This section describes the potential impacts of the activities associated with oil and gas exploration and development on threatened, endangered, proposed and candidate species & sensitive species of wildlife and plants.

The information presented in this section addresses the following issue that was identified in the scoping process.

- Issue 1** The effects of oil and gas leasing and possible exploration and development activities on wildlife and wildlife habitat.
  
- Issue 3** The effects of oil and gas leasing and possible subsequent exploration and development activities on water, soils and riparian values.

Impacts to threatened, endangered, and proposed wildlife and fish species would be considered to be significant if exploration or development would:

- Cause a loss of critical habitat (designated or proposed) for any protected species, such as those listed as threatened, endangered, or proposed by US Fish and Wildlife Service (FWS); migratory birds; and Forest Service sensitive. Impacts to threatened and endangered species are considered significant if a Biological Assessment (BA) required under Section 7 of the Endangered Species Act assigns a "may affect" rule to any such species.
  
- Threaten the viability of a sensitive species which could result in the listing of the species as threatened or endangered as determined in the Biological Evaluation.



Species locations and habitats requiring protection are based on the best available data. As new data becomes available, lease stipulations may be applied where appropriate. The purpose of this EIS is to provide the overall scenario for oil and gas leasing on the Dixie National Forest, including identifying areas where oil and gas exploration and development is most likely to occur based on geological conditions and identifying potential impacts of oil and gas exploration and known wildlife resources, as well as, providing the background for mitigating potential adverse impacts. Individual proposals for drilling and constructing facilities must be evaluated on a site-specific basis. If special status species (i.e., threatened, endangered, proposed, sensitive) are identified in such areas and a "may affect" determination is made, then measures would be taken to protect these species regardless of lease stipulations.

### **Threatened, Endangered, Proposed, and Sensitive Wildlife Species**

Species listed, or proposed for listing, by the Federal government as endangered or threatened are protected by the Endangered Species Act. A Lease Notice (LN) containing detailed information concerning limitations that already exist in law, lease terms, regulations, or operational orders would be attached to the lease. If appropriate, lease stipulations will need to be applied to protect critical habitat. Known or potential habitat for threatened, endangered, and proposed wildlife and fish species which occur on the Dixie National Forest, and are protected by LN includes:

- Utah Prairie Dog
- Bald Eagle
- Peregrine Falcon
- Mexican Spotted Owl
- Southwestern Willow Flycatcher

### **Effects Common to All Action Alternatives**

Impacts to threatened, endangered, and candidate species; species proposed for listing; and sensitive species from oil and gas leasing and subsequent geophysical exploration and development are characterized as either direct or indirect impacts. Direct impacts are those actions which result in immediate mortality of species, such as vehicle collisions and the destruction of burrows or nests when occupied by birds, mammals, or herpetofauna. Indirect impacts result from activities that affect species behavior, species dispersion, or the reduction of habitat quality or quantity. The indirect and direct impacts discussed below are based on the reasonable foreseeable development scenario (RFDS) for each alternative as discussed in Chapter 2 and Appendix E.

### **Threatened and Endangered Species**

Lease notices will be attached to leases granted where threatened and endangered species are potentially located. This will ensure the protection of these species through the Endangered Species Act rather than through a lease stipulation. A Biological Assessment/Evaluation (BA/BE) is being prepared concurrently with this EIS on oil and gas leasing on the Dixie National Forest. Where it is determined that any such species could be adversely affected (i.e., a "may effect" determination), appropriate measures will be identified to prevent significant impacts. If a "may effect" determination is made, the Forest Service will enter into Section 7 consultation with the US Fish and Wildlife Service (FWS) pursuant to the Endangered Species Act to identify those measures needed to reduce potential adverse impacts to an insignificant level.



The four listed species for which habitat has been identified as occurring or potential occurring within the Dixie National Forest are bald eagle, Mexican spotted owl, southwestern willow flycatcher, and Utah prairie dog. Approximately 2,600 acres of bald eagle wintering grounds exist on the Pine Valley Ranger District. A total of approximately 13,100 acres of Utah prairie dog habitat occurs within areas which would be leased under controlled surface use (CSU) or timing limitation (TL) stipulations on the Markagunt Plateau (1,200 acres), the Sevier and Paunsagant Plateaus (3,300 acres), the South Escalante Mountains (600 acres), and the Aquarius Plateau (8,000 acres). Suitable habitat exists for Mexican spotted owls, although no nest sites are known on the Forest. Mitigation measures set forth by the FWS would further protect these species and their habitat from being adversely effected by the Proposed Action or other alternatives.

The southwestern willow flycatcher, recently listed as endangered, potentially habitats in riparian areas on the Forest. Riparian habitat throughout the analysis area would not be leased (NL) or would be protected is protected under NSO stipulations which would prevent loss or degradation of potential habitat for this species.

## **Raptors**

The forest provides habitat for numerous species of raptors, including wintering bald eagles, Mexican spotted owls, goshawks, flammulated owls, and ferruginous hawks. Oil and gas leasing activities could result in the destruction of nests, the elimination of essential habitat components (i.e., nest sites or prey base) or cause the birds to abandon nests with eggs or young. Each raptor species reacts differently to human interference, so information on identified species would have to be gathered for those sites for which an Application for Permit to Drill (APD) is submitted. A species viability analysis would then be conducted and a Biological Evaluation prepared. If a "may effect" viability determination is made, no action would be allowed during the nesting period.

Reducing the density of trees in some areas could be beneficial by increasing hunting capabilities of some raptors, such as the goshawk; however, removal of large old trees within the nesting and rearing area could cause nest abandonment and failure. Removal of trees within nest areas should be avoided whenever possible. At a minimum, at least three nest areas within a given goshawk pair's home range should be maintained and three potential replacement nest areas should be identified and protected within each pair's home range. Post-fledgling family areas (PFAs) are more amenable to disturbance, and may actually be enhanced by limited opening of small patches. Activities within PFAs should be limited to the period between October and February.

If raptor nests or habitat for other special status species are identified during site specific analysis, then mitigation measures would be implemented. For example, Conditions of Approval (COA) can be applied to prevent activities during nesting seasons and buffer zones can be designated around nest sites. Standard lease terms would be applied to most raptors which would allow a well site or a road to be moved up to 200 meters (656 feet) to avoid a nest, although certain activities may still preclude the use of a nest. In addition, oil and gas activities could be suspended for up to 60 days provide protection during critical periods. Raptor nests identified after a lease had been granted can be protected by COA as long as they do not violate the rights of the lessee. Therefore, site specific surveys are important prior to the approval of an APD.

## **Fisheries**

The Bonneville and Colorado cutthroat trout are Federal Candidate Category 2 and Forest Service sensitive species, therefore, CSU stipulations would provide adequate protection. Additionally, no Surface



Occupancy (NSO) stipulations that would be applied to aquatic and riparian areas would result in a higher protection level for these trout. Approximately 33,200 acres of riparian habitat exists on the Dixie National Forest, providing habitat for numerous wildlife species in addition to protecting streams from increased sedimentation. Riparian areas would either not be leased (NL) or would be protected by NSO stipulations throughout the analysis area and impacts would be reduced to minimum levels.

### **Threatened, Endangered, Proposed, and Sensitive Plant Species**

This section addresses the potential impacts to threatened, endangered, proposed, or sensitive (TEP&S) plant species that could result from oil and gas and CO<sub>2</sub> exploration and development within the project area. This analysis focuses on areas with high oil and gas or CO<sub>2</sub> reserve potential that could be leased under the four alternatives. These alternatives vary in application of lease stipulations and in effects that could occur to TEP&S plant species, either directly from construction activities or from secondary sources that occur from adjacent areas (indirect effects). Acreage within the various lease stipulations for each alternative are listed in Table 2-11 in Chapter 2. A list of TEP&S plant species that have potential to occur within Forest is presented in Table 3-4 in Chapter 3.

In accordance with Forest Service Policy, areas containing TEP&S species or their habitats are to be protected and therefore no direct impacts are predicted from oil and gas leasing. This conclusion presupposes that TEP&S species' locations would be known prior to leasing certain areas and no inadvertent impacts would occur.

### **Effects Common to All Alternatives**

Impacts that need to be considered for each of the alternative include activities that affect areas adjacent to exploratory and production development, as alternatives do not allow leasing of areas containing threatened or endangered plant species. Therefore, impacts include effects that may be transported into adjacent areas from development that occurs outside restricted areas. Examples include changes to drainage patterns from construction of roads and drill pads that change moisture regimes of TEP&S species' habitats, and accelerated soil erosion that either inundates areas with soil or causes soil losses from uncontrolled runoff.

Impacts to TEP&S plant species would most likely occur in areas which have a high potential for oil and gas and CO<sub>2</sub> reserves in combination with a lease stipulation which would allow for surface development, (i.e. TL, CSU or SLT).

### **Proposed Action: Forest Plan Intent**

Under the Proposed Action Alternatives, the potential for development would occur as specified in the Dixie National Forest Plan. Impacts to TEP&S plant species would be greater in areas having high potential for oil and gas and CO<sub>2</sub> reserves, and CSU stipulations, which allows for surface development. In the case of CSU, areas known to contain TEP&S species would be avoided by construction activities. The Forest Plan specifies that TEP&S species and their habitats are to be protected in accordance with the Endangered Species Act (1973) and are considered sensitive in the USDA Forest Service Region IV TEP&S Species Action Plan. Therefore, a lease notice would be attached as a condition that T&E and candidate plant species and their habitats be protected. Similarly, CSU stipulations would be applied to leases that contain sensitive species and/or their habitat. Under such leasing terms, areas with the potential to contain TEP&S plant species would need to be surveyed prior to initiating exploration or



development activities. Oil and gas activities could be delayed for 60 days, as specified in 43 CFR 3101.1-2, until an analysis of the potential for TEP&S plant species occurrence in an area is conducted. Similarly, development plans would need to be cognizant of TEP&S plant areas to minimize secondary impacts (e.g., change in drainage patterns, soil erosion inundation) from developed areas.

Areas with the highest potential to be disturbed, namely those with high CO<sub>2</sub> potential and either CSU or TL stipulations, include a total of approximately 78,900 and 43,800 acres under each of these stipulations respectively. These areas occur in the Aquarius Plateau and the Escalante anticline. TEP&S plant species that have potential to occur in these areas are *Astragalus henrimontanensis*, *Castilleja aquariensis*, *C. parvula* var. *revealii*, *Eriogonum aretioides*, *Heterotheca jonesii*, *Lepidium montanum* var. *neeseae*, *Penstemon parvus*, and *Silene petersonii* (refer to Table 3-4 in Chapter 3).

### **Alternative 1: No Action/No Lease**

Exploration under the existing lease is estimated to disturb approximately 156 gross acres of which 69 acres would not be reclaimed until the project is decommissioned. Areas that would be disturbed under existing leases would need to be surveyed prior to disturbance activities for TEP&S plant species in accordance with the Forest Plan. No additional impacts to TEP&S plant species would be anticipated under Alternative 1.

### **Alternative 2: Forest Plan Modification A**

Under this alternative, TEP&S plant habitat would either not be leased (NL) or would be leased with the NSO stipulation. Acreages are shown in Table 2-11 in Chapter 2. Therefore, no direct impacts to TEP&S plant species would occur from oil and gas and CO<sub>2</sub> development. This conclusion is based on the assumption that locations of TEP&S plant species and their habitats are, or would be known, and can be avoided by development. In addition, project plans would need to be developed whereby indirect effects would also not impact these areas. TEP&S plant species of concern in areas of the Forest that have high potential for CO<sub>2</sub> reserves and moderate potential for oil and gas reserves are discussed in the Proposed Action Alternative. A total of approximately 89,000 acres would not be leased (NL) and about 89,934 acres that occur in areas of high CO<sub>2</sub> potential would be leased with the NSO stipulation respectively (Table 2-11 in Chapter 2). These areas occur in the Aquarius Plateau and Escalante anticline.

### **Alternative 3: Forest Plan Modification B**

The potential impacts to TEP&S plant species would be similar to those discussed for the Proposed Action Alternative. TEP&S species are protected by either the Endangered Species Act or Forest Service policy, and areas known to contain TEP&S species and their habitats would be protected from oil and gas development by a lease notice attached as a condition to leasing agreements. Therefore, areas that are likely to contain TEP&S plant species would need to be surveyed prior to exploration or development.

Areas with the highest potential to be disturbed, namely those with high CO<sub>2</sub> potential and either CSU or TL lease stipulation, include a total of approximately 86,900 and 52,000 acres under each of these stipulations, respectively. These areas occur in the Aquarius Plateau and the Escalante anticline. In addition to the TEP&S plant species that have potential to occur in the Aquarius Plateau and Escalante anticline area (refer to Proposed Action Alternative), the following TEP&S species have the potential to occur in areas located in the Teasdale Ranger District for this alternative: *Gilia caespitosa*, *Potentilla*



*angelliae*, and *Thelesperma subnudus* var. *alpinum* (see Affected Environment Section, Table 3-11 in Chapter 3).

#### **Alternative 4: Forest Plan Modification C**

Unlike the other alternatives, Alternative 4 would allow acreage to be leased under SLT. Forest Service policy regarding TEP&S species for the various stipulations is that a lease notice would be attached to the lease conditions indicating that such species and their habitat would be protected. In order for such conditions to be met, the presence of TEP&S plant species and their habitats must be known, and surveys would be required in appropriate areas prior to any development.

Areas with the highest potential to be disturbed, namely those with high CO<sub>2</sub> potential and either or SLT CSU stipulations, include a total of approximately 98,700 and 49,700 acres under each of these stipulations, respectively. These areas occur in the Aquarius Plateau and the Escalante anticline.

#### **Cumulative Impacts**

Cumulative impacts include incremental adverse or beneficial effects which result from other resource development activities that are specified in the Forest Plan (USDA Forest Service 1985 and 1986a). The total acreage disturbed by the proposed action may not be significant but, when added to other uses, may result in detrimental impacts to special status plant and wildlife species. Therefore, the impacts of other on-going activities such as livestock grazing, timber harvest, and recreation must be considered in relation to oil and gas exploration and development to assess the total impacts on the study area. Reduction of impacts to TEP&S plant and wildlife species and their habitats requires application of guidelines that are specified by the Endangered Species Act or by Sensitive Species Action Plans for Region IV and by policies of the Dixie Forest Plan.

Road construction or road upgrading in conjunction with oil and gas development could result in direct or indirect impacts to wildlife by increasing accessibility. Any projects that allows for more access into an area generates increased motorized recreational opportunities for the public, which could result in additional disruption and displacement of elk and other wildlife species.

Cumulative impacts are likely to be more severe in the summer months, rather than the winter months as a result of proposed exploration.

Some sensitive species (raptors, small mammals, herpetofauna) or threatened/endangered species have narrow ranges and very specific habitat requirements. If these are identified when conducting a site-specific analysis, the cumulative impacts of other activities would have to be analyzed to ensure protection of the identified species habitat.

#### **WILDLIFE AND FISHERIES**

This section provides a discussion of the potential impacts of the activities associated with oil and gas exploration and development on wildlife and fisheries resources and includes an assessment of the effectiveness of lease stipulations in terms of mitigating effect to wildlife resources.

The information presented in this section addresses the following issue that was identified in the scoping process.



**Issue 1** The effects of oil and gas leasing and possible exploration and development activities on wildlife and wildlife habitat.

**Issue 3** The effects of oil and gas leasing and possible subsequent exploration and development activities on water, soils and riparian values.

Lease stipulations are necessary only when the identified resource is not otherwise protected by existing legislation. If appropriate, lease stipulations will need to be applied to protect critical habitat. Those wildlife resources which occur on the Dixie National Forest, and the protection afforded those resources by the various lease options as discussed in this section, include the following:

- Critical Elk Winter Range
- Critical Elk Calving Grounds
- Critical Mule Deer Winter Range
- Critical Mule Deer Fawning Areas
- Sage Grouse Leks

Impacts to wildlife and fisheries would be considered to be significant if exploration or development would:

- Disturb more than 1 percent of critical habitat available for wildlife (for example, elk/deer calving/fawning areas and critical winter range) during the critical time of year. Disturbance includes vegetation removal or activities that cause avoidance of the area by the species. One percent has been determined based on professional judgement and existing research (Sarz and Armbuster, 1983).

Critical habitats requiring protection are based on the best available data. As new data becomes available, lease stipulations may be applied where appropriate. The purpose of this EIS is to provide the overall scenario for oil and gas leasing on the Dixie National Forest, including identifying areas where oil and gas exploration and development is most likely to occur based on geological conditions and identifying potential impacts of oil and gas exploration and known wildlife resources, as well as, providing the background for mitigating potential adverse impacts.

### **Effects Common to All Action Alternatives**

Impacts to wildlife from oil and gas leasing and subsequent geophysical exploration and development are categorized as either direct or indirect impacts. Direct impacts are those actions which result in immediate mortality of wildlife, such as vehicle collisions and the destruction of burrows or nests when occupied by small birds, mammals, or herpetofauna. Indirect impacts result from activities that affect animal behavior, animal dispersion, or the reduction of habitat quality or quantity. Impacts will vary in type and magnitude during different phases in exploration being most severe, yet of short duration, when actual construction/blasting is occurring and less severe, but longterm, during the operation and maintenance of the facility. The magnitude will also be dependent on the time of year, the location, the amount of surface disturbance, and the sensitivity of the wildlife species involved. The indirect and direct impacts discussed below are based on the reasonable foreseeable development scenario (RFDS) for each alternative as discussed in Chapter 2 and Appendix E.

The different phases of construction would impact wildlife resources to varying degrees depending on the duration, the amount of ground disturbance, and other associated activities. The following phases are discussed in the assessment of impacts: seismic activity, road construction, exploratory drilling, and production.



## Big Game

Seismic activity and exploration seldom result in significant impacts when it occurs during noncritical phases in the life cycle of the animals. This is due to the short duration of the activities and the limited area affected. Big game would be temporarily displaced during blasting, but would return following completion of the activity. Seismic activity would have a greater impact during more critical times, such as birthing and wintering. Elk and mule deer winter range and birthing areas are high sensitivity habitats (critical) that exist within the analysis area (Figures 3-5 and 3-6 at the end of Chapter 3). These big game species depend on these ranges to survive harsh winter conditions and would potentially be forced into marginal habitat by seismic activities. Direct impacts could result from increased human presence and vehicular traffic. Elk calving and mule deer fawning areas also occur. Females forced from selected birthing areas have a high potential for increased mortality due to predation, accidents, and disease (Knight 1980).

Exploratory drilling is of longer duration and could, therefore, potentially result in greater impacts to big game. Studies done on the response of elk to drilling activities show varying degrees of severity. In Wyoming, elk moved 0.5 to 2.5 miles away from a well site often placing visual and auditory barriers between the herd and the well site (Hayden-Wing Associates 1990). Elk displacement away from activities has sometimes been shown to be significant (Johnson and Lockman 1980) and in other cases elk appear to habituate to such activities (Knight 1980). Disturbance in elk calving areas may result in a significant shift in elk distribution (Brekke 1988) and by avoidance of drill sites and areas visible from access routes (Hayden-Wing Associates 1990). Loss of habitat resulting from drilling solitary exploratory wells at this phase of development could be reduced depending on the lease stipulation.

Oil and gas development and production has the greatest potential for impacts within big game winter ranges and birthing areas. These impacts could result from the loss of habitat and displacement of the animals during critical phases of their life cycle. The continual activities associated with a developed oil field could have significant impacts on wildlife. Disturbance to wildlife could be minimized by restricting drilling activities to non-critical periods through the use of timing limitations (TL) and CSU stipulations.

New road construction into previously isolated areas has the potential to significantly impact big game species and would result in the direct loss of approximately five acres of land per linear mile of new road and could affect wildlife on as much as 640 acres of habitat along the road. Roads could create increased public access resulting in added stress from vehicular traffic, intentional or unintentional harassment, poaching, and increased harvest levels by legal hunting. Road kills would also likely increase from existing levels. Seismic operations, wildcat wells, and new field development may all require new roads or upgrading existing roads.

## Sage Grouse

Although not listed as threatened, endangered or sensitive, there is a high level of concern for the Sage Grouse. Sage grouse are limited on the Dixie National Forest with populations being dependent on sagebrush for food and cover. Two sage grouse leks have been identified on the Cedar City District, three on the Powell Ranger District and one is on the edge of the Teasdale Ranger District (UDWR 1993a). These leks may or may not be currently active. A lek (strutting ground) is the center of courtship activity, breeding, nesting, and brood rearing for sage grouse and comprises a critical component of their habitat. It has been shown that 80 percent of all nests occur within a two-mile radius of a lek (Figure 3-5). Activities associated with oil and gas exploration and development within 0.25-mile of a lek could disturb breeding and could disrupt nesting and brood-rearing within a two mile radius. Any activity that disrupts strutting or



active nests could result in adverse changes to the local population and long-term declines in sage grouse populations (Autenrieth et al. 1982). The critical time period for use of these areas is March 15 to June 1.

## **Fisheries**

Fisheries resources exist in the streams and lakes throughout the Dixie National Forest. Impacts to riparian and aquatic habitats would result from increased sedimentation associated with ground disturbing activities during oil and gas exploration and development. The loss of riparian vegetation, the alteration of drainage patterns, and water flows could reduce the suitability of habitat for fish and macroinvertebrates. Bank erosion could increase sediment levels in adjacent streams, resulting in the degradation of habitat for macroinvertebrates which are the primary food source for most fish species. Increased sedimentation could substantially degrade spawning habitat, reduce spawning success, and recruitment, as well as decrease rearing and overwintering habitat. Any spill of hazardous materials into an aquatic habitat could have severe detrimental effects on fish or other species dependent on resources associated with that habitat. Fisheries resources would generally be protected by those stipulations which would be applied to riparian areas associated with aquatic habitats. Stipulations applied to riparian areas are generally more stringent than those which would be necessary to protect the fisheries resource. For example, SLT and CSU stipulations would allow a well site or a road to be moved up to 200 meters (656 feet) to avoid riparian areas and minimize potential effects to aquatic habitats. In addition, oil and gas activities could be suspended for up to 60 days provide protection during particularly sensitive periods.

## **Effects of Each Alternative**

Although activities associated with oil and gas exploration could result in significant impacts to wildlife resources, as identified in lease options analysis and impact assessment, the implementation of lease stipulations would decrease such impacts. One of the main issues for wildlife resources is the potential for loss of habitat effectiveness for big game species. To quantify the direct impacts on productive elk habitat and the displacement of elk, caused by a reduction in habitat effectiveness, the following assumptions were made based on studies referenced previously (Hayden-Winge Associates 1990; Johnson and Lackman 1980; Knight 1980; Brekke 1988; Leege):

- five acres of productive habitat would be removed per mile of road constructed
- elk would be displaced and elk densities reduced within one-quarter mile of roads, well pads, pipeline construction, because of a reduction in habitat effectiveness
- elk densities within the 0.25-mile distance would return within one year following the end of the activity
- elk densities within the 0.25-mile distance would remain lower than before the project during the life of the development and production because of reduced habitat effectiveness; and, elk densities would be higher during production than during development and exploration, because of less activity and traffic

Elk numbers or herd size would not be expected to decrease because of oil and gas activities. For example, during the development and production of the Hickey-Table Mountain field on the Wasatch-Cache National Forest, the size of the elk herd on the North Slope of the Uinta Mountains has increased in size.



## Proposed Action: Forest Plan Intent

Under this alternative, all Federal minerals would be administratively available for leasing with the exception of all Wilderness areas, Antone Bench, and Areas 2, 3, 4, and 5. Lands would be leased with one of several types of lease stipulations attached. The RFDS for the proposed action includes drilling eight exploratory wells with the potential for two CO<sub>2</sub> field developments. If field development occurs for CO<sub>2</sub> and hydrocarbons a total of 730 gross acres or 317 net acres would be directly affected. This constitutes a small percentage of the forest. However, the site specific location of the proposed wells and potential field developments could result in adverse effects to biological resources. Stipulations would be attached to leases located where known moderate and high sensitive wildlife resources exist. Although the TL stipulation is recommended for big game habitat, in some cases, a different stipulation, including CSU, NSO, and standard lease terms (SLT), would be attached based on the existence of other resources (i.e., geologic hazard).

The TL stipulation would place seasonal constraints on construction activities occurring near wildlife or within wildlife habitat. This stipulation would apply to specific big game resources during the following seasons:

Critical Elk Calving	May 1 - July 1
Critical Elk Winter Range	November 1 - April 15
Critical Deer Fawning	May 16 - July 1
Critical Deer Winter Range	November 1 - April 15
Sage Grouse Leks	March 15 - June 1

There are approximately 180,800 and 67,400 acres of deer fawning and elk calving areas on the Dixie National Forest, respectively. Under the Proposed Action, deer fawning areas would be protected by either the stipulations under TL--64,800 acres (36% of the total) or NSO--99,000 acres (55%), or by areas that would not be leased (NL)--17,000 acres (9%). Elk calving areas would be protected by the stipulations under TL--83,200 acres (54%) or NSO--67,400 acres (44%), or would be protected in areas that would not be lease (NL)--3,900 acres (2%). These stipulations would be effective in reducing impacts to big game during their respective birthing periods by prohibiting use of the area or limiting activity to non-critical seasons.

Extensive critical winter range exists for deer and elk. Critical winter range, approximately 143,300 acres for deer and 229,200 acres for elk, would not be leased (NL) or would be protected under NSO or TL stipulations. As with birthing areas, these stipulations are effective in eliminating impacts by not allowing construction activities within these areas either at any time (NL or NSO stipulations) or by reducing impacts to minor levels during the winter season (TL stipulation).

Sage grouse leks have been identified on the Cedar City and Powell Ranger Districts. These areas would be protected by NSO and CSU stipulations. The CSU stipulation would provide some protection of leks by relocating ground disturbing activities within 200 meters (656 feet) or suspending activities for up to 60 days to during sensitive periods. On the Cedar City District, the leks occur in areas that would be protected by TL stipulations, which would be effective if construction activities were prohibited during the mating and breeding season (March 15 - June 1). It is not known whether or not these leks are active and site-specific surveys would be necessary if an APD is requested within suitable habitat for sage grouse.

Based on the RFDS for this alternative, one exploratory well would be expected on the Markagunt Plateau (Cedar City Ranger District); three wells and one field development would occur on the Aquarius Plateau, Northern Escalante Mountains, and Boulder Mountains (Escalante and Teasdale Ranger Districts); two wells and one CO<sub>2</sub> field development would occur on the Escalante anticline (Escalante Ranger District);



one exploratory well would occur on the Sevier and Paunsaugunt Plateaus (Powell Ranger District); and, one well and one CO<sub>2</sub> field development would occur on the Southern Escalante Mountains (Escalante Ranger District). Table 2-11 (in Chapter 2) provides acres of big game winter range (critical value) and birthing areas for deer and elk, and riparian areas, for each of these potential areas and the stipulation that would be applied under each alternative.

The following acreage are approximate for the Proposed Action and it is unlikely that all facilities would be located within critical big game habitat. On the Dixie National Forest, productive habitat would be temporarily removed on about 1,600 acres during the 15-year RFDS projection period as a result of exploration activities. The drilling of exploratory wells would occur over the planning period and approximately 200 acres of productive habitat would be disturbed or removed at one well site for a total of about 1,300 acres at eight exploratory wells. About 741 (gross) acres of productive habitat would be temporarily removed as a result of CO<sub>2</sub> field development and about 900 (gross) acres as a result of a hydrocarbon field production. Disruption and displacement of big game, primarily elk, within 0.25-mile of road construction would be extensive; however, disturbance would be greatest during early exploration phases and during initial development of a field. Miles of road required would be 32.8, 35 and 40 for exploration, CO<sub>2</sub> field development, and oil field development, respectively. These roads would result in the loss of a total of 500 acres of habitat. Big game would be disturbed on approximately 34,500 acres if these roads occur in big game habitat, but would be significant only if critical habitat exists. This does not take into account the existence of barriers (woodlands, hills, etc.) and traffic density. Construction and exploration activities would likely have more direct impacts on wildlife than actual production due to the greater level of activity and increased human presence. All phases of exploration and production would result in displacement or disruption of big game on approximately 2,500 acres during active exploration and field development, excluding roads.

Impacts to wildlife resulting from this alternative would be minor with the implementation of the proposed lease stipulations. In some instances, more stringent stipulations would be applied due to the presence of other resources. There would be some irreversible and irretrievable commitment of wildlife resources; however, substantial disruption or loss of big game populations or habitat would not be expected. Site specific environmental studies at the APD stage would help ensure the protection of wildlife resources. Mitigation measures which could be implemented on a site specific basis include the relocation of surface activities, closure of oil and gas access roads to all but authorized personnel, and controlling the rate of development to limit activity within a given location at any one time.

### **Alternative 1: No Action/No Lease**

Under this alternative, two of the nine exploratory wells would be reasonably foreseeable. Because this alternative would offer no new land for lease, these two wells would occur on the Escalante anticline on one of the existing leases. This limits the amount of acreage for available to those existing leases. As a result, field development for hydrocarbons would not be reasonably foreseeable; however, the development of a CO<sub>2</sub> field would be foreseeable because it is a known resource. The total gross acres disturbed as a result of the implementation of the No-Action Alternative would be approximately 156 acres, with a net loss of 67 acres. Impacts associated with this disturbance likely result in some minor impacts considering the small acreage involved on the regional basis and the relatively short duration of the disturbance.

The following assumes that exploration and development would occur within big game habitat. On the Dixie National Forest, approximately 5 acres of productive habitat would be removed over the 15-year planning period because of exploration, well pads (assuming 2 wells drilled) resulting in the disturbance of big game habitat on approximately 300 acres. The development of a CO<sub>2</sub> field would result in the removal of about 100 acres. Displacement and disruption of big game habitat would occur within 0.25-mile



of approximately 8.2 miles of road during exploration activities and 17.5 miles of road during field development and production which would result in a loss of about 100 acres of habitat and reduced habitat effectiveness on approximately 2,600 acres.

## **Alternative 2: Forest Plan Modification A**

Forest Plan Modification A was developed in response to concerns about the presence of special resources other than potential areas for oil and gas discovery. Therefore, it is the most restrictive of the alternatives, with the exception of the No-Action (Alternative 1), would greatly limit the amount of land on the Dixie National Forest available for oil and gas leasing. Under this alternative, four of the nine exploratory wells are reasonably foreseeable, three on the Teasdale and Escalante Ranger Districts and one on the Cedar City District. Due to the limited number of wells foreseen and limited accessibility into areas where surface occupancy would be allowed, hydrocarbon field development is unlikely. However, the development of a CO<sub>2</sub> field would likely occur. The total gross acres that would be disturbed as a result of implementation of this alternative would be approximately 330 acres, with a net loss of 155 acres.

The TL stipulations would not be applied to any leases under this alternative. All deer fawning and elk calving areas would either not be leased (NL) or would be protected under NSO stipulations, which are more stringent than the TL stipulations and would reduce impacts to minimum levels. Impacts to critical value winter range for deer and elk would likewise be reduced to minimum levels through the application of NSO stipulations or no lease (NL).

Based on the RFDS for this alternative, one exploratory well would likely be on the Markagunt Plateau (Cedar City Ranger District); two wells and one field development would occur on the Aquarius Plateau, Northern Escalante Mountains and Boulder Mountains (Escalante and Teasdale Ranger Districts); and, one exploratory well and one CO<sub>2</sub> field development would occur on the Escalante anticline. Table 2-11 (in Chapter 2) provides acreages of big game winter range (critical value) and birthing areas for deer and elk, that occur in each of the oil and gas potential areas and the stipulations that would be applied under this alternative.

The following assumes that exploration and development would occur within big game habitat. On the Dixie National Forest, productive habitat would be temporarily removed or disturbed on about 600 acres during the 15-year RFDS planning period as a result of exploration wells. The drilling of exploratory wells would occur over the planning period and approximately 200 acres of productive habitat would be disturbed at any given time. About 100 acres of productive habitat would be temporarily removed as a result of the development of one CO<sub>2</sub> field. New roads would be constructed or existing roads upgraded during all phases of oil and gas exploration, development, and production. However, impacts would be greatest during the exploration and development periods. Miles of roads needed would be 16.4 and 35 during the respective phases resulting in the loss of approximately 300 acres and reduction of habitat effectiveness on approximately 16,400 acres. This does not take into consideration natural barriers along the roads. Road construction and exploration activities would likely result in greater direct impacts on wildlife than actual production due to the greater level of activity and increased human presence.

Impacts to wildlife resulting from this alternative would be minor with the implementation of proposed lease stipulations. In some instances, more stringent stipulations would be applied due to the presence of other resources. There would be some irreversible and irretrievable commitment of wildlife resources; however, substantial disruption or loss of big game populations or habitat would not be expected. Fewer exploratory wells are anticipated as part of the RFDS for this alternative than for the Proposed Action or Alternatives 3 or 4, and therefore, there would be less loss of habitat. Site specific environmental studies during the APD phase would help ensure the protection of wildlife resources. Mitigation measures which could be



implemented on a site specific basis include the relocation of surface activities, closure of oil and gas access roads to all but authorized personnel, and controlling the rate of development to limit activity within a given location at any one time.

### **Alternative 3: Forest Plan Modification B**

This alternative was developed in response to the need for a sufficient amount of land to be open to oil and gas leasing in accordance with the Forest Service mandate. Under this alternative, all Federal minerals within the analysis area would be administratively available for leasing, except all Wilderness areas, Antone Bench, and Areas 2, 3, 4, and 5, and all nine exploratory wells would be reasonably foreseeable as well as field development for CO<sub>2</sub> and hydrocarbons. The total gross acres disturbed would be approximately 733 acres, with a net loss of 317 acres. Deer fawning and elk calving areas would be protected primarily under TL stipulations, 67 and 82 percent, respectively; and, NSO stipulations would protect 23 and 16 percent, respectively. The TL stipulations would place seasonal constraints on construction activities occurring near wildlife or within wildlife habitat. These stipulations would apply to specific big game resources during the following seasons:

Critical Elk Calving	May 1 - July 1
Critical Elk Winter Range	November 1 - April 15
Critical Deer Fawning	May 16 - July 1
Critical Deer Winter Range	November 1 - April 15
Sage Grouse Leks	March 15 - June 1

Critical winter range for deer and elk would be protected under TL or NSO stipulations. No leases would be issued on approximately 700 and 1,800 acres for deer and elk critical winter range (less than 1% for each), respectively. Timing limitations (TL) would apply to approximately 119,300 acres (83.3%) and 181,300 acres (79%) for deer and elk; NSO stipulations would be applied on 23,300 acres (16%) and 46,200 (20%) acres for deer and elk.

Based on the RFDS for this alternative, one exploratory well would be reasonably foreseeable in the South and Central Pine Valley Mountains (Pine Valley Ranger District) and one on the Markagunt Plateau (Cedar City Ranger District); three wells and one field development on the Aquarius Plateau, Northern Escalante Mountains and Boulder Mountains (Escalante and Teasdale Ranger Districts); two exploratory wells and one field development each on the Escalante anticline and the Southern Escalante Mountains; and one exploratory well on the Sevier and Paunsagant Plateaus. Table 2-11 (in Chapter 2) provides acreages of big game winter range (critical value) and birthing areas for deer and elk, that occur in each of the oil and gas potential areas and the stipulations that would be applied under this alternative.

The following assumes that exploration and development would occur within big game habitat. On the Dixie National Forest, productive habitat would be temporarily removed on >50 acres during the 15-year RFDS planning period as a result of exploration wells reducing habitat effectiveness on approximately 1,400 acres assuming nine wells. The drilling of exploratory wells would occur over the planning period and approximately 200 acres of productive habitat would be disturbed at a well site. About 100 and 200 acres of productive habitat would be temporarily removed as a result of the development of one CO<sub>2</sub> field and one oil field, respectively. Construction and exploration activities would likely result in greater direct impacts on wildlife than actual production due to the greater level of activity and increased human presence.

During these phases, road construction would potentially have the greatest impacts. Miles of road required are 36.9, 35, and 40 for exploration, CO<sub>2</sub> field development, and oil field development, respectively. These roads could reduce habitat effectiveness on approximately 35,800 acres over during all phases of oil and gas activities. These are unlikely to be significant with the implementation of stipulations, the presence of



barriers between roads, and big game (site specific). Furthermore, it is unlikely that many roads would be located within critical game habitat.

Although Alternative 3 would result in greater loss of productive habitat over the planning period and potentially result in more potential impacts to wildlife than other alternatives, overall impacts would be minor with the implementation of proposed lease stipulations. There would be some irreversible and irretrievable commitment of wildlife resources; however, substantial disruption or loss of big game populations or habitat would not be expected. The Nine exploratory wells anticipated in the RFDS for this alternative would result in a slightly greater loss of habitat. Site specific environmental studies at the APD phase would help determine the level of protection required for wildlife resources. Mitigation measures which could be implemented on a site specific basis include the relocation of surface activities, closure of oil and gas access roads to all but authorized personnel, and controlling the rate of development to limit activity within a given location at any one time.

#### **Alternative 4: Forest Plan Modification C**

Under this alternative, all Federal minerals within the analysis area would be administratively available for leasing with the exception of all Wilderness areas, Antone Bench, and Areas 2, 3, 4, and 5. The RFDS would be the same as that described for Alternative 3.

In much of the deer fawning and elk calving areas, leases would be granted under standard lease terms (SLT) which allows for movement of a well or road 200 meters (656 feet) from the staking location and suspension of activities for up to 60 days during critical periods. Although this stipulation is somewhat less restrictive than TL or CSU stipulations, these stipulations are expected to provide adequate protection in reducing impacts to big game during the birthing seasons and, because

Approximately one-half of the deer fawning and elk calving areas would be leased under SLT (53 percent for deer and 49 percent for elk), some adverse impacts could result if activities occur within these areas during the season of use. Big game would likely move 0.25-mile from the activity. CSU stipulations would be applied in 35 percent of deer fawning areas and 43 percent of elk calving areas, which would offer a higher level of protection than SLT by strictly controlling surface activities, and are would be expected to result in only minor impacts.

Based on the RFDS for this alternative, one exploratory well is reasonably foreseeable in the South and Central Pine Valley Mountains (Pine Valley Ranger District) and one on the Markagunt Plateau (Cedar City Ranger District); three wells and one field development would be on the Aquarius Plateau, Northern Escalante Mountains and Boulder Mountains (Escalante and Teasdale Ranger Districts); two exploratory wells and one field development each on the Escalante anticline and the Southern Escalante Mountains; and one exploratory well on the Sevier and Paunsagant Plateaus. Table 2-11 (in Chapter 2) provides acreages of big game winter range (critical value) and birthing areas for deer and elk, that occur in each of the oil and gas potential areas and the stipulations that would be applied under this alternative.

Potential loss of habitat and impacts to wildlife that would result from this alternative would be the same as those previously described under Alternative 3 - Forest Plan Modification B.

Birthing areas and critical winter range for deer and elk would be adequately protected by SLT or CSU stipulations as proposed if adequately enforced. There would be some irreversible and irretrievable commitment of wildlife resources and significant disruption or loss of big game populations or habitat would potentially result from exploration and development activities occurring in sensitive habitat during the critical time periods. Nine exploratory wells are anticipated as part of the RFDS for this alternative, therefore there



will be a greater loss of habitat. Site specific environmental studies may help protect wildlife resources, although the lease stipulations are not sufficient to reduce impacts to an insignificant level. Mitigation measures which could be implemented on a site specific basis include the relocation of surface activities, closure of oil and gas access roads to all but authorized personnel, and controlling the rate of development to limit activity within a given location.

### Cumulative Impacts

Cumulative impacts to those areas where sensitive wildlife and fisheries resources occur would be insignificant on a regional basis. The major concern is that the amount of surface disturbance when added to other surface disturbing activities (such as road construction) could result in additional indirect and direct impacts to known sensitive habitats.

Road construction or road upgrading in conjunction with oil and gas development could result in direct or indirect impacts to wildlife by increasing accessibility. Any project that allows for more access into an area generates increased motorized recreational opportunities for the public, which could result in additional disruption and displacement of elk and other wildlife species.

Cumulative impacts are likely to be more severe in the summer months, rather than the winter months as a result of proposed exploration.

Some sensitive species (raptors, small mammals, herpetofauna) or threatened/endangered species have narrow ranges and very specific habitat requirements. If these are identified when conducting a site-specific analysis, the cumulative impacts of other activities would have to be analyzed to ensure protection of the identified species habitat.

### **WILDERNESS AND ROADLESS AREAS**

This section provides a description of the potential effects to the Wilderness and roadless resources that could result from oil and gas leasing, exploration, and development within the study area.

The amount and type of disturbance that could be expected by the drilling of exploratory oil wells and disturbance associated with oil and gas field development and ancillary facilities including site access roads in this area are discussed in the RFDS.

Future leasing of Wilderness areas is prohibited by the Utah Wilderness Act, therefore the only leasing option available for consideration is No Lease.

### Effects Common to All Alternatives

The following effects may occur if exploratory drilling and/or field development occurred within or adjacent to Wilderness or roadless areas.

**Natural Integrity and Apparent Naturalness** Natural integrity and apparent naturalness indicate the extent to which long-term ecological processes are intact and operating. Impacts to natural integrity are a measure of human influences on natural ecological processes. Impacts to apparent naturalness are measured by the presence and magnitude of human modifications in an area. These changes includes physical developments as well as activity in the area. Modifications to the environment associated with oil



and gas activity would result in adverse effects to the natural integrity and apparent naturalness of the roadless or Wilderness resources.

**Opportunities for Solitude** Opportunities for solitude are defined as the ability to experience isolation from the sights, sounds, presence of others, and the developments of man. In the study area, there exists the opportunity for experiencing solitude. However, should exploration and development occur in previously undisturbed areas of the Forest, opportunities for solitude could be degraded and users of roadless and Wilderness areas could be displaced to other areas offering the opportunity for solitude which would place increased pressure on those resources.

**Opportunities for Primitive Recreation** Wilderness and roadless areas within the Dixie National Forest provide opportunities for primitive recreation. Refer to the *Recreation* section of this chapter for a description of primitive recreation opportunities.

**Special Features** Special features are unique geological, biological, ecological, cultural, or scientific features contribute to the uniqueness of Wilderness or roadless areas. Some of the roadless and Wilderness areas within the Forest contain unique landscapes with geologic formations, including sharply dissected canyons, rock cliffs with some of the cliff faces colored with shades of pink, red, white, and purple.

**Manageability/Boundaries** Manageability relates to the ability of the Forest Service to manage an area to meet the size criteria for Wilderness consideration (at least 5,000 acres) and maintain the five characteristics described in this section (above).

Oil and gas exploration and development activities would cause direct adverse impacts to roadless and Wilderness resources where they would occur within the existing roadless and Wilderness areas on the Forest. Indirect impacts to roadless and Wilderness resources would result where oil and gas activities near or adjacent to roadless and Wilderness would degrade or reduce the values of any of the characteristics described above.

## **Wilderness**

There would be no direct effects to Wilderness because No Lease (NL) would be applied under all alternatives. Drill sites may be located close to Wilderness areas which would result in indirect effects. Noise and visual intrusions adjacent to the Wilderness areas would be cause the most evident effects during drilling operations. Drilling would be a relatively short-term activity and, once completed, the subsequent activities would be reduced significantly.

Activities associated with the drilling of wells and construction of roads and facilities would create visual and noise impacts to adjacent Wilderness areas. Wilderness characteristics associated with these areas would be diminished or degraded while these activities are ongoing. Activities would degrade the primitive unconfined experience of recreation opportunities. Noise from the drilling and production in a field development would diminish opportunities for solitude. Although mitigating measures, such as using topographic and vegetative screening and camouflage of facilities would be applied to minimize visual and auditory impacts to these areas, these impacts would be largely unavoidable and potentially significant. Removal of facilities and reclamation during final abandonment would reduce the visual intrusions. There would be some evidence of man's activities and the primeval, untrammled character of the area would be reduced in the long term.



After completion of drilling and construction activities, the activity associated with oil and gas production is expected to be relatively unobtrusive to users within adjacent Wilderness areas. The periodic maintenance or updating of facilities may result in short-term increases in activity at individual well sites, along pipelines, and other facilities during the production phase.

The quality of Wilderness experiences would be decreased in the short term from activities adjacent to Wilderness areas. Increased human presence during field development may degrade opportunities for solitude in primitive recreation areas. Decreased activities after reclamation of sites to substantially unnoticeable conditions could reestablish most primitive values. Some evidence of these activities would always remain and the primeval character would be lost.

Congress recognized that Wilderness cannot be totally isolated from activities. In Section 303 of the Utah Wilderness Act of 1984, Congress stated that it did not intend that designation of Wilderness areas lead to the creation of protective perimeters or buffer zones around a Wilderness. It is further stated in the Act that, "The fact that nonwilderness activities or uses can be seen or heard from areas within the Wilderness shall not, of itself, preclude such activities or uses up to the boundary of the Wilderness area." Although impacts to the Wilderness characteristics can be mitigated, proposed lease operations cannot be denied or otherwise mitigated based solely on the fact that they can be seen or heard from within the Wilderness.

### **Roadless Resources**

Oil and gas activities such as exploratory drilling, oil and gas field development, and other activities that involve the construction of roads, well sites and other facilities would adversely affect the naturalness, remoteness/solitude, integrity, and other characteristics associated with roadless areas. These impacts would be of relatively limited area and of short duration, and once drilling and reclamation was completed, the impacts to the roadless characteristics would not be significant. However, some evidence of man's activities would be present for a long period of time.

Impacts may be of higher intensity and longer duration if they are associated with oil and gas field development and the subsequent production of oil and gas. The impacts associated with a producing oil and gas field would be long term and potentially significant. Vehicular traffic and human activities associated with a developed oil field would directly effect remoteness and opportunities for solitude. The presence of roads, well sites, pipelines and other facilities would be incompatible with the natural integrity. If oil and gas were discovered and production undertaken, there would be a direct loss of roadless acres for the life of development and for some time after while reclamation returns the area to a more natural setting. Depending on the location of the development, some inventoried roadless areas could be fragmented and isolated, making them too small (less than 5,000 acres) to be managed effectively as roadless areas.

Activities associated with seismic exploration, exploratory drilling, field development, and production of oil and gas would likely impact the various roadless characteristics to the extent that the area could not be effectively managed as a roadless area for the life of the development.

Drilling and construction activities associated with oil and gas activity adjacent to the roadless areas may be audible and visible from various locations within or adjacent to roadless areas. High-profile drill rigs, powerlines, roads, and compressor stations may be visible and the associated activities heard within roadless areas. Topographic and vegetative screening, camouflaging, and other mitigating measures would reduce, but not totally eliminate these visual and noise impacts. The impacts associated with drilling and construction activities would be unavoidable, but of relatively short duration. After mitigation, it is not



expected that the visual and noise impacts resulting from activities outside the roadless area would be significant.

## **Effects of Each Alternative**

### **Proposed Action: Forest Plan Intent**

Under the Proposed Action Alternative, eight (8) exploratory wells would be reasonably foreseeable and a field development for CO<sub>2</sub> could also occur. There would be no exploratory wells drilled on the Pine Valley Ranger District. Existing leases would be honored, should a lease holder choose to exercise the rights associated with the lease.

The RFDS indicates reasonable potential for two field developments within the Escalante and Teasdale Ranger Districts under this alternative. One field development would be located in the Escalante anticline, and would disturb a total of approximately 111 acres (net). The other field development would occur in another high carbon dioxide potential area on the Aquarius Plateau. The total number of wells considered reasonably foreseeable, between the two fields, would be 54 wells which would result in a total disturbance of approximately 284 acres (net).

Direct effects to Wilderness or roadless areas would be limited to areas under existing leases where oil and gas exploration and development could occur. Several existing leases are located within the Box-Death Hollow Wilderness on the Escalante Ranger District. Mineral leases also exist in four roadless areas, including: Table Cliffs-Henderson Canyon Roadless Area (Number 07030), Hog Ranch Roadless Area (07032), McGath Lake-Auger Hole Roadless Area (Number 07034), and Boulder Mountain/Boulder Top/Deer Lake Roadless Area (07040). Oil and gas exploration and development activity on existing leases within either the Wilderness or roadless areas would substantially effect their characteristics as described under *Effects Common to All Alternatives*, above.

As no new oil and gas leases will be authorized in Wilderness areas, Antone Bench, or in Areas 2, 3, 4, and 5 (Forest Plan), there would be no direct impacts to these Wilderness or roadless areas under the Proposed Action. However, there may be some potential for indirect impacts if exploration activities were to occur adjacent to these areas.

The Proposed Action would apply NSO stipulations to any lease granted within the boundary of any inventoried roadless area. While no direct impacts to roadless areas would be expected to occur, there may be some indirect effects to opportunities for solitude and remoteness if drilling occurred on adjacent lands. Indirect effects of oil and gas exploration and development would be largely associated with noise, fugitive dust, and activities in adjacent areas. Also refer to the section titled *Effects Common to All Alternatives*, above.

### **Alternative 1: No Action/No Lease**

Under this alternative, two (2) exploratory wells would be reasonably foreseeable and would occur in the area of the Escalante anticline on one of the existing leases located on the Escalante Ranger District. The No-Action/No Lease Alternative would grant no new leases (NL) for oil and gas on the Dixie National Forest and, therefore, would not result in direct or indirect effects to Wilderness or roadless areas.

There may be some direct effects to roadless in areas under existing leases where oil and gas exploration and development could occur. Oil and gas exploration and development activity on the existing leases that



occur within the Forest (previously described) would substantially effect the Wilderness or roadless areas characteristics as described under the Proposed Action. Also refer to the section titled *Effects Common to All Alternatives*, above.

#### **Alternative 2: Forest Plan Modification A**

Under this alternative, four (4) exploratory wells would be reasonably foreseeable. Three wells would occur on the Teasdale and Escalante Ranger Districts, and one well would occur on the Cedar City District. The development of a CO<sub>2</sub> field would also be reasonably foreseeable on the Escalante Ranger District in the Escalante anticline area.

Like the no-action alternative, this alternative would grant no new leases (NL) for oil and gas on the Dixie National Forest and, therefore, would not result in direct or indirect effects to Wilderness or roadless areas. However, oil and gas exploration and development activity on the existing leases that occur within the Dixie National Forest would substantially effect the Wilderness or roadless areas characteristics. Refer to Proposed Action above and the section titled *Effects Common to All Alternatives*.

#### **Alternative 3: Forest Plan Modification B**

Under this alternative, nine (9) exploratory wells and two field developments are reasonably foreseeable in the Escalante and Teasdale Ranger Districts. One field development would occur in the Escalante anticline area, which would disturb a total of approximately 111 acres (net). Another field development would occur in another high CO<sub>2</sub> potential area on the Aquarius Plateau. The total number of wells foreseeable for these two fields is 54 wells, which would result in a total disturbance of approximately 291 acres (net).

Alternative 3 would apply CSU stipulations for leases issued within inventoried roadless areas. These stipulations would require careful siting of facilities to minimize ground disturbance and other impacts on the roadless resource and to ensure intensive reclamation of any disturbed areas once activities have been completed. Roads, wells, and other facilities may be relocated up to 200 meters (656 feet) to avoid hiking trails and other sensitive features or to take advantage of surrounding terrain or vegetation to screen of activities from view, reducing adverse effects on roadless characteristics. Activities could also be delayed for up to 60 days which would reduce the effects of noise or the visibility of oil and gas activities on the users of roadless areas during peak recreational periods. Reducing the noise level and visibility during high use periods would somewhat reduce the adverse effects to the characteristics of natural integrity, apparent naturalness, opportunities for solitude, and remoteness.

In addition, oil and gas operations would directly and indirectly effect remoteness and opportunities for primitive recreation (refer to *Recreation* later in this chapter). Also refer to the section titled *Effects Common to All Alternatives*, above. Once oil and gas activities cease and affected areas are reclaimed and returned to a natural state, potential impacts to roadless characteristics are not expected to be evident to the casual observer.

#### **Alternative 4: Forest Plan Modification C**

Under this alternative, nine (9) exploratory wells and two field developments are reasonably foreseeable within the Escalante and Teasdale Ranger Districts. One field development would be located in the Escalante anticline that would disturb a total of approximately 111 acres (net). Another field development



would occur in a high CO<sub>2</sub> potential area on the Aquarius Plateau. The total number of wells foreseeable for the two fields is 54 wells, which would disturb a total of approximately 291 acres (net).

Leases granted within inventoried roadless areas under Alternative 4 would be issued with standard lease terms (SLT). There are no laws or regulations that require the protection of roadless areas so there would be limited protection of the roadless characteristics and associated resource uses. The effects would be similar to those described for Alternative 3.

Like CSU stipulations applied under Alternative 3, SLT would allow relocating activities up to 200 meters (656 feet) to and delaying activities to reduce adverse effects on roadless characteristics, as described for Alternative 3. Exploration, development, and production of oil and gas in roadless areas would be less restricted under SLT and may result in somewhat more extensive impacts.

### **Cumulative Impacts**

Road construction or road upgrading, in conjunction with oil and gas exploration and development, would result in direct impacts to roadless resources and characteristics (under Alternatives 3 and 4). Road development in roadless areas would allow for more access into the remaining inventoried roadless areas and would potentially reduce the roadless character of those lands.

Cumulative impacts would result from oil and gas exploration and development and other development or surface disturbing activities, including timber harvesting, livestock grazing, off-highway vehicle use, and other activities, occurring in the same or adjacent areas simultaneously.

### **OLD GROWTH**

This section addresses the potential impacts to old growth resources that could result from oil and gas exploration and development within the Dixie National Forest based on the following issue that was identified in the scoping process.

**Issue 1** The effects of oil and gas leasing and possible exploration and development activities on wildlife and wildlife habitat.

The issue for old growth relates primarily to the potential effects of ground disturbance that would result from oil and gas activity on goshawk habitat. For this reason, potential effects to old growth are described under *Threatened, Endangered, Proposed, and Sensitive Wildlife and Plant Species* earlier in this chapter.

Overall, potential impacts to old growth from oil and gas exploration and development activities are expected to be minor if areas of old growth that are functionally important to the ecosystem are not lost.

### **Effects Common to All Alternatives**

Direct effects to old growth vegetation would occur primarily during clearing and earth-moving operations for the construction of well pads, access roads, and support facilities. Direct impacts include loss of structure and productivity and loss of habitat acreage and diversity. Indirect effects may result from erosion and sedimentation impacts, degraded water quality, and alterations to existing drainage patterns. Roads, well sites, pipelines, and other ancillary facilities constructed on side slopes would have the potential to cause sedimentation impacts.



Mitigation measures to reduce impacts to old growth resources include: site reclamation; minimization of land-disturbing activities by restricting vehicle travel to designated right-of-way corridors; site selection to avoid, as much as possible, areas which require a longer reclamation period (i.e., mature forests) and which are prone to erosion (i.e., hillsides)

## RIPARIAN AND WETLANDS

This section provides a description of the effects to riparian and wetland areas that could result from oil and gas exploration and/or development within the Dixie National Forest. The analysis addresses the following issue:

**Issue 3** The effects of oil and gas leasing and possible subsequent exploration and development activities on water, soils and riparian values.

Impacts to riparian and wetland areas are considered to be significant if changes in wetland acreage or function occur. Secondary or indirect effects that impact areas of adjacent wetlands, such as sedimentation from soil excavation, soil erosion, and other construction or drilling activities, would also be considered to be significant impacts if normal functional value of riparian or wetland areas is reduced.

The site-specific resource areas discussed in this section are shown on Figure 3-8 (at the end of Chapter 3). Differences between the alternatives are a result of various combinations of the leasing stipulations and the number of acres affected by ground-disturbing activities.

### Effects Common to All Alternatives

Principal direct effects to riparian areas could occur primarily during clearing and earth-moving operations for construction of well pads, access roads, and support facilities. However, none of the proposed alternatives include activity in riparian and wetland areas and direct impacts to these areas are not expected to occur with this project. Furthermore, all riparian and wetland areas that qualify as jurisdictional wetlands are regulated under Section 404 of the Clean Water Act and a Section 404 permit is required before "dredge and fill" activities can occur in such areas.

Indirect secondary effects may result if site development occurs outside, but adjacent to, riparian and wetland areas where lateral drainage is interrupted by road or well site construction, or when increased erosion affects water quality. Roads, well sites, pipelines, and other ancillary facility construction on side slopes above riparian and wetland areas all have the potential to cause sedimentation impacts. In order to provide an estimation of the magnitude of indirect effects from erosion impacts from areas adjacent to wetlands, the number of disturbed acres (i.e., not riparian or wetland areas) is projected for each alternative

Under certain conditions where occupancy is unavoidable (i.e., access to existing leaseholds or private mineral estates can only be obtained by crossing a riparian or wetland area), impacts to riparian and wetland areas could occur. Under the provisions of Federal Regulation 43 CFR 3101.1-2, well sites and other facilities within a leased site can be moved up to 200 meters without the need for additional lease stipulations. This adjustment opportunity would allow for the avoidance of significant resources (i.e., riparian and wetland areas) in the event that such sites are identified after lease areas have been designated.

Mitigation measures to reduce impacts to riparian and wetland areas include: site and routing selection to avoid riparian and wetland areas; check dams and siltation fences and other best management practices



to reduce sedimentation impacts; and, reclamation of disturbed sites to reduce erosion. If impacts to wetland areas cannot be avoided, mitigation through replacement and enhancement will be necessary, as specified in Section 404 of the Clear Water Act.

### Effects of Each Alternative

Table 2-11 (in Chapter 2) provides a comparison the number of riparian and wetland acres and the oil and gas and CO<sub>2</sub> potentials for each of the alternatives.

#### **Proposed Action: Forest Plan Intent**

Under this alternative, riparian and wetland areas in the Dixie National Forest would not be leased (NL) in some areas and lease under NSO stipulations in other areas. There would be no direct effects to riparian areas would occur from oil and gas activities under this alternative; however, wetland areas could be affected indirectly by erosion-sedimentation impacts from ground disturbance and drilling on adjacent areas.

The NSO stipulation would be applied to riparian and wetland areas that are 40 acres or larger in size to meet State water quality standards by maintaining and improving surface and ground water quality, to provide habitats to maintain populations of fish and riparian-dependent wildlife, maintain long term soil productivity, minimize man-caused soil erosion, and to maintain the integrity of associated ecosystems. Riparian and wetland areas that are smaller than 40 acres would not require a specific lease stipulation but would be protected by existing regulations (43 CFR 3101.1-2 and 36 CFR 228.108 (j)), which controls the locations of facilities in riparian areas and wetlands through the Plan of Operations. Forest Service policy is to avoid wetlands and floodplains whenever possible.

A gross total of 718 acres of land and, following reclamation, a net total of 284 acres would be disturbed by implementing this alternative. Although construction and clearing operations will not occur on riparian areas and wetlands, the potential exists for indirect impacts to occur from adjacent areas. Indirect impacts to riparian and wetland areas are more likely to occur in areas with the moderate oil and gas potential and high CO<sub>2</sub> moderate oil and gas potential as these areas have a higher likelihood of development. The Markagunt Plateau contains areas of moderate oil and gas potential. A total of approximately 200 riparian and wetland acres would not be leased (NL) and about 8,500 riparian and wetland acres would be leased under the NSO stipulation. Reasonably foreseeable activity in the Markagunt Plateau includes one exploratory well pad with ancillary structures.

The Sevier and Paunsaugunt Plateaus have moderate oil and gas potential. A total of about 4,700 riparian and wetland acres would be leased under the NSO stipulation. Reasonably foreseeable activity in the Sevier and Paunsaugunt Plateaus includes one exploratory well pad with ancillary structures.

The Southern Escalante Mountains have moderate oil and gas potential. A total of approximately 2,800 riparian and wetland acres would be leased under the NSO stipulation. Reasonably foreseeable activity in the Southern Escalante Mountains includes one exploratory well pad with ancillary structures and 23 CO<sub>2</sub> wells with ancillary structures.

The Aquarius Plateau has high potential for CO<sub>2</sub> and moderate oil and gas potential. A total of approximately 7,000 riparian and wetland acres would be leased under the NSO stipulation. The Boulder Mountains have areas of both low and moderate oil and gas potential. A total of approximately 300 riparian and wetland acres in the low oil and gas potential area would be leased under the NSO stipulation. A total



of approximately 3,700 riparian and wetland acres in the moderate oil and gas potential area would be under the NSO stipulation. Reasonably foreseeable activity in these areas include three exploratory well pads with ancillary structures and 25 oil well pads with ancillary structures.

The Escalante anticline has high potential for CO<sub>2</sub> and moderate oil and gas potential. A total of approximately 400 riparian and wetland acres would not be leased (NL) and about 1,500 riparian and wetland acres would be leased under the NSO stipulation. Reasonably foreseeable activity in the Escalante anticline includes two exploratory well pads with ancillary structures and 25 oil well pads with ancillary structures.

### **Alternative 1: No Action/No Lease**

Under the No Action Alternative, only existing oil and gas leases would be developed and no new exploratory or field development activities would occur. A total of two exploratory well pads and 25 CO<sub>2</sub> production well pads, including ancillary facilities, would occur within existing leases under the No Action Alternative. Ground disturbances from these activities would consist of a gross total of 156 acres (gross) and, following reclamation, a net total of 69 acres. Indirect effects to wetland areas, such as water quality deterioration from sedimentation and interruption of drainage, could occur from development of sites adjacent to riparian and wetland areas.

### **Alternative 2: Forest Plan Modification A**

Under this alternative all riparian and wetland areas in the Dixie National Forest would not be leased (NL), therefore, no direct effects to riparian and wetland areas would occur from construction activities. Riparian and wetland areas; however, could be affected indirectly by erosion-sedimentation impacts from ground disturbance and drilling on adjacent areas.

A gross total of 317 acres of land and, following reclamation, a net total of 157 acres would be disturbed by implementing this alternative. Although construction and clearing operations will not occur on riparian areas and wetlands, the potential exists for indirect impacts to occur from adjacent areas. Indirect impacts to riparian and wetland areas are more likely to occur in areas with the moderate oil and gas potential and high CO<sub>2</sub>/moderate oil and gas potential as these areas have a higher likelihood of development.

The Markagunt Plateau contains a total of approximately 8,700 acres of riparian and wetland areas that would not be leased. The Aquarius Plateau has a high potential for CO<sub>2</sub> and moderate oil and gas potential, and about 7,000 acres of riparian and wetland areas would not be leased. The Boulder Mountains have areas of both low and moderate oil and gas potential. A total of approximately 300 riparian and wetland acres would not be leased in areas with low oil and gas potential and approximately 3,600 riparian and wetland areas would not be leased in areas of moderate oil and gas potential. The Escalante anticline has high potential for CO<sub>2</sub> and moderate oil and gas potential. A total of 1,865 riparian and wetland acres would not be leased in these areas.

### **Alternative 3: Forest Plan Modification B**

Under this alternative, riparian and wetland areas in the Dixie National Forest would be either not be leased (NL) or leased under NSO stipulations. As a result, there would be no direct effects to riparian and wetland areas would occur from construction activities; however, riparian and wetland areas could be affected indirectly by erosion-sedimentation impacts from ground disturbance and drilling on adjacent areas.



The NSO stipulations would be applied to riparian and wetland areas that are 40 acres or larger in size to meet State water quality standards by maintaining and improving surface and ground water quality, to provide habitats to maintain populations of fish and riparian-dependent wildlife, maintain long-term soil productivity, minimize man-caused soil erosion, and to maintain the integrity of associated ecosystems. Riparian and wetland areas that are smaller than 40 acres would not require a specific lease stipulation but would be protected by existing regulations (43 CFR 3101.1-2 and 36 CFR 228.108 (j)), which would control operations in riparian areas and wetlands through the Plan of Operations. In addition, Forest Service policy is to avoid wetlands and floodplains wherever possible.

A total of 733 gross acres of land and, following reclamation, a total of 291 net acres would be disturbed by implementing this alternative. Although construction and clearing operations will not occur on riparian areas and wetlands, the potential exists for indirect impacts to occur from adjacent areas. Indirect impacts to riparian and wetland areas are more likely to occur in areas with the moderate oil and gas potential and high CO<sub>2</sub> potential as these areas have a higher likelihood of development.

The south and central Pine Valley Mountains has moderate oil and gas potential where a total of approximately 400 acres riparian and wetland acres would not be leased and about 1,100 riparian and wetland acres would be leased under the NSO stipulation. The Markagunt Plateau has moderate oil and gas potential where a total of approximately 200 riparian and wetland acres would be not be leased and about 8,500 riparian and wetland acres would be leased under the NSO stipulations. The Sevier and Paunsaugunt Plateaus have moderate oil and gas potential where a total of approximately 4,700 riparian and wetland acres would be leased under the NSO stipulation. The Southern Escalante Mountains have moderate for oil and gas potential where a total of approximately 2,800 riparian and wetland acres would be leased under the NSO stipulation. The Aquarius Plateau has high potential for CO<sub>2</sub> and moderate oil and gas potential where a total of approximately 7,000 riparian and wetland acres would be leased under the NSO stipulation. The Boulder Mountains have both low and moderate oil and gas potential where a total of approximately 300 riparian and wetland acres in the low oil and gas potential area would be leased under the NSO stipulation and a total of approximately 3,700 riparian and wetland acres would be leased under the NSO stipulation in the moderate oil and gas potential area. The Escalante anticline has high potential for CO<sub>2</sub> and moderate oil and gas potential where a total of approximately 400 riparian and wetland acres would not be leased and about 1,500 riparian and wetland acres would be leased under the NSO stipulation.

#### **Alternative 4: Forest Plan Modification C**

Under this alternative, riparian and wetland areas in the Dixie National Forest would not be leased in some areas or would be leased with either NSO or CSU stipulations. There would be no direct effects from construction activities to riparian and wetland areas that would be either not leased or leased under the NSO stipulation; however, riparian and wetland areas could be affected indirectly by erosion-sedimentation impacts from ground disturbance and drilling on adjacent areas.

CSU stipulations applied to riparian and wetland areas that are 40 acres or larger in size would ensure that activities would be designed and located to insure protection of functions and values of riparian/wetlands/floodplains, aquatic habitat, and surface and groundwater quality. Roads, well sites, and other oil and gas activities could be relocated up 200 meters (656 feet) or delay activities for up to 60 days during sensitive periods. Special operating constraints may also be required such as lined or closed system reserve pits, non-toxic drilling fluids, and no land application of wastewaters in a riparian zone. For areas of less than 40 acres, existing regulations (43 CFR 3101.1-2 and 36 CFR 228.108 (j)) would provide some level of protection, but it would be possible for oil and gas activities to directly affect wetland and riparian areas.



A gross total of 733 acres of land and, following reclamation, a net total of 317 acres would be disturbed by implementing this alternative. Although construction and clearing operations would likely not occur on riparian areas and wetlands, the potential exists for indirect impacts to occur from adjacent areas. Indirect impacts to riparian and wetland areas are more likely to occur in areas with the moderate oil and gas potential and high CO<sub>2</sub> potential as these areas have a higher likelihood of development.

The south and central Pine Valley Mountains have moderate oil and gas potential where a total of approximately 400 riparian and wetland acres would not be leased, about 100 acres would be leased under the NSO stipulation, and about 900 acres would be leased under the CSU stipulation. The Markagunt Plateau has moderate oil and gas potential where a total approximately 200 riparian and wetland acres would not be leased (NL), about 1,500 acres would be leased under the NSO stipulation, and approximately 7,000 acres would be leased under CSU stipulations. The Sevier and Paunsaugunt Plateaus have moderate oil and gas potential where a total of approximately 4,700 riparian and wetland acres that would be leased under the CSU stipulation. The Southern Escalante Mountains have moderate for oil and gas potential where a total of about 200 riparian and wetland acres would be leased under the NSO stipulation and approximately 2,600 acres would be leased under CSU stipulations. The Aquarius Plateau has high potential for CO<sub>2</sub> and moderate oil and gas potential a total of approximately 300 riparian and wetland acres would be leased under the NSO stipulation and about 6,800 acres leased under the CSU stipulation. The Boulder Mountains have both low and moderate oil and gas potential where a total of approximately 300 riparian and wetland acres would be leased under CSU stipulations in the low oil and gas potential area, and about 100 would be leased under the NSO stipulation and approximately 3,600 acres would be leased under the CSU stipulation in the moderate oil and gas potential area. The Escalante anticline has high CO<sub>2</sub> moderate oil and gas potential where a total of approximately 400 riparian and wetland acres would not be leased (NL), about 600 acres would be leased under the NSO stipulation, and about 1,400 acres would be under CSU stipulations.

### Cumulative Impacts

Multiple uses of the Dixie National Forest, in conjunction with each of the alternatives, have the potential to increase impacts to riparian and wetland areas as well as to degrade water quality. Land uses that have potential to cause impacts include: timber harvesting, livestock grazing, and recreation. However, adherence to the Forest Plans would reduce such impacts. Opportunities for enhancement could occur by reducing existing pressure on these resources and by the reclamation of degraded sites.

### **WATER RESOURCES (Surface and Ground)**

This section addresses the effects that oil and gas leasing, exploration, and/or development may have on the study area's water resources. This impact analysis focuses on surface and groundwater quality and uses as indices of impact the acreage of municipal water supply watersheds, riparian areas, streams and lakes, and sensitive aquifers that would potentially be affected by oil and gas exploration and/or developments.

The analysis addresses the water portion of the following issue:

**Issue 3** The effects of oil and gas leasing and possible subsequent exploration and development activities on water, soils and riparian values.

The potential impacts to surface water include:



- sediment loading due to the earth work associated with site construction
- introduction of pollutants via spills and releases to surface water from;
  - mud or reserve pits used to contain drilling muds
  - oil and produced water treatment, storage and handling facilities
  - sanitary facilities
  - oil/produced water transportation facilities (trucks, pipelines)
- water consumption during the early development of a field could have a short-term adverse effect on local stream flow
- hydrogen sulfide emissions to air during gas well development could potentially affect low alkalinity lakes
- secondary effects on downstream water use due to changes in water quantity or quality described above

The potential impacts to ground water include:

- transfer of drilling fluids and saline production water to fresh water aquifers could occur if wells are not properly constructed
- introduction of pollutants from spills and releases via exposed ground surfaces to surface aquifers from:
  - mud or reserve pits used to contain drilling muds
  - oil and produced water treatment, storage and handling facilities
  - sanitary facilities
  - oil/produced water transportation facilities (trucks, pipelines)
- water consumption during the early development of a field could have a short term adverse effect on local groundwater levels
- secondary adverse effects of each of the above on seeps and springs

All surface waters geographically located within the outer boundaries of National Forests are designated as antidegradation segments under the State of Utah Water Quality Standards. Water in these segments "shall be maintained at existing high quality". Within these segments, "new point discharges of wastewater, treated or otherwise, are prohibited...". The standards further state "other diffuse sources (nonpoint sources) of wastes shall be controlled to the extent feasible through implementation of best management practices or regulatory programs". The ground waters in Navajo Aquifer and Straight Cliffs Aquifer, although not formally classified throughout their extent are generally considered equivalent to the state class of Pristine, Irreplaceable, Ecologically, Important, or Drinking-Water Quality.

Using state standards and management direction taken from the Dixie National Forest Plan Forest-Wide Standards and Guidelines, the following impacts to water resources would be considered significant, as a result of oil and gas and CO<sub>2</sub> leasing, exploration, and development activities:

- needed instream flows for protection of public property and resources are not maintained
- water quality at the current level is not maintained, which includes:
  - degradation due to spills or releases



- any increase in stream sediment load (due to site construction and/or operation) adversely affecting fisheries (e.g. no more than 25% of stream substrate should be covered by inorganic sediment less than 3.2 mm in size) or other use
- degradation in seeps and springs water quality or quantity due to spills or releases or improper well construction and/or operation

### Effects Common to All Alternatives

All the alternatives, including Alternative 1: No Action/No Lease, involve operation of new or existing wells and fields. Potential impacts from long-term operation are primarily the potential for spills and releases, increased erosion and stream sedimentation due to failure of Best Management Practices.

All the alternatives, except Alternative 1: No Action/No Lease, involve the potential new construction of exploratory wells and a well field. Potential impacts from new construction include increased potential for spills and releases (from mud or reserve pits), for inter-aquifer transfer of fluids due to improper well construction, for short term high water quantity demands, for increased short term erosion and stream sedimentation due to new construction (if Best Management Practices fail), and for low quality air emissions.

The regions noted below are the only ones within Dixie National Forest in which there is reasonably foreseeable development and therefore the potential for impact to water resources from exploration and development activity.

#### Oil and Gas Potential Area

Southern and Central Pine Valley Mountains  
 Markagunt Plateau  
 Sevier and Paunsaugunt Plateaus  
 Aquarius Plateau  
 Escalante anticline  
 Southern Escalante Mountains

#### Foreseeable Development

1 exploratory well  
 1 exploratory well  
 1 exploratory well  
 3 exploratory wells, 1 CO<sub>2</sub> field  
 2 exploratory wells, 1 CO<sub>2</sub> field  
 1 exploratory well, 1 oil and gas field

Other areas within Dixie National Forest are not projected to have exploration and development activity. Within the above regions there are the following areas of particular sensitivity to water resources impacts.

### **Markagunt Plateau**

- The surface water draining from the Markagunt Plateau is particularly sensitive to contamination. The primary source for surface water in this area is precipitation transmitted through underground channels in the limestone formation underlying the surface volcanics. There is little soil to attenuate contaminants, and little opportunity for remediation of a spill in this area prior to the rapid transmission, over a wide area of contaminants to surface streams. Rainfall over a small area near Navajo Lake can be transmitted via underground channels (draining the lake) across the divide of major river basins. In addition, the high quality waters from this area are used downstream of the Dixie National Forest for irrigation, domestic, and industrial purposes.
- Panguitch Lake water quality is significantly lower than other lakes in the study area. The relatively low quality is attributable to the high nutrient levels in the lake, due to heavy grazing within the watershed and rapid development of recreational facilities and summer homes. The nutrients have been carried to the lake by sediments eroded from upstream streambanks.



- Water quality sampling in Mammoth Creek (below Tommy Creek) has shown exceedances of the Forest Service standard for small inorganic sediment in the streambed.

### **Sevier and Paunsaugunt Plateaus**

- The State of Utah Nonpoint Source Management Plan (1988), lists the East Fork Sevier River (Antimony) watershed (which includes the eastern slope of the Sevier and Paunsaugunt Plateaus) as a High Priority Nonpoint Source watershed for total phosphorus, nitrogen, total dissolved solids, sodium, and turbidity. The excess turbidity is an indirect indicator of excess sediment load, likely to be aggravated by any increase in watershed erosion. This indicator is reinforced by water quality sampling in East Fork Sevier River by the Forest Service, which has shown exceedances of the Forest Service standard for small inorganic sediment in the streambed.

### **Aquarius Plateau**

- As noted above, the State of Utah Nonpoint Source Management Plan (1988) lists the East Fork Sevier River (Antimony) watershed (which includes the western slope of the Aquarius Plateau) as a High Priority Nonpoint Source watershed for total phosphorus, nitrogen, total dissolved solids, sodium, and turbidity. The excess turbidity is an indirect indicator of excess sediment load, likely to be aggravated by any increase in watershed erosion.
- Similarly, the Grover (Upper Fremont River basin) watershed (which includes a portion of the northern slope of the Aquarius Plateau) is listed as a High Priority Nonpoint Source watershed for total phosphorus, dissolved oxygen, total dissolved solids, sodium, and manganese.
- Water quality sampling in Pleasant Creek (whose headwaters drain from the Aquarius Plateau) has shown exceedances of the Forest Service standard for small inorganic sediment in the streambed.

### **Escalante anticline, Southern Escalante Mountains**

- Water quality sampling in Pine Creek (whose headwaters arise from both these regions) has shown exceedances of the Forest Service standard for small inorganic sediment in the streambed.

Every region with projected oil and gas development, except the Central and Pine Valley Mountains, has areas which drain to surface water which at times have sediment and other parameter levels below the water quality desired for fish habitat or other uses. These areas are under active programs for the protection and improvement of the water resource, and can be considered particularly sensitive to increased erosion.

The most significant potential adverse impact to surface and groundwater quality is on the Markagunt Plateau, where the geology would potentially rapidly spread pollution from spills or releases over a wide area of aquifer, affect major springs, and inhibit attempts at remediation.

The comparison between water resource impacts for the various alternatives, which follows, is based upon a tabulation of wells and fields, potential disturbed acreage, municipal watershed acreage, riparian acreage, and sensitive aquifer acreage, shown in Table 2-11 in Chapter 2.

**Wells and Fields** The number of exploratory wells, CO<sub>2</sub> fields, and oil and gas fields provided in Table 2-11 (in Chapter 2) is a direct indicator of the potential for spills and releases of development-related



pollutants into surface waters. A CO<sub>2</sub> field is estimated to contain 25 production wells and associated production facilities. An oil and gas field is projected to have 23 production wells, 13 injection wells, 2 outpost wells, and associated production facilities.

**Disturbed Acreage** The number of disturbed acres provided in Table 2-11 (in Chapter 2) is a direct indicator to the potential for erosion from disturbed natural surfaces with subsequent sedimentation in downstream surface waters.

The potential for this erosion is discussed in more detail in the Soils/Geomorphology resource section of this report.

**Municipal Watershed** The municipal watershed acreage provided in Table 2-11 (in Chapter 2) is an indicator of the extent of natural watershed used for municipal water supply which could be potentially impacted by sedimentation or spills and releases.

**Riparian Acreage** The riparian acreage provided in Table 2-11 (in Chapter 2) is an indicator of the extent of natural streambed which could be potentially impacted by sedimentation or spills and releases.

**Sensitive Aquifer** The acreage for sensitive aquifer provided in Table 2-11 (in Chapter 2) is an indicator of the extent of natural aquifer recharge zone potentially impacted by spills and releases, inter-aquifer transfer of production-related fluids, and other potential adverse groundwater-related impacts.

### Effects of Each Alternative

#### **Proposed Action: Forest Plan Intent**

This alternative is estimated to result in 718 gross acres disturbed and 284 net acres disturbed for the entire forest, with the bulk of the disturbed acreage due to two CO<sub>2</sub> fields, one in the Escalante anticline (159 gross acres), the other (174 gross acres) on the Aquarius Plateau, and one oil and gas field in South Escalante Mountain (356 gross acres).

Impacts to municipal watersheds, and to established municipal water supplies, should be minimal because the entire municipal watershed acreage is protected by stipulations of No Surface Occupancy (NSO) or No Lease (NL).

In a similar fashion, potential direct impacts to surface streams in the area are reduced substantially by either no lease or NSO stipulations on the entire delineated riparian areas, and on all streams and lakes.

Standard lease terms (SLT) would be applied in this alternative to remaining watershed areas (not given a more restrictive stipulation for other resources), including about 5 percent of the potentially impacted total sensitive aquifer area, and about 45 percent of the very sensitive aquifer area on the Markagunt Plateau. Standard lease terms have provisions which require, among other measures:

- Strict standards for well construction
- Requirements for adequate spill prevention and protection through preparation and enforcement of a Spill Prevention Control and Countermeasures (SPCC) Plan, and through the preparation, approval, and enforcement of a Surface Use Plan of Operations (SUPO)
- Requirements for Best Management Practices to control erosion during and following construction.



These measures if properly executed would result in low short-term impacts to water resources from exploratory activities, and low-to-moderate long-term impacts for field development and operation. These impacts are much more likely to be experienced where the CO<sub>2</sub> fields or oil and gas field are constructed than where exploration only is conducted.

CSU stipulations or TL stipulations would also applied under this alternative, due to other resource restrictions to about 50 percent of the total sensitive aquifer area, and about 34 percent of the very sensitive aquifer area on the Markagunt Plateau. These additional restrictions, which are not necessarily tied to protection of water resources, are unlikely to provide substantially greater protection of the aquifer recharge zone than the standard lease terms.

The remaining 44 percent of the total sensitive aquifer area, and 20 percent of the very sensitive aquifer area on the Markagunt Plateau, would be leased under NSO stipulations or would not be leased (NL). Activities in these area are expected to result in very little or no impact to water resources.

### **Alternative 1: No Action/No Lease**

Under this alternative, federal minerals within the study area would not be available for leasing once the existing leases have expired. However, oil and gas activity is reasonably foreseeable development in the existing leases, including: two (2) exploratory wells and one CO<sub>2</sub> field, resulting in disturbance of 156 gross acres and 69 net acres, all located on the Escalante anticline.

The standard lease terms under the existing leases are expected to result in low short-term impacts to water resources from exploratory activities, and low-to-moderate long term impacts from field development and operation, confined to the lease area on the Escalante anticline.

### **Alternative 2: Forest Plan Modification A**

This alternative differs from the Proposed Action in that all sensitive aquifer areas would not be leased (NL). Potential impacts to the water resources of sensitive aquifers under this alternative would be very low. Compared to the Forest Plan, this alternative protects an additional approximately 132,000 acres of sensitive aquifer (about 56 percent of the total sensitive aquifer area) from the projected low-to-moderate water resource impacts that would result under the Proposed Action.

Watershed areas not protected by sensitive aquifer, municipal watershed, or riparian designations (and their accompanying restrictive stipulations) are protected by standard lease terms (SLT). As discussed under the Proposed Action, measures dictated under SLT, if properly applied, would result in low short-term impacts to water resources from exploratory activities, and low-to-moderate long-term impacts for field development and operation. These impacts are much more likely to be experienced where the CO<sub>2</sub> fields or oil and gas field would be constructed than areas where activity would be limited to exploration.

### **Alternative 3: Forest Plan Modification B**

This alternative would have the same effects as the Proposed Action in that the number of acres of municipal watershed protected by no lease (NL) or NSO stipulations are the same. Impacts to municipal watersheds and to established municipal water supplies should be minimal. This alternative is also the same as the Proposed Action for delineated riparian areas and all streams and lakes where no lease and NSO stipulations substantially reduce potential direct impacts to surface streams.



This alternative and the Proposed Action each protect sensitive aquifers with standard lease terms or no lease (NL); however, sensitive aquifer acreage under CSU and TL stipulations would be less than the Proposed Action and fewer acres would be lease under the NSO stipulation. Under this alternative, 18 percent (42,000 acres) of the sensitive aquifer acres would be leased under the NSO stipulation, 39 percent (93,300 acres) would be under CSU stipulations, and 32 percent (75,800 acres) would be under TL stipulations. Overall, the level of protection of sensitive aquifers is less under this alternative than the Proposed Action.

#### **Alternative 4: Forest Plan Modification C**

This alternative differs from the Proposed Action in that municipal watersheds, riparian areas, and streams and lakes would be protected under CSU stipulations rather than the Proposed Action's more restrictive NSO stipulation.

CSU stipulations could involve a site-specific stipulation limiting the rate or amount of development that would be allowed at any one time within a watershed, in order to maintain water quality. This stipulation would be expected to provide a level of protection somewhat higher than standard lease terms.

Under this alternative, 82 percent (27,600 acres) of municipal watershed acres would be lease under CSU stipulations, with the remaining 18 percent under NSO stipulations or in areas that would not be lease (NL). A total of 88 percent (23,400 acres) of the riparian acres would be leased under CSU stipulations, with the remaining 12 percent under NSO or in areas that would not be leased (NL).

This alternative and the Proposed Action each protect sensitive aquifers with standard lease terms. Because of changes in other resource stipulations; however, the sensitive aquifer acreage under NSO stipulations or that would not be lease (NL) varies greatly between the two alternatives. Under this alternative, 11 percent of the sensitive aquifer acres would either not be leased (NL) or would be leased under NSO stipulations, 41 percent (95,200 acres) would be leases under CSU stipulations, and the remaining 48 percent (112,800 acres) would be leased under standard lease terms (SLT).

With respect to the very sensitive aquifer area on the Markagunt Plateau, under this alternative, 3 percent of the sensitive aquifer acres would either not be leased (NL) or would be lease under NSO stipulations, 36 percent (5,600 acres) would be leased under CSU stipulations, and the remaining 61 percent (9,800 acres) would be leased under SLT.

Watershed areas not protected by sensitive aquifer, municipal watershed, or riparian designations (and their accompanying restrictive stipulations) would be protected by SLT. As discussed under the Proposed Action, measures dictated under SLT, if properly applied, would result in low short-term impacts to water resources from exploratory activities, and low-to-moderate long-term impacts for field development and operation. These impacts are much more likely occur where the CO<sub>2</sub> fields or oil and gas field are expected than where only exploration would occur.

#### **Cumulative Impacts**

Cumulative impacts to water resources would result from additional surface water requirements or disturbances of other interrelated projects. Potential impacts would increase with the area made available for oil and gas leasing. Thus, Alternative 4 (Forest Plan Modification C) which allows the maximum area for oil and gas leasing under the least restrictive conditions, would possess the highest potential to impact surface water.



Cumulative impacts would largely be related to other resource extraction activities such as recreation and livestock development activities, which may result due to road access created by oil and gas leasing. These new activities would primarily lead to increased sediment and nutrient loading from expanded disturbed surfaces, with accompanying deleterious effects on water quality, fish habitat, and riparian zones. The areas noted above as being particularly sensitive to increased sediment and nutrient loading include the watersheds of: the Panguitch Lake, lower Mammoth Creek, East Fork Sevier River, Upper Fremont River (Grover), Pleasant Creek, and Pine Creek.

## AIR QUALITY

This section provides a description of the effects to air quality that could result from oil and gas leasing, exploration, and/or development within the study area. The information provided here is focused on the analysis of data that relates to the air quality portion of the following issue:

**Issue 5** The effects of oil and gas leasing and possible subsequent exploration and development activities on established National Parks, National Monuments, and Wilderness.

None of the oil and gas leasing alternatives would result in significant deterioration of the ambient air quality in the study area. The oil and gas lease activities that could have a minor impact on regional air quality include:

- Particulate matter (dust) emissions generated during road building, site development and drilling operations; and from vehicle traffic on unpaved roads
- Carbon monoxide and nitrogen oxide emissions from gasoline and diesel engine exhaust (mobile and stationary) and from flaring of natural gas

A slight deterioration in regional air quality could result from flaring of the natural gas that is produced (if any is produced) along with oil. The gas is produced at high pressure and is burned using an igniter in a bermed flare pit located a safe distance from the wellhead, resulting in some emissions into the atmosphere. This practice is used to mitigate adverse impacts by decreasing the potential for explosions from natural gas entering the atmosphere until such time as a pipeline for the gas can be built if needed or feasible. Permits from Utah Division of Oil, Gas, and Mining and the BLM are required in order to flare gas from an oil well.

If reservoirs of "sour" oil and gas are discovered and developed, then the potential for emissions of hydrogen sulfide and sulfur dioxide could be significant. Also, operation of pipeline pump stations or gas compressor stations has the potential for emissions of carbon monoxide and nitrogen oxides. The Federal and State Air Quality Standards (refer to Chapter 3) would regulate emissions from these activities and would limit or preclude significant long-term or widespread deterioration of the ambient air quality.

The impact to the ambient air environment is affected by several factors, including: 1) meteorological conditions (e.g., wind speed), 2) geographic features (e.g., topography), and 3) emission characteristics (e.g., pollutant concentration). Another consideration is proximity to other pollution generating sources and the proximity to sensitive receptor locations. Only a detailed and site specific analysis can determine the specific impacts. In general, the impacts would be localized near the development area and would not be significant.

The Dixie National Forest and surrounding areas would remain in compliance with the NAAQS, including Class I and Class II allowable emission increments. The air quality in the region will not substantially



change with oil and gas exploration and development. No significant impacts to the airsheds of Ceder Breaks National Monument, Bryce Canyon National Park, and Capitol Reef National Park are expected to occur. The provisions of standard lease terms that are included in all the other leasing options (i.e., NSO, CSU, TL) that would be applied under the action alternatives would minimize fugitive dust and other potential effects of oil and gas exploration and development.

## SOILS/GEOMORPHOLOGY

This section provides a description of the effects to soils that could result from oil and gas leasing, exploration and/or development within the Dixie National Forest. The analysis focuses on the soils portion of the following issue:

**Issue 3** The effects of oil and gas leasing and possible subsequent exploration and development activities on water, soils and riparian values.

Potential impacts to soils may occur as a result of oil and gas leasing and subsequent exploration and development within the project area. The impact analysis focuses on areas that have high to moderate potential for hydrocarbon or CO<sub>2</sub> exploration and development, and areas of erosive soils, unstable soils, and steep (greater than 40 percent) slopes. The degree of potential impacts to soils from oil and gas development would depend on the types and locations of disturbance necessary to construct facilities.

Three major types of land disturbance would be associated with well field development: gathering system pipelines, well pads, and roads. Construction would result in direct removal of soil, clearing of vegetation which would cause an increase in erosion by wind and water, reduced soil productivity as a result of vegetation removal (and from sidecasting of earth materials), soil compaction, losses of soil and rock in areas of steep sidehill cuts, alteration or removal of topsoil resources, possible chemical contamination, and activation or reactivation of unstable areas. Some of these disturbances would potentially increase surface water runoff, accelerate erosion losses, interfere with drainage systems, and increase landslide hazards.

The Multiple Use and Sustained Yield Act of 1960 and the National Forest Management Act of 1976 directs the Forest Service to sustain outputs of renewable resources without permanently impairing the productivity of the land.

Impacts to soils as a result of oil and gas and CO<sub>2</sub> leasing, exploration, and development activities are considered to be significant if:

- Erosion rates are appreciably more than existing conditions causing a loss of topsoil.
- Reclamation of soils does not occur during the life of the project.
- Increased erosion rates or reduction of soil productivity and stability prevents successful reclamation to near preconstruction conditions.
- Construction of roads, well pads, and pipelines disturbs poorly-drained soils supporting riparian or wetland vegetation. Long-term productivity would be reduced and successful reclamation would become unlikely because the composition and addition of fill material would alter the soil-and-water relationship in this zone permanently.



- Project construction disturbs areas of landslide and rock-fall hazard or unstable soils. These areas have high potential for long-term point-source erosion through mass movement exposure and range in consequence from inconvenient debris cleanup to life-threatening slope failures.
- Disturbances resulting from exploration activities are considered short-term because access roads and well pads operate only long enough to determine the viability of a site for long term production. Because the life of producing wells can range from 12 to 35 years, disturbances resulting from development are considered long term.

### **Effects Common to All Alternatives**

Impacts to soils and geomorphology are site-specific. These impacts depend on:

- 1) the component of the activity (roads, drilling, pipeline, etc.)
- 2) the soil and land capability for the affected site

Soils impacts from drilling include disturbances from temporary road access plus soil disturbances at well sites. Should a discovery occur, soil impacts from oil and gas production include the impacts mentioned above plus the effects of pipeline and additional road construction.

Unstable soils are particularly sensitive to road and well pad construction. The potential for slope failure increases for major excavations requiring extensive cut-and-fill operations. During the construction phase, prior to implementation of reclamation efforts, some small soil losses would occur. In addition, some areas may require follow-up reclamation efforts until the site is stabilized. Generally, impacts on soils would be low where best management practices are followed and where reclamation, revegetation, and erosion control measures are implemented and are successful.

Excavation of pipeline trenches alters soil profiles, brings large boulders and poor productivity sub-soils to the surface resulting in revegetation and rehabilitation difficulties. If routes are placed on gentle slopes, the amount of cuts and fills would be reduced. Reduction in the amount of disturbance relates to the amount of soil erosion and loss of site productivity. Implementation of erosion control and revegetation measures immediately would reduce the amount of erosion. Under most situations, accelerated soil erosion and productivity losses would be short term until pipeline rights-of-way are stabilized (two to five years).

Locating well pads on more gently sloping surfaces greatly reduces the amount of cuts and fills and would result in less erosion. Where construction on steeper slopes is necessary, cuts and fills would be required and impacts to soils would increase. Sidehill cuts and fills on slopes greater than 40 percent would require extensive sidewall cuts that would cause slope instability and would result in large volumes of soil and rock debris being sidecast onto otherwise undisturbed areas. In cut areas, replacement of sidecast material, regrading and revegetation is difficult. Successful application of intensive revegetation and mechanical erosion-control techniques would stabilize such areas within five years; however, steep slopes such as these should be avoided.

Construction of new access roads have the greatest potential for adverse impacts on soils. Most sediment entering stream channels originates from forest roads. Water quality is affected by the number and location of roads as well as their construction and maintenance. proper planning, construction, and maintenance can substantially reduce watershed erosion from roads. Similarly, road construction and use has the potential to activate areas susceptible to land slides, slumping, and/or mass erosion. Depending on the type of binding materials used, exposure of bare soil could result in varying degrees of continued erosion losses.



These impacts would be greatest where extensive sidehill cuts are constructed. Additional impacts from access road construction include:

- 1) more area would be open for off-road vehicular land disturbance
- 2) unsurfaced access roads may rut in wet weather or where constructed in wet areas
- 3) construction and maintenance reduces infiltration rates on road surfaces, disrupts natural drainage by concentrating subsurface and overland flow, and channelizes runoff resulting in gully erosion

With proper engineering design, road impacts to sensitive soils and geologic hazards can be minimized. Overall, the chance for significant soil impacts to occur is higher in areas of limited reclamation potential (e.g., steep slopes, unstable soils, landslide zones). Such sensitive areas require avoidance (e.g., NL or NSO) or more intensive construction, engineering, erosion control, and reclamation measures in order to minimize impacts on the soil resource.

Soil losses can be reduced or minimized through the application of Forest Service Best Management Practices on a site specific basis. Examples of such practices include use of erosion curtains to protect drainages, surface fabric, water bars and check dams to control runoff, stock piling of topsoil for reclamation and revegetation, and use of riprap to control gullying and head-cutting.

Other measure include appropriate engineering design of roads, well pads, and ancillary facilities; and avoidance of steep and/or unstable slopes and sensitive soils. Soil displacement/losses cannot be predicted with any degree of accuracy until the APD stage.

### Effects of Each Alternative

Table 2-11 (in Chapter 2) presents a tabulation and comparison of wells and fields, potential disturbed acreage, erosion/unstable soil acreage, and acres of slopes greater than 40 percent.

**Wells and Fields** The number of exploratory wells, CO<sub>2</sub> fields and oil and gas fields provided in Table 2-11 (in Chapter 2) is a relative indicator of the potential for surface disturbance.

**Disturbed Acreage** The number of disturbed acres provided in Table 2-11 (in Chapter 2) is a direct indicator of the potential for surface disturbance and erosion from disturbed natural surfaces.

**Erosive/Unstable Soils** This factor is an indicator of the extent of erosion potential, slumping, level of potential soil loss, and an indicator of erosion control, reclamation and revegetation requirements.

**Slopes Greater than 40%** This factor is an indicator of slope constraints to the siting of well pads and roads and an indicator of the potential level of impact if construction on steeper slopes is necessary, where cuts and fill may be required resulting in increased impacts to soils.

### **Proposed Action - Forest Plan Intent**

Under the Proposed Action, exploration and development of oil and gas and CO<sub>2</sub> fields would result in 718 gross acres of disturbance with 284 net acres of disturbance following reclamation. The Proposed Action would implement leasing stipulations in accordance with the Forest Plan. The NSO stipulation would be



applied in areas with highly erosive soils, unstable areas with landslides, and slopes greater than 40 percent. Such areas with a moderate potential for oil and gas or high CO<sub>2</sub> potential include the Pine Valley, the southern part of the Markagunt Plateau, and the Aquarius Plateau and Escalante anticline primarily within the Escalante and Teasdale Ranger Districts (Table 2-11 in Chapter 2). The NSO stipulation in these areas would minimize the potential for impacts to soils from topsoil disturbances and accelerated erosion. Disturbance by the construct of roads, drill pads, and production facilities would cause a loss of the soil productivity for the life of the project or until reclamation can be implemented.

Marginally unstable slopes would be leased under standard lease terms (SLT). Therefore, soils would be directly affected by exploration and development/production activities that cause surface disturbances. These disturbances would likely increase erosion rates as well as remove soils from productive capacities where roads and drill pads would be constructed. Erosion control measures during construction that would be implemented according to the Forest Service policy to reduce would reduce potential soil losses and subsequent impacts. Marginally unstable slopes occur in the Dissected Slopes, Rocklands Association, Faultlands Association, Rim and Sideslopes Association, and Glaciated Rimlands and Benchlands Association landtypes (refer to Tables 3-14 through 3-17, and Figure 3-10, Landtype Associations, in Chapter 3). All of these landtypes have some acreage in area of moderate oil and gas and high CO<sub>2</sub> potential, which increases the likelihood for leasing to occur. Forest Service Best Management Practices Development would be applied in these areas to control soil erosion during excavation, and road and drill pad construction. Reclamation plans would need to specifically address measures that would be employed for areas that are erosive, inherently have high depositional characteristics, or which are located on steep slopes. Such requirements are specified in CFR 36 Section 228.108--Surface Use Requirements. Of the areas that could be disturbed by exploration and development 317 acres would remain unreclaimed for the life of the project, and would be considered an irretrievable commitment of soils resources.

### **Alternative 1: No Action/No Lease**

Under this alternative, federal minerals within the study area would not be available for leasing once the existing leases have expired. However, some oil and gas exploration and development is reasonably foreseeable within existing leases, including: two (2) exploratory wells and one CO<sub>2</sub> field, resulting in disturbance of 156 gross acres and 69 net acres, all located on the Escalante anticline.

Assuming implementation of applicable reclamation and mitigation measures and adherence to the Forest Plan, soil and land surface disturbances that could occur on existing leases would be low to moderate and short-term for exploration activities, and low to moderate and long-term for CO<sub>2</sub> field development. Following expiration of existing leases, no impacts to soil and geomorphology would occur.

Indirect effects of soil disturbances would be a loss or decrease in vegetation productivity, the potential for increased stream sedimentation and gully erosion disruption of natural drainage systems, deterioration of water quality and decreased land stability in selected areas. Proper implementation of a mitigation plan and use of best management practices should would reduce indirect impacts to pre-project conditions in affected areas.

### **Alternative 2: Forest Plan Modification A**

Under Alternative 2, exploration and development of oil and gas and CO<sub>2</sub> fields would result in 317 gross acres of disturbance with 157 net acres of disturbance following reclamation. Leasing of acres with highly erosive soils and areas prone to landslides would be limited in this alternative because the majority of these



acres would either not be leased (NL) or would be leased under the NSO stipulation. Slopes greater than 40% would not be available for leasing (refer to Table 2-11 in Chapter 2).

Compared to the Proposed Action, this alternative is more restrictive in areas with highly erosive soils and steep slopes. Therefore, limited or no impacts to soils are anticipated, because no project facilities would be located in these areas. Control of erosion would be required in less erosive areas which would minimize potential. For example, marginally unstable areas would be leased under CSU stipulations, and impacts to soils are likely. However, as per 36 CFR Section 228.108 reclamation measures would be implemented to control erosion and reduce the amount of top soil lost. Soil losses; however, would occur during construction of roads and pads that disturb soil profiles and remove areas from production for at least the life of the project. Of the area that could be disturbed by exploration and field development, 155 acres as disturbed by four exploratory wells would remain unreclaimed for the life of the project. This loss is considered to be an irretrievable commitment of soils resources.

### **Alternative 3: Forest Plan Modification B**

With Alternative 3, exploration and development of oil and gas and CO<sub>2</sub> fields would result in 733 gross acres of disturbance with 291 net acres of disturbance following reclamation. Impacts to soils from this alternative would be similar to those described for the Proposed Action as many of the acres of highly erosive soils would be leased under the NSO stipulation. This alternative would differ from the Proposed Action in that more acres would be lease under CSU stipulations (refer to Table 2-11 in Chapter 2).

For slopes greater than 40%, this alternative is the same as the Proposed Action where the NSO stipulation would be applied for most steep slope acreage. Removing these areas from potential surface development and excavation would reduced or eliminate the potential for impacts to soils from topsoil disturbances and accelerated erosion.

A small number of acres of marginally unstable slopes would be leased under SLT, and soil losses would primarily be controlled through Forest Service Best Management Practices which would need to be implemented during exploration, development, and production construction activities. Although effective use of erosion control measures can minimize soil losses, during construction some losses can be expected under this alternative. An irretrievable commitment of soils resources would occur on a total of 317 acres under this alternative.

### **Alternative 4: Forest Plan Modification C**

Under Alternative 4, exploration and development of oil and gas and CO<sub>2</sub> fields would result in 733 gross acres of disturbance with 291 net acres of disturbance following reclamation. Under this alternative, more areas with highly erosive soils and steep slopes would be lease under CSU stipulations. This includes the southern part of the Markagunt Plateau and the Southern Escalante Mountains (Table 2-11 in Chapter 2).

Although CSU stipulations would require that measures be implemented to minimize soil erosion, some losses are expected during construction activities that include road and pad excavation and building, and pipeline construction. Soil productivity would be reduced where facilities are placed until they reclaimed. Some soil losses can also be expected in areas with marginally unstable slopes that would be leased under SLT; however, the use of Forest Service Best Management Practices during construction would minimize losses from erosion.



## Cumulative Impacts

Additional pressures, resulting in potential cumulative impacts would be placed on soil resources as an area is subjected to increased land disturbances through exploration and resource extraction activities, timber harvest, and recreational use. The level of soil displacement and loss cannot be determined until the site specific APD stage.

## **RECREATION**

This section provides a description of the potential effects to recreation resources that could result from oil and gas leasing, exploration, and/or development within the study area. The locations of recreation resource features and values are discussed in Chapter 3. The information provided here is focused on the analysis of data that relates primarily to the following issues:

**Issue 4** The effects of oil and gas leasing and possible subsequent exploration and development activities on the visual and recreation resources.

**Issue 5** The effects of oil and gas leasing and possible subsequent exploration and development activities on established National Parks, National Monuments, and Wilderness.

The amount and type of disturbance that could be expected by the drilling of exploratory oil and gas wells and possible field development are described in the RFDS (Appendix E).

The RFDS has determined that, forest-wide, nine (9) exploration wells are forecast over the next 15 years. Based on the historic success ratio, no more than one field discovery out of the nine exploration wells could reasonably be forecast. However, if additional oil and gas resources are discovered, both exploration and development activity are likely to increase.

## Effects Common to All Alternatives

Oil and gas exploration and development may cause impacts to recreation users in the vicinity of activity areas. Impacts may include:

- increased conflict with recreation use due to the presence of drilling rigs
- heavy construction equipment
- pipeline construction, and trucks hauling supplies
- equipment and crews
- visible and audible activities during construction and drilling associated with development.

Oil and gas exploration and development activities would be generally be considered highly intrusive on experiences sought by many forest visitors. Visual and audible impacts associated with oil and gas exploration and development activities and equipment would intrude on recreation opportunities particularly hiking, hunting, sightseeing, wildlife viewing, and other opportunities that depend on largely undisturbed landscapes and semi-primitive recreation settings. Oil and gas activities may result in displacing recreation users to other areas of the Forest where the setting would be more compatible for their activity.



Visual intrusions may result in high to moderate impacts to recreation users where strong visual contrasts (i.e., drill rigs, roads, equipment) would be visible from sensitive viewpoints, like adjacent trails, roads, or highways, in the foreground (0-0.25 mile) or middleground (0.25-3 miles) distance zones. For example, users anticipating a wilderness experience may have their experience diminished by oil and gas activities could occur near a trail that accesses a Wilderness area. Also refer to *Visual Resources* section later in this chapter.

Effects on the recreation resource were estimated in terms of the level of change to Recreation Opportunity Spectrum (ROS) settings expected to result from implementing each alternative. Oil and gas exploration and development in areas of Primitive (P) or Semi-Primitive Non-Motorized (SPNM) settings would potentially change these settings to Semi-Primitive Motorized (SPM) or Roaded Natural (RN) depending on topography, vegetative cover, or density of road development. However, once oil and gas activities cease and reclamation is completed, affected areas would return to their previous ROS setting, except where access roads would be left open.

Dispersed recreation use (e.g., hiking) would likely be diminished by the effects of visible oil and gas activity, noise, and dust that would intrude on the experiences typically sought by visitor to the Dixie National Forest. These effects would likely displace many dispersed recreation users to other areas in the Forest, which could in turn put increased pressure on recreation resources in other areas of the Forest.

### Effects of Each Alternative

#### **Proposed Action: Forest Plan Intent**

Under this alternative, eight (8) exploratory wells would be reasonably foreseeable. One exploratory well on the Pine Valley Ranger District would likely not be drilled due to the limited acreage available for surface occupancy. Because existing management restrictions would limit or preclude field development in this area, an exploratory well would not be economically justified.

The NSO stipulation would be applied to developed recreation sites, SPNM areas, and high recreation areas. As a result, oil and gas activity under the Proposed Action would have no direct effects on these recreation resources.

Standard lease terms (SLT) would be applied to the hunting seasons. Under this leasing option, leases would be granted under the conditions of the standard Federal oil and gas lease (Appendix B) and subject to existing regulations. SLT would allow roads and other facilities to be relocated up to 200 meters (656 feet) and/or suspend oil and gas activities for up to 60 days to minimize potential adverse effects on hunting within leased areas. New roads may provide increased access into some areas and provide new or additional hunting opportunities.

#### **Alternative 1: No Action/No Lease**

Under this alternative, federal minerals within the study area would not be available for leasing once the existing leases have expired. However, some oil and gas exploration and development is reasonably foreseeable within existing leases, including: two (2) exploratory wells and one CO<sub>2</sub> field.

Although there would be no direct impacts to developed recreation sites or high recreation areas from oil and gas activities within existing leases, activities could indirectly affect dispersed use, alter ROS settings, degrade the quality of recreation experiences, and reduce hunting success in adjacent areas. These



effects would result where oil and gas activities would be visible, create noise, and generate dust that would intrude on the experiences typically sought by forest users.

### **Alternative 2: Forest Plan Modification A**

Under this alternative, four (4) exploratory wells would be reasonably foreseeable. Three of these wells would likely occur on the Teasdale and Escalante Ranger Districts, and the fourth would likely occur on the Cedar City District.

The NSO stipulation would be applied to developed recreation sites and high recreation areas, and SPNM areas would not be leased (NL). As a result, oil and gas activities under Alternative 2 would have no direct effects on these recreation resources.

The TL stipulation would be applied to the hunting season which would restrict oil and gas exploration and/or development activities during the hunting season(s). This stipulation would minimize potential conflicts between oil and gas activities and hunters by suspending oil and gas activities for up to 60 days during the hunting season(s) to minimize potential adverse effects on hunting within leased areas. New roads may provide increased access into some areas and provide new or additional hunting opportunities.

### **Alternative 3: Forest Plan Modification B**

Under this alternative, nine (9) exploratory wells would be reasonably foreseeable. This alternative would apply the NSO stipulation to developed recreation sites and high recreation areas. Like Alternative 2, there would be no direct effects to these recreation resource areas. Potential effects on the hunting season would be the same as described under the Proposed Action.

The CSU stipulation would be applied to areas with ROS class of SPNM. Under this leasing option, oil and gas leases would be issued with stipulations that allow surface occupancy but with specific controls on oil and gas activities. This option would allow relocating roads and oil and gas facilities up to 200 meters (656 feet) and/or suspending activities for up to 60 days to minimize direct conflicts with recreation users and to reduce adverse effects on their recreation opportunities available in an affected area. Access routes would also be controlled to minimize conflicts with recreation users. Under the CSU stipulation, oil and gas activity would alter the ROS setting changing the natural setting of the affected area by allowing motorized access, increasing the probability of social encounters with other recreation users, and diminishing opportunities for experiencing solitude and tranquility. Increased road access would change portions of existing SPNM areas to SPM or RN. Field development in either SPNM or SPM would change portions of these settings to RN (also refer to *Effects Common to All Alternatives* above).

### **Alternative 4: Forest Plan Modification C**

Like Alternative 3, there are nine (9) exploratory wells considered reasonably foreseeable under this alternative. This alternative would apply the NSO stipulation to developed recreation sites of greater than 40 acres and CSU stipulations to sites of less than 40 acres. Standard lease terms (SLT) would apply to areas of SPNM, the hunting season, and high recreation areas. Potential effects on the hunting season would be the same as described under the Proposed Action.

For developed recreation sites of less than 40 acres, this alternative would apply CSU stipulations. Although activities under CSU stipulations would be strictly controlled, oil and gas exploration and



development could result in some direct impacts to developed recreation sites. The CSU stipulation would allow the relocation of roads and other oil and gas facilities up to 200 meters (656 feet) to minimize potential adverse effects by taking advantage of vegetative or topographic screening, avoiding direct conflicts with trails and other recreation facilities, and reducing potential conflicts with recreation users. CSU stipulations could also suspend oil and gas activity for a period of up to 60 days to minimize adverse effects during periods of peak recreation use. However, adverse effects (i.e., increased traffic, dust, and noise) to developed recreation sites may be substantial during drilling, especially if the affected area is a popular site and/or receives year round use. These effects would degrade the experience of users of affected sites reducing recreation opportunities during active oil and gas exploration and development which could result in displacement of recreation users to other sites. This displacement could, in turn, result in increased pressure and competition for other recreation site and resources potentially causing some adverse effects to the overall recreation resource.

This alternative would apply SLT to areas of SPNM and high recreation areas. SLT would apply conditions of the standard Federal oil and gas lease (Appendix B) and requirements of existing regulations to protect these areas. Potential adverse effects of oil and gas activities under SLT would be very similarly to those described for CSU stipulations under Alternative 3. SLT would allow roads and oil and gas facilities to be relocated up to 200 meters (656) feet and/or suspending activities for up to 60 days to minimize direct conflicts with recreation users and to reduce adverse effects on the recreation opportunities available in an affected area. Like CSU stipulations in Alternative 3, oil and gas activity under SLT would alter the ROS setting changing the natural setting of the affected area by allowing motorized access, increasing the probability of social encounters with other recreation users, and diminishing opportunities for solitude. However, changes in setting of SPNM areas would likely remain following the completion of oil and gas exploration and development where roads and other disturbed areas may not be reclaimed (also refer to *Effects Common to All Alternatives* above).

### **Cumulative Impacts**

Road construction or road upgrading, in conjunction with oil and gas development, timber harvest, or other actions, could result in direct or indirect impacts to recreation resources by increasing motorized access into presently SPNM areas. Actions that would allow for more access into an area could potentially change recreational opportunities. An increase in the level of access to an area would increase the opportunities available for certain user groups (e.g., snowmobile and ATV users) while reducing opportunities available to other user groups (e.g., hikers).

If these activities occur in areas where the Forest Plan road density levels would be exceeded, by proposed oil and gas activity, recreation resource values could be reduced. The effect of closing and reclaiming existing roads when new roads are built would potentially allow reclassification of these areas, over time, from SPM or RN back to SPNM.

The cumulative effects of planned and existing oil and gas activity, as well as other activities (e.g., timber harvest, range management, recreation development) could result landscape and would potentially result in reducing recreation opportunities, particularly those requiring largely undisturbed landscapes (i.e., SPNM settings). Changes ROS settings could reduce the availability of recreation opportunities or degrade quality of the associated experiences in affected areas of the Forest. Recreation users may be displaced to other parts of the Forest where the desirable settings exist. This could place further demands on recreation resources in those areas. Through careful mitigation and planning, the effects of these activities may be avoided or minimized.



## VISUAL RESOURCES

This section describes the potential effects of oil and gas exploration and development on the visual resources of the Dixie National Forest. Potential effects associated with oil and gas activities are based on the reasonably foreseeable development scenario (RFDS) from each alternative (refer to Appendix E). The assessment of potential visual impacts focuses on two key issues identified during scoping:

- Issue 4** - The effects of oil and gas leasing and possible subsequent exploration and development activities on the visual and recreation resources.
- Issue 5** - The effects of oil and gas leasing and possible subsequent exploration and development activities on established National Parks, National Monuments, and Wilderness.

Oil and gas exploration and development would potentially result in direct effect to view from key observation points (e.g., recreation sites, roads, trails) and cause substantial change in landscape scenery. Significant visual impacts would occur where strong visual contrasts would be seen from sensitive viewpoints in the foreground distance zone (0-0.25 mile) or where changes in the landscape would not meet the visual quality objective (VQO) of Retention. Moderate visual impacts would result from strong visual contrasts seen in the middleground distance zone (0.25-3 miles) or moderate contrasts in the seen in the foreground distance zone, and where changes in the landscape would not meet the VQO of Partial Retention. Oil and gas exploration and development activities in areas with VQOs of Modification or Maximum Modification would be expected to meet these objectives.

### Effects Common to All Alternatives

Oil and gas exploration and development activities would result in adverse effects wherever visual contrasting elements or modifications would be introduced in the characteristic landscape. Visual contrasting elements would include roads, drill rigs, storage tanks, and other facilities as well as changes to land forms and vegetation patterns that would result from clearing sites for these facilities. Essentially, any change to the form, line, color, and texture elements of the existing landscape would cause visual contrast. The introduction of visually contrasting elements or modifications into the existing landscape by oil and gas activity could potentially alter the scenic quality of the area and/or impact views from key observation points.

Drilling would typically result in the most evident visual contrasts, particularly in areas that are largely undisturbed. However, impacts from exploration activities are usually short-term. Following the exploratory phase, the presence of drilling equipment would be removed and the area reclaimed, mitigating most significant impacts. In the case of a discovery, oil and gas activities would move into the development and production phases, which would typically result in long-term impacts visual that would vary in magnitude. Visual impacts can be reducing by siting facilities to take advantage of terrain and vegetation to screen activities from views. road rehabilitation, and the use of non-contrasting colors on structures would help minimize or avoid impacts.

Exploratory drilling may result in significant visual impacts where this activity would be visible in the foreground from sensitive viewpoints, particularly in previously undisturbed landscapes. Because it is unlikely that more than one exploratory wells would be located in an area visible from a particular viewpoint, visual impacts from exploratory drilling are expected to be minor in context of the Forest. The presence of the equipment would be potentially noticeable for nine to twelve months. If no discovery is made, the equipment would be removed and the area reclaimed.



Field development visible in foreground from sensitive viewpoints would typically create strong contrasts that would result in significant viewer impacts. Where a field development would be seen in middleground and background views, visual contrasts would range from strong-moderate to moderate-weak that would result in moderate to low viewer impacts.

Oil and gas activities that would result in strong visual contrasts in the foreground or middleground distance zones would tend to be dominant in the landscape views and be evident to the casual forest observer, and would not meet the intent of either VQOs of Retention or VQO Partial Retention. Strong visual contrasts in unseen areas that would degrade highly scenic landscapes (Variety Class A) also would not meet VQOs of Retention or VQO Partial Retention.

Impacts to the visual resources on the Dixie National Forest could also occur as a result of the development of private mineral development areas within the Forest. Oil and gas activities within private mineral areas are not required to meet Forest Plan standards for visual resources.

Oil and gas exploration and development under No-Action/No Lease Alternative in the existing leases could result in visual impacts. Although these impacts would be limited to area of existing leases, viewpoints outside these leases could be adversely affected. For the purpose of this EIS, this alternative represents the existing visual condition of the landscapes in the Dixie National Forest. The changes in these landscapes that would result from the action alternatives are described below.

### **Effects of Each Alternative**

#### **Proposed Action: Forest Plan Intent**

Under this alternative, eight (8) exploratory wells would be reasonably foreseeable. One exploratory well on the Pine Valley Ranger District would likely not be drilled due to the limited acreage available for surface occupancy. Because existing management restrictions would limit or preclude field development in this area, an exploratory well would not be economically justified.

The CSU stipulation would be applied in areas with VQOs of Retention and Partial Retention. Under this leasing option, leases would be issued with special stipulations that would permit oil and gas exploration and production to occur as long as these VQOs could be met within one year following the completion of activities. This stipulation would relocate roads, proposed well sites, and other facilities up to 200 meters (656 feet) to take advantage of vegetation or terrain to screen activities from view or place them in areas with higher visual absorption capacity. This stipulation may include painting the facility to match the surrounding vegetation/landscape, using low-profile tanks and other production facilities, and road rehabilitation. CSU stipulations would also include "feathering" vegetation along clearing edges, shaping cut and fill slopes to repeat adjacent landforms, and minimizing construction disturbance will help reduce impacts to the viewer.

Where oil and gas activities with a CSU stipulation would be located in the foreground or middleground, visual contrasts are expected to be strong to moderate which could result in moderate to significant impacts to sensitive viewpoints. Visual contrasts in previously undisturbed, highly scenic landscapes also would likely result in significant visual impacts.

Although CSU stipulations would reduce the visual contrasts, oil and gas activities under this stipulations would in most cases be evident to the casual forest observer and would not meet the VQOs of Retention or Partial Retention.



### **Alternative 1: No Action/No Lease**

Under this alternative, federal minerals within the study area would not be available for leasing once the existing leases have expired. However, some oil and gas exploration and development is reasonably foreseeable within existing leases, including: two (2) exploratory wells and one CO<sub>2</sub> field.

This alternative would result in no adverse effects to visual resources.

### **Alternative 2: Forest Plan Modification A**

Under this alternative, four (4) exploratory wells would be reasonably foreseeable. Three of these wells would likely occur on the Teasdale and Escalante Ranger Districts, and the fourth would likely occur on the Cedar City District.

The NSO stipulation would be applied in areas with a VQO of Retention. Because there would be no surface disturbance, oil and gas activities this stipulation would meet the intent of the VQO of Retention. As a result, there would be no viewer impacts or impacts to landscape scenery in areas under the NSO stipulation.

The CSU stipulation would be applied to areas with a VQO of Partial Retention. The effects on visual resources that would result from oil and gas exploration and development under the CSU stipulation would be the same as those described for the Proposed Action.

### **Alternative 3: Forest Plan Modification B**

Under this alternative, nine (9) exploratory wells are reasonably foreseeable. The CSU stipulation would be applied to areas with VQOs of Retention and Partial Retention. The effects on visual resources that would result from oil and gas exploration and development under the CSU stipulation would be the same as those described for the Proposed Action.

### **Alternative 4: Forest Plan Modification C**

Under this alternative, nine (9) exploratory wells are reasonably foreseeable. The effects on visual resources that would result from oil and gas exploration and development under the CSU stipulation would be the same as those described for the Proposed Action.

Standard lease terms (SLT) would be applied to areas of VQO Partial Retention. Under this leasing option, leases within areas of VQO Partial Retention would be issued under the conditions of the standard Federal oil and gas lease (Appendix B) and subject to existing regulations. Similar to the CSU stipulations, SLT would relocate roads, proposed well sites, and other facilities up to 200 meters (656 feet) to take advantage of vegetation or terrain to screen activities from view or place them in areas with higher visual absorption capacity. However, SLT do not require oil and gas exploration and production to meet VQOs within one year following the completion of activities or require the mitigation measures that would reduce visual contrasts. As a result, visual impacts can be expected to be somewhat higher under SLT, and visual contrasts could occur in areas with VQOs of Retention and Partial Retention that would not meet these VQOs.



## Cumulative Impacts

To determine cumulative visual impacts, the impacts of the proposed oil and gas leasing development are added to those resulting from past and present activities, as well as other proposed future actions within the analysis area. This includes other oil and gas developments, existing and proposed timber sales, and other foreseeable activities that could alter the landscape.

The cumulative effect of oil and gas activity would be greatest if a discovery were to occur and a field was developed. A field development would substantially alter the characteristic landscape. Timber harvest activity in the area could result in a significant change in the landscape that may directly effect sensitive views or degrade the scenic values of the landscape.

## **SOCIOECONOMICS**

This section describes the potential effects of oil and gas exploration and development on economic and social values that would result in the study area under each alternative. This section addresses the following issue:

**Issue 7** The effects of Federal leasing decisions and possible subsequent exploration and development activities on local communities and socioeconomic values.

Under the reasonably foreseeable development scenario (RFDS) for the Dixie National Forest minerals leasing program, a variety of changes could occur in the human environment of the region. Chapter 3 described the demographic and socioeconomic characteristics of the six-county area that encompasses the Dixie National Forest, within which most of the effects of the Proposed Action (or its alternatives) would be experienced. This section discusses the socioeconomic impacts of the RFDS. These impacts would include direct as well as indirect effects. Direct effects would take the form of changes in employment and income as a result of jobs opening up to local residents during the exploration, development and production phases. Indirect effects would include increased business for local merchants and professionals (which would increase the demand for labor), and possibly increases in population if the development activities induced people to relocate permanently to the area. Increases in personal income would result, as well as changes in demand for housing, schools and public services.

Of importance is the potential magnitude of these changes relative to the ability of local communities to accommodate them. Also important is distinguishing the differences in impacts of variation of the RFDS that result under the combination of stipulations that would be applied by each alternative (refer to Table 2-1 in Chapter 2). The principal focus is on projected changes in jobs and income, from which other direct and indirect impacts can be estimated.

## Reasonably Foreseeable Development Scenario

Five variations of the RFDS have been identified by the Forest Service for evaluation of the leasing program's environmental impacts. For the socioeconomic analysis the interest is the economic resources that would be mobilized--investment and operating expenditures and labor to explore, develop and produce the oil, gas, and carbon dioxide reserves. Money flows (procurement of materials, equipment and manpower) and relocation of personnel (and dependents) are the direct causes of socioeconomic impacts. Accordingly, it is necessary to estimate the values of expenditures and employment involved in developing the leases. Extensive use was made of the Final Environmental Impact Statement for Oil and Gas Leasing on Lands Administered by the Manti-La Sal National Forest (Manti-La Sal FEIS), published in December



1992. This report contains a detailed appendix (A-2) entitled "Description of Oil and Gas Activities and Associated Socioeconomic Factors," which provides a comprehensive list of the costs and manpower requirements for each major element of exploration, development and production of oil and gas reserves in an area similar to the Dixie National Forest. Unit costs, personnel requirements and work duration values were extracted and configured to the Dixie National Forest setting. Lease development actions from the RFDS (the Forest Service's expected numbers of wells and fields to be explored, developed and produced) were then parameterized with the activities associated with exploration and development drilling and production of developed fields (e.g. seismic exploration, access road and pad site construction, pipeline collection system development). Annualized costs and labor requirements were then extracted for each alternative.

### **Maximum RFDS**

Surface disturbance constraints determine the amount of mineral lease activity in the National Forest. Limitations on exploration work (drilling and seismic blasting), road construction, development drilling, pipeline construction and product transportation in order to protect habitat, wildlife and other environmental resources affect the economics of developing mineral resources. These limitations (or stipulations to the leases), when juxtaposed on the locations of reserves and the overlying surface environmental characteristics of the National Forest, translate into the number of wells that can be expected to be drilled. Also affecting the leasing decisions are the prospects for oil, gas, and CO<sub>2</sub> prices and the relative costs of developing other reserves elsewhere in the world. The Forest Service's basic development scenario, upon which the RDF scenario is based, calls for a maximum of 101 wells to be drilled over a 15-year period, consisting of nine exploration wells, 38 oil and gas wells and 54 CO<sub>2</sub> wells (Appendix E). Production of CO<sub>2</sub> fields could extend upwards of 20 years, while oil and gas fields could be productive for as much as 20 to 50 years.

The principal communities of counties in southern Utah where wells would be drilled would experience much of the economic impact of the leasing activity. An estimate of which counties the wells would be located in is presented in Table 2-11 in Chapter 2. The RFDS does not identify which counties the wells would be drilled in; only the ranger districts. Accordingly, it was necessary to estimate how the wells would be distributed among the counties, some of which include more than one ranger district. The data in Table 2-11 (in Chapter 2) is a best estimate of the distribution (Dames & Moore, 1994).

As shown in Table 2-11 (in Chapter 2), most of the drilling activity would be in Garfield County, where the most promising reserves of oil, gas and CO<sub>2</sub> are located. A total of 84 wells are projected for Garfield County: five exploration wells, 38 oil and gas wells in one field (the Escalante anticline) and 41 CO<sub>2</sub> wells in two fields (Escalante anticline and Aquarius Plateau). The Escalante anticline (in the Escalante Ranger District in Garfield County) and Aquarius Plateau formation (split between the Escalante and Teasdale Ranger Districts) are identified by the Forest Service as being "areas with moderate potential for hydrocarbons and high potential for carbon dioxide" (RFDS, 1994). The Teasdale Ranger District includes portions of southern Wayne County, so the estimate was made that two of the three exploration wells in the Teasdale Ranger District and approximately one-half (13) of the projected 27 CO<sub>2</sub> wells to be drilled on the Aquarius Plateau would be located in Wayne County; the third exploration well and the other 14 CO<sub>2</sub> development wells in the Aquarius Plateau area of the Teasdale Ranger District are assumed to be drilled in Garfield County. One each of the exploration wells are projected to be drilled in Washington and Iron Counties. The Forest Service projects no development well drilling for either oil, gas or CO<sub>2</sub> in these counties, (RFDS, 1994).



## Alternatives

The relevant characteristics of the five leasing alternatives are as follows:

- **Proposed Action: Forest Plan Intent** This alternative consists of eight of the nine exploratory wells (the Pine Valley Ranger District well would not be possible due to limited surface acreage) and all 92 development wells in Garfield and Wayne Counties. A total of 100 wells would be drilled for the Proposed Action, involving Garfield, Wayne and Iron Counties. The only difference between this alternative and the maximum development scenario in Table 2-11 (in Chapter 2) is exclusion of the Pine Valley Ranger District exploration well in Washington County.
- **Alternative 1: No Action/No Lease** This alternative consists of two of the nine exploratory wells (both in the Escalante anticline area of Garfield County), none of the oil and gas wells, but all of the CO<sub>2</sub> wells in Garfield and Wayne Counties. This alternative would exclude Washington and Iron Counties from any involvement in the leasing program's socioeconomic impacts.
- **Alternative 2: Forest Plan Modification A** This alternative consists of four exploratory wells (three in the Teasdale and Escalante Ranger Districts and one in the Cedar City Ranger District) and 54 CO<sub>2</sub> wells in the Escalante and Teasdale Ranger Districts. No oil and gas wells would be drilled with this alternative. Garfield County would gain two exploratory and 51 CO<sub>2</sub> development wells; Wayne County would gain two exploratory and 13 CO<sub>2</sub> development wells; and Iron County would gain one exploratory well. Washington County would be excluded from activity under this alternative. The Forest Service in the RFDS notes that with the limited number of exploration wells and limited accessibility with surface occupancy opportunities, it is unlikely that field development of oil and gas reserves would take place, but for purposes of the EIS analysis, development of the CO<sub>2</sub> will be considered reasonably foreseeable since it is a known resource.
- **Alternatives 3 and 4: Forest Plan Modification B and C** Under these alternatives all nine exploratory wells, all 38 oil and gas development wells, and all 54 CO<sub>2</sub> development wells would be drilled. Thus, Alternatives 3 and 4 are equivalent to the maximum development scenario presented in Table 2-11 (in Chapter 2).

## Effects of Alternatives

### **Maximum versus Minimum Impact Alternatives**

For purposes of socioeconomic impact assessment, the RFDS essentially reduces to two cases--a maximum case and a minimum case. The maximum case includes the Proposed Action and Alternatives 3 and 4, which differ in content by only one exploration well; otherwise they both include 38 oil and gas wells, 54 CO<sub>2</sub> wells and the production of three well fields. This difference translates into a monetary value spread among them of only one percent (the share of impacts represented by one exploration well in Washington County). Alternatives 1 and 2--the No Action/No Lease and Modification A scenarios--comprise the *de minimus* case: they consist of either two or four exploration wells, all 54 CO<sub>2</sub> wells, but no oil and gas wells and the production of only the two CO<sub>2</sub> fields. The two minimum case scenarios differ in content by only two exploration wells, which amounts to only a 3.7 percent difference in their total yearly spending and employment (through inclusion versus exclusion of two exploration wells in Iron and Wayne Counties with two other exploration wells in Garfield County).



## Direct Spending and Employment Impacts

Table 2-11 (in Chapter 2) summarizes the well counts and field production levels for each alternative and presents their associated spending and employment impacts.<sup>2</sup> All alternatives assume that exploration and development drilling will extend over a 15-year period, which for the maximum development scenario implies an average annual drilling rate of 6.7 wells (the minimum alternatives would have an average annual rate of between 3.7 and 3.9 wells per year). On an annualized basis, the maximum development alternatives (the Proposed Action and Alternatives 3 and 4) would entail outlays of about \$6.7 million per year, of which approximately \$2.3 million would be for wages and salaries. Some portion of the \$4.4 million in materials procurement would accrue to local merchants, but the exact amount is unknown. A conservative estimate might be on the order of 15 to 20 percent for locally available building materials and equipment (in line with the percentage of field work going to local residents), but the majority of the procurement would be for specialized oilfield equipment brought in from other parts of the country. The minimum development alternatives are approximately 56 percent of the maximum development alternatives in terms of expenditures and employment, primarily due to exclusion of the 38 oil and gas development wells.

Oilfield work is relatively capital-intensive, so large sums of money are tied up in each job. On the basis of the employment requirements for the various exploration, development and production phases (tabulated in Table 2-11 in Chapter 2) it is estimated that the maximum development alternatives would generate the equivalent of 90 full-time jobs per year, of which approximately 17 (or 20 percent) would be available to local residents. The minimum development alternatives would generate around 50 full time equivalent jobs, of which approximately ten would be filled by local residents.

As Table 2-11 (in Chapter 2) reveals, the various well field jobs vary considerably with respect to crew size and duration, so there would be considerable turnover of personnel as work progressed through the various phases.

Thus, the numbers of full time equivalent jobs is misleading in that a significantly larger number of seasonal or part time jobs would probably become available for a particular development alternative.

It is important to keep in mind the context of the proposed leases: they will represent a resumption of activities that had been going on for several decades until the mid-1980s. Thus, instead of being a newly introduced activity, the exploration and development work would serve to restore pre-existing economic activities in the region. Between 1947 and 1984 over 60 wells were drilled in the Dixie National Forest, with annual levels ranging from zero to nine. There is a large number of inactive leases with expirations occurring later in the 1990s. No wells have been drilled since 1984, however, reflecting the severe depression in world oil prices since the mid-1980s. With oil and gas prices prospectively improving, some new interest has been manifested in exploring the Dixie National Forest's hydrocarbon and CO<sub>2</sub> resources.

As indicated in Table 2-11 (in Chapter 2), several score of people could be employed on the Dixie leases at any one time, depending on the pace of activity and the amount of overlapping of exploration and development activities. Around 20 percent of the workers would be locally hired, based on the skill requirements for the various stages of work and the availability to contractors and workers. Construction and mining trades would be the principal beneficiaries of the work, notably equipment operators, truck drivers, drill rig operators, explosives technicians and mechanics. Landscaping skills would be an important

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<sup>2</sup>The impact data in the lower panel of Table 4-8 are based on the unit costs for exploration, development and production of oil and gas wells developed from Appendix A-2 of the Manti-La Sal FEIS. Table 4-9, below, presents the spreadsheet analysis used to obtain unit costs per well, which were then multiplied by the well count and field production data input values from the upper panel of Table 4-9 to produce the impact values in the lower panel.



element, moreover, for reclamation of abandoned well sites and access roads after the exploration phase was completed.

State and local governments would receive revenues from the lessees in the form of lease payments, royalties, the 25 percent of receipts payments, and in lieu of property tax payments. The transfers of revenues from the Forest Service to the state and local governments has been a minor but not unimportant source of funds. Execution of the oil and gas leases would preserve these fiscal inflows.

### Localized Effects

Permitting of new leasing of oil and gas mineral rights under the maximum development alternatives in the Dixie National Forest would generate a modest amount of new employment and income in the construction and mining sectors of, principally, Garfield and Wayne Counties. It would augment the inflow of tax and fee revenues to the six counties that enclose the National Forest. The numbers of new hydrocarbon and CO<sub>2</sub> related jobs to be filled locally would not be large under the Proposed Action and Alternatives 3 and 4, and would be even less with the minimum development alternatives. Earlier it was estimated that an average drilling rate of 6.7 wells per year plus production of three oil, gas and CO<sub>2</sub> wellfields would generate about 90 jobs (full time equivalent), of which about 17 would accrue to local residents. In 1991, Garfield and Wayne Counties registered 131 workers in the construction sector and an estimated 20 in mining, for a total of approximately 150 jobs in the sectors that would be mainly involved in the Dixie National Forest leases. Thus, the projected local hire component of the maximum development alternatives could absorb a little more than ten percent of the Garfield and Wayne County construction and mining labor force. This would not be a significant increment of demand for local workers. If the local hire component of the mineral lease activity were to absorb over one-half of the two counties' construction and mining workers it would likely create a noticeable shortage of workers for other projects, put pressure on local wage rates, and induce relocation of workers from other areas. But the projected numbers of new jobs from the Dixie National Forest leases are nowhere near that threshold of incremental demand. In point of fact, the six-county project region could easily supply all the local component of construction and mining workers; in 1991 there were nearly 2,600 such workers in the regional workforce.

The lease program would have little or no direct impact on communities in Washington and Iron Counties owing to there being only one exploratory well projected to be drilled in each county. Exploration drilling typically takes about three months per well, after which the rig is demobilized and the site is abandoned and reclaimed. The local employment and spending generated by one well will not significantly affect the local economy. The two counties' local governments as well as those of Piute and the other three counties comprising the Dixie National Forest project area would benefit, however, from intergovernmental transfers of revenues based on lease activities in the National Forest. As noted earlier, the sums would be modest (in FY 1991, the six-county region's receipts of Payments In Lieu of Taxes and 25 percent Receipts Payments from the Dixie National Forest represented about nine percent of total revenues of the six counties).

Residents of towns in and adjacent to the Escalante and Teasdale Ranger Districts might notice some increases in traffic and expanded demand for transient accommodations from the approximately 70-75 non-locally contracted workers that would comprise the majority of the hydrocarbon field development crews, but the changes would probably not be unwelcome for the additional business that local merchants and service-providers would gain. The new workers' local spending for shelter, food and entertainment, particularly during the off-season, would help the local economy as would lessees' procurement of local construction materials and other supplies.



Some permanent relocation of oilfield workers to the six-county region might occur if exploration activities revealed good prospects for long-lived reserves. The numbers would be in the few dozens at most, however, per the above analysis of the maximum development alternatives. This could lead to some pressure on housing prices, but it would also stimulate housing construction and would add to local tax and fee bases for schools, public utilities and other public services. Local planners would have to assess the needs for mitigation measures in the form of impact or connection fees on new residential developments to provide capital for expansion of community infrastructure.

The socioeconomic impacts of the minimum development alternatives would take the form of reduced numbers of jobs and income (both earnings and fiscal revenues). There would be fewer rigs at work in the field and, probably, periods of interrupted activity, both of which would cut down spending and employment. Local communities would see less support and stimulus to their economies from the National Forest.

## **MINERALS/GEOLOGY**

### **Introduction**

This section describes the potential effects to minerals/geology that could result from oil and gas leasing, exploration and/or development within the study area. Site specific resource areas discussed in this section are shown on Figure 3-16, Federal Subsurface Oil & Gas Ownership (at the end of Chapter 3). The information presented in this section relates to the following issue:

**Issue 6** The effects of Federal Leasing decisions on the opportunities to explore for and develop oil and gas resources within the analysis area.

Changes in topography and geology are not considered issues in this analysis, although there will be changes in topography as a result of surface disturbing activities associated with oil and gas exploration and development. The changes in topography and surficial geology may be measured by the gross and net disturbance of the area.

Based on the reasonable foreseeable development scenario (RFDS), projections were made on exploration and development activities for each of the ranger districts and subdivided by oil and gas potential areas. The oil and gas potential areas are broad geographic areas of consistent geologic character and oil and gas resource potential.

Table 2-7 (in Chapter 2) provides comparison of the ground disturbance activities of the Proposed Action and the alternatives. As shown by the table, potential development under the Proposed Action would result in 718 gross acres and 284 net acres of disturbance. Under Alternative 1, potential development would result in 156 gross acres and 69 net acres; Alternative 2 would result in 317 gross acres and 157 net acres; Alternative 3 would result in 733 gross acres and 291 net acres. Alternative 4 would result in 733 gross acres and 291 net acres.

The Stipulation Matrix, Table 2-1 (in Chapter 2), indicates the types of leases recommended based on resource category limitations, and the maps of the alternatives indicate the proposed type of lease for the Dixie National Forest. Table 2-8 (in Chapter 2), gives total acreage by lease stipulation and by oil and gas potential areas for the ranger districts of the Dixie National Forest, and is an indication of the amount and location of the lands available for oil and gas leasing.



## Effects Common to All Alternatives

There would be no direct environmental impacts to mineral and geological resources associated with oil and gas leasing; however, subsequent exploration and development activities following granting of the lease(s) would result in various environmental impacts.

In general, potential environmental impacts would be essentially the same for the Proposed Action and other alternatives, except for Alternative 1: No Action/No Lease. With Alternative 1 no new leases would be offered and as existing leases expire, eventually there would be no exploration for or development of oil and gas reserves on the Dixie National Forest.

There is the potential for oil and gas activities to conflict with exploration and development of other locatable, leasable, or saleable mineral resources if they occur at the same locations leased for oil and gas. Currently, there is very limited mining activity on each of the ranger districts. There are a number of existing oil and gas leases mostly on the Teasdale and Escalante Ranger Districts and two leases in the southern part of the Powell Ranger District (refer to Figure 1-2 in Chapter 1). Throughout the Dixie National Forest there are various claims for metallics, nonmetallics, coal, and other minerals. Areas where these commodities have been or could be surface or subsurface mined may be in conflict with oil and gas leasing.

## Effects of Each Alternative

### **Proposed Action: Forest Plan Intent**

Under the Proposed Action, exploration and development of oil and gas and CO<sub>2</sub> fields would result in 718 gross acres of disturbance with 284 net acres of disturbance, following reclamation. Exploration is anticipated in South and Central Pine Valley Mountains (Pine Valley District); Markagunt Plateau (Cedar City Ranger District); Sevier and Paunsaugunt (Powell Ranger District); Southern Escalante Mountains and Escalante anticline (Escalante Ranger District); and Aquarius Plateau, Northern Escalante Mountains and Boulder Mountains (Escalante and Teasdale Ranger Districts). Development of an oil field is projected to occur in the Aquarius Plateau, Northern Escalante Mountains, and Boulder Mountains oil and gas potential area of the Escalante/Teasdale Ranger District. Development of CO<sub>2</sub> fields are projected in the Escalante anticline; and, Aquarius Plateau.

The acreage available within the Dixie National Forest with generally minimal restrictions (i.e., under TL or CSU stipulations, or standard lease terms (SLT)) is approximately 996,900 acres. The remaining approximately 970,400 acres would be either not be leased (NL) or would be leased with NSO stipulations which would limit or exclude exploration and development in these areas. In the areas where development is projected as likely to occur by the RFDS, areas available under TL and CSU lease stipulations or under SLT include in approximately 198,000 acres the Aquarius Plateau, Northern Escalante Mountains, and Boulder Mountains of the Escalante/Teasdale Ranger District; approximately 127,000 acres the Southern Escalante Mountains; and approximately 28,900 acres in the Escalante anticline.

Although fairly large acreage are excluded from exploration and development, this alternative still provides acreage available for oil and gas and CO<sub>2</sub> development while meeting the objectives of the Forest Plan, Forest Service Policy, and the Federal Land Policy Management Act (FLPMA).



### **Alternative 1: No Action/No Lease**

Under this alternative, no new leases would be issued and as existing leases expire, they would not be reissued. No lease (NL) for the entire Dixie National Forest is not consistent with the Forest Plan, Forest Service Policy, the National Energy Policy, or FLPMA. Impacts to the oil and gas industry would be significant as exploration and development would be precluded on approximately 1,869,600 acres of the total 1,967,296 acres within the Dixie National Forest.

### **Alternative 2: Forest Plan Modification A**

Under the alternative action, exploration and development of oil and gas and CO<sub>2</sub> fields would result in 317 gross acres of disturbance with 157 net acres of disturbance following reclamation. Exploration is anticipated in South and Central Pine mountains (Pine Valley District); Markagunt Plateau (Cedar City Ranger District); Sevier and Paunsaugunt (Powell Ranger District); and Aquarius Plateau, Northern Escalante Mountains, and Boulder Mountains (Escalante and Teasdale ranger districts). Exploration and development are not anticipated in the Southern Escalante Mountains and Escalante anticline (Escalante Ranger District). Development of an oil field is projected to occur in the Aquarius Plateau, Northern Escalante Mountains, and Boulder Mountains oil and gas potential area of the Escalante/Teasdale Ranger District. Development of a CO<sub>2</sub> field is projected in the Escalante anticline and Aquarius Plateau, Northern Escalante Mountains, and Boulder Mountains.

The acreage available within the Dixie National Forest with generally minimal restrictions (i.e., TL or CSU stipulations, or SLT) is approximately 367,500 acres. The remaining approximately 1,599,800 acres either would not be leased (NL) or would be leased under NSO stipulations which would exclude exploration and development. In the areas where development is projected as likely to occur by the RFDS, areas available under TL and CSU lease stipulations or under SLT include approximately 29,000 acres available in the Aquarius Plateau, Northern Escalante Mountains, and Boulder Mountains of the Escalante/Teasdale Ranger District; and only about 200 acres would be available in the Escalante anticline.

The impact to oil and gas lease exploration and development potential may be significant since available acreage is quite limited in comparison to the Proposed Action. Under Alternative 2, broad areas throughout the Aquarius and Escalante anticline would either not be leased (NL) or would be lease under NSO stipulations in these areas that are high CO<sub>2</sub> and moderate oil and gas potential areas where development is projected as likely to occur. This alternative may not provide adequate acreage to meet the objectives of the Forest Plan, Forest Service Policy, and FLPMA.

### **Alternative 3: Forest Plan Modification B**

Under Alternative 3, Forest Plan Modification B, exploration and development of oil and gas and CO<sub>2</sub> fields would result in 733 gross acres of disturbance with 291 net acres of disturbance following reclamation. Exploration is anticipated in South and Central Pine mountains (Pine Valley district); Markagunt Plateau (Cedar City Ranger District); Sevier and Paunsaugunt (Powell Ranger District); Southern Escalante Mountains and Escalante anticline (Escalante Ranger District); and Aquarius Plateau, Northern Escalante Mountains, and Boulder Mountains (Escalante and Teasdale ranger districts). Development of an oil field is projected to occur in the Aquarius Plateau, Northern Escalante Mountains, and Boulder Mountains oil and gas potential areas of the Escalante/Teasdale Ranger District. Development of CO<sub>2</sub> fields are projected in the Escalante anticline; and, Aquarius Plateau.



The acreage available within the Dixie National Forest with generally minimal restrictions (i.e., TL or CSU stipulations, or SLT) is approximately 1,483,900 acres. The remaining approximately 483,300 acres either would not be leased or would be leased under NSO stipulations which would limit or exclude exploration and development in these areas. In the areas where development is projected as likely to occur by the RFDS, areas available under TL and CSU lease stipulations or under SLT include approximately 235,400 acres in the Aquarius Plateau, Northern Escalante Mountains, and Boulder Mountains of the Escalante/Teasdale Ranger District; approximately 156,900 acres in the Southern Escalante Mountains; and about 38,600 acres in the Escalante anticline.

Similar to the Proposed Action, this alternative would exclude a fairly large acreage from exploration and development, but it provides substantial acreage available for oil and gas and CO<sub>2</sub> development. This alternative meets or exceeds the objectives of providing acreage for oil and gas and CO<sub>2</sub> leasing areas of the Forest Plan, Forest Service Policy, and FLPMA.

#### **Alternative 4: Forest Plan Modification C**

Under Alternative 4, Forest Plan Modification C, exploration and development of oil and gas and CO<sub>2</sub> fields would result in 733 gross acres of disturbance with 291 net acres of disturbance following reclamation. Exploration is anticipated in South and Central Pine mountains (Pine Valley District); Markagunt Plateau (Cedar City Ranger District); Sevier and Paunsaugunt (Powell Ranger District); Southern Escalante Mountains, and Escalante anticline (Escalante Ranger District); and Aquarius Plateau, Northern Escalante Mountains and Boulder Mountains (Escalante and Teasdale ranger districts). Development of an oil field is projected to occur in the Aquarius Plateau, Northern Escalante Mountains, and Boulder Mountains oil and gas potential area of the Escalante/Teasdale Ranger District. Development of CO<sub>2</sub> fields are projected in the Escalante anticline; and, Aquarius Plateau.

The acreage available within the Dixie National Forest with generally minimal restrictions (i.e., TL or CSU stipulations, or SLT) is approximately 1,838,400 acres. The remaining approximately 128,900 acres either would not be leased (NL) or would be leased under NSO stipulations which would limit or exclude exploration and development in these areas. In the areas where development is projected as likely to occur by the RFDS, areas available under TL and CSU lease stipulations or under SLT include approximately 255,300 acres in the Aquarius Plateau, Northern Escalante Mountains, and Boulder Mountains of the Escalante/Teasdale Ranger District; approximately 198,800 acres in the Southern Escalante Mountains; and about 42,800 acres in the Escalante anticline.

Alternative 4 would provide substantial acreage available for oil and gas and CO<sub>2</sub> development. This alternative would exclude only those areas critically sensitive to exploration and development activities and meets or exceeds the objectives of providing acreage for oil and gas and CO<sub>2</sub> leasing areas of the Forest Plan, Forest Service Policy, and FLPMA.

#### **Cumulative Impacts**

The cumulative effects to minerals/geology are represented by the effects *Effects of Each Alternative* above. There would be no cumulative effects on mineral exploration and development associated with implementation of any of these oil and gas leasing alternatives in conjunction with known past, present, or future resource activities.



## TRANSPORTATION SYSTEM

### Introduction

This section addresses the potential effects of oil and gas exploration and development may have on the study area's existing transportation system. The existing road network is shown on Figure 3-17 (at the end of Chapter 3). Oil and gas exploration and development would likely require modification of the transportation system to accommodate the activities. Specific roads that may be affected cannot be predicted at this time; however, based on past experience with oil and gas activities in the study area, some reasonable predictions can be made.

The roads of a transportation system are linear affecting nearly all other resources. The improvement of existing roadways and the development of new roadways may result in more impacts and effects to other resources (i.e., wildlife habitat, visual resources, recreation, etc.) than the effects of oil and gas exploration and development would have on the existing transportation system.

The Dixie National Forest would encourage the use of existing roads to access drill sites where feasible and possible. Short roads, less than 200 meters (656 feet), connected to existing roads, would be used where possible. Some roads may be closed or eliminated as a better transportation system is completed, through reconstruction or new construction, for oil and gas or other resource management activities.

### Effects Common to All Alternatives

The total miles of roads may increase with each action alternative. The improvement of existing roadways and the development of new roadways may result in more effects on other resources than the effects of oil and gas exploration and development activities would have on the transportation system. In some instances, relocation or improvement of a road would result in a reduction of long-term impacts by correcting existing erosion and sediment problems. Impacts of road construction on other resources are discussed in the appropriate sections.

Assuming the Forest Plan direction is adhered to during implementation of any of the leasing options, each leasing option would provide for upgrades to existing roadways, which in turn, would improve the overall transportation system. The actual effects of road construction activities can only be determined when the detailed, site-specific Application to Drill (APD) and Surface Use Plans of Operation (SUPO) are submitted to the Forest Service for review and approval.

The Proposed Action and Alternatives 2, 3, and 4 would apply the standard lease terms (SLT) to the transportation system. Alternative 1, the No Action/No Lease Alternative, would preclude oil and gas exploration and development through no lease (NL), and therefore, no adverse impacts to the existing transportation system occur.

Under SLT, oil and gas activities may be relocated up to 200 meters (656 feet). This would provide the opportunity to locate oil and gas facilities off of existing or proposed road networks and right-of-ways, thereby avoiding direct effects to the road system completely. Activities could also be delayed for up to 60 days, for such things as wet conditions or when the ground is frozen, to mitigate effects on roads. Adverse impacts to the existing transportation system are expected to be limited to increased traffic and wear and tear, and would be minor. SLT would impose minor restrictions on exploration, development, and production of the oil and gas resource.



Except where existing oil and gas leases occur, the minerals under the transportation system would not be available for exploration, development, or production of oil and gas, even through directional drilling. By not leasing the minerals under the transportation system, areas could not be blocked up and controlled to allow for production. As a result, there would be a loss of revenues from bonus bids on lease sales, lease rentals, and royalties.

### Effects of Each Alternative

#### **Proposed Action: Forest Plan Intent**

Under this alternative, eight (8) exploratory wells would be reasonably foreseeable. One exploratory well on the Pine Valley District would not likely be drilled due to the limited acreage available for surface occupancy and other stipulations.

SLT would be applied for transportation systems in this alternative. Approximately 4 miles of access road would be necessary for each exploration well, disturbing a total of approximately 13 acres (gross). If exploration and development were to occur in locations where the collector roads do not meet the desired traffic service level, or are contributing to resource degradation, these existing new roads would be reconstructed or upgraded to the desired traffic service level. If exploration and development were to occur where the local roads do not meet the desired service level or there are no existing roads, reconstruction of the existing roads, as well as construction of new access roads, would be necessary.

No exploratory wells are foreseeable in the Pine Valley Ranger District in this alternative, and as a result, no additional road construction for oil and gas activity would occur.

One exploratory well is reasonably foreseeable in the Cedar City Ranger District. If the existing road system does not meet the needs of access to the exploration well, approximately 4 miles of road may be reconstructed or newly built, disturbing up to a total of approximately 13 acres (gross). For a description direct impacts under SLT, refer to the *Effects Common to All Alternatives*, above.

One exploratory well is reasonably foreseeable in the Powell Ranger District. The impacts and changes to the transportation system would be similar to those described for the Cedar City Ranger District.

For this alternative, six exploratory wells are reasonably foreseeable for the Escalante and Teasdale Ranger Districts. The RFDS states that three exploratory wells would occur in the Aquarius Plateau and Northern Escalante Mountains, two in the Escalante anticline, and one in the Southern Escalante Mountains, Table Cliffs Plateau, or Kaiparowits Plateau/ Escalante Benches. If the existing road system does not meet the needs of access for exploration well(s), approximately 4 miles of road for each well may be reconstructed or constructed. This would result in up to approximately 78 acres (gross) of potential disturbance.

There is also a reasonable potential for two field developments within the Escalante and Teasdale Ranger Districts. One field development would be located in the Escalante anticline where 2 wells plus 25 future CO<sub>2</sub> wells are foreseeable. Approximately one mile of road would be necessary for each exploratory well resulting in approximately 60 acres (gross) of disturbance for each field development (i.e., 27 total wells). The second foreseeable field development would occur in another high CO<sub>2</sub> potential area on the Aquarius Plateau where 27 CO<sub>2</sub> wells are foreseeable. The total number of wells foreseeable between the two fields would be 54 wells, resulting in a total disturbance of approximately 120 acres (gross) for road construction (also refer to the RFDS in Appendix E).

For a description of direct impacts under SLT, refer to the *Effects Common to All Alternatives*, above.



### **Alternative 1: No Action/No Lease**

Under this alternative, federal minerals within the study area would not be available for leasing and existing lease would not be renewed once they have expired. There would be no new leasing, however, exploration and development on existing leases would be allowed. Excluding the roads developed for the existing leases, there would be no changes in the transportation system on the Dixie National Forest.

### **Alternative 2: Forest Plan Modification A**

Under this alternative, four (4) exploratory wells would be reasonably foreseeable. Three of these wells would likely occur on the Teasdale and Escalante Ranger Districts, and the fourth would likely occur on the Cedar City District. SLT would be applied to this alternative for transportation systems.

No exploratory wells are foreseeable in the Pine Valley Ranger District in this alternative, and as a result, no additional road construction for oil and gas activity would occur.

One exploratory well is reasonably foreseeable in the Cedar City Ranger District. Impacts to or changes in the transportation system in this ranger district would be the same as described for the Proposed Action.

No exploratory wells are foreseeable on the Powell Ranger District in this alternative, and as a result, no additional road construction for oil and gas activity would occur.

For this alternative, three exploratory wells are foreseeable on the Escalante and Teasdale Ranger Districts. If the existing road system does not meet the needs of access for exploration wells, approximately 4 miles of road for each well may have to be reconstructed or newly built. This would result in up to approximately 39 acres (gross) of potential disturbance.

Like the Proposed Action, there is a reasonable potential for two field developments within the Escalante and Teasdale Ranger Districts under this alternative. Impacts to or changes in the transportation system in this ranger district would be the same as described for the Proposed Action.

### **Alternative 3: Forest Plan Modification B**

Under this alternative, nine (9) exploratory wells are reasonably foreseeable. SLT would be applied to this alternative.

One exploratory well is reasonably foreseeable in the Pine Valley Ranger District. If the existing road system does not meet the needs of access to the exploration well, approximately 4 miles of road may have to be reconstructed or newly built. This would result in approximately 13 acres (gross) of disturbance.

Impacts to or changes in the transportation system in the Cedar City, Powell, Escalante, and Teasdale Ranger Districts would be the same as described for the Proposed Action.



## Alternative 4: Forest Plan Modification C

Like Alternative 3, nine (9) exploratory wells are reasonably foreseeable under this alternative and SLT would be applied. Impacts to or changes in the transportation system would be the same as described for the Alternative 3.

### Cumulative Impacts

To determine cumulative impacts, proposed oil and gas exploration and development activity impacts are added to those resulting from past activities, as well as other future actions within the study area. The affected environment section provides a discussion of the transportation system as it currently exists. Impacts to the existing transportation system as a result of these future actions are expected to be mitigated through requirements placed on the user to provide road maintenance or contribute to the road maintenance program. Deterioration of the existing transportation system is not expected. The existing transportation system would be improved from both a resource and maintenance standpoint and additional roads would be added to the transportation system. These additional roads would be constructed to meet the desired traffic service levels.

## WILD AND SCENIC RIVERS

This section addresses the following issue:

**Issue 2** The effects of oil and gas leasing and possible subsequent exploration and development activities on roadless resources and eligible Wild and Scenic Rivers.

Presently, there would be no effects to Wild and Scenic Rivers in the study area, as none have been identified or designated on the Dixie National Forest (refer to Chapter 3, Wild and Scenic Rivers section).

## CULTURAL AND PALEONTOLOGICAL RESOURCES

### Cultural Resources

A wide range of cultural resources have been identified within the study area and include small lithic scatters, lithic procurement areas, Formative-period habitations, and a variety of small to moderately sized historic sites. While only a small percent of the area has been formally inventoried, the types of sites present and their dispersion across the landscape are generally understood. However, the presence of cultural resources at any specific location cannot be determined without an intensive pedestrian survey. Such surveys will be required under regulation 36 CFR Part 800, and will adequately protect any cultural resources present.

Estimates of surface disturbance during an exploration phase of oil and gas development suggest that approximately 136 acres would be disturbed in low and moderate sensitivity areas, resulting in potential effects to approximately 1 to 2 historic properties. If, subsequently, two CO<sub>2</sub> fields were developed, approximately 265 acres in low sensitivity areas would be disturbed, resulting in potential effects to another approximately 1 to 2 historic properties. And, if an oil field, similar to the Upper Valley field were developed, about 341 acres in low and moderate sensitivity areas would be disturbed, resulting in potential effects to approximately 3 to 4 historic properties. In total, approximately 5 to 8 historic properties could be potentially affected by potential oil and gas exploration and development activities.



However, it is extremely unlikely that all of these sites would be affected. Approximately ninety percent of the previously recorded prehistoric sites and many of the historic sites are small, less than 200 feet in diameter, and as such are easily avoided by oil and gas development. Exceptions might be some of the larger prehistoric sites and linear features, such as historic roads or canals. In addition, of the sites that would be adversely affected, it is estimated that only 40 percent are eligible for listing on the National Register of Historic Places (NRHP).

Where significant sites cannot be avoided, impacts can often be mitigated through data recovery studies. This is usually done by partially excavating the site, using methodologies defined in a reviewed and approved research design. While information is retrieved from the site, the impacts to the site are irreversible. However, certain sites are considered significant for reasons other than their scientific value. Sites associated with significant events (criterion "a") or persons (criterion "b") or which embody distinctive characteristics (criterion "c") cannot have direct impacts mitigated merely through data collection. In these cases, memoranda of agreement stipulating other types of mitigation measures must be developed and signed before a proposed action can proceed. Indirect impacts must also be considered at these sites and some standing structures or prehistoric rock art may require that a sensory buffer be defined and developed.

While no traditional cultural properties have been identified at this time, these types of sites must also be considered. Impacts to sites significant because of their association with traditional Native American land use or religion are difficult to mitigate and avoidance is usually the easiest solution.

Indirect impacts to cultural resources would probably be confined to an increase in illegal site collection and possible vandalism to rock art or standing structures, resulting from increased access. Conversely, increased access can often increase the recreational or educational value of such sites.

In summary, the study area has a rich inventory of both identified and undiscovered cultural resources, both in quantity and in complexity. Many sites are ineligible for listing on the National Register of Historic Places, and impacts on those sites that are National Register eligible are likely to be adequately mitigated, either through avoidance, data collection studies, or other measures. No portion of the study area should be restricted from oil or gas exploration on the basis of cultural resources. However, it should be noted that specific actions might be subject to stipulations or restrictions based on existing protective measures if significant cultural resources are identified.

### **Paleontological Resources**

The Dixie National Forest contains fifteen geologic formations that are considered to have a potential to contain scientifically significant fossil resources. The determination is based on the presence of significant fossil remains in the formations in question or their correlatives either within or in the vicinity of the project area (refer to Table 3-33 Paleontologically Sensitive Formations in Chapter 3).

If a proposed project has a high likelihood of encountering and/or impacting significant paleontological resources, a plan for evaluating the site and mitigating the effects will be developed and would likely include the points listed below. Such a plan should include consultation with a qualified paleontologist who will work with the responsible agency personnel.

- A literature and records search
- Development of field assessment strategy
- Field Survey
- Development of a comprehensive paleontologic resource plan.



## Cumulative Impacts

The cultural resource base within the area subject to decision has never been quantitatively characterized. However, past surveys suggest that the National Forest contains approximately 15,000 to 18,000 historic resource or, on average, 5.5 sites per square mile within the 2,969 square miles subject to decision. It is estimated that 40 percent of these are eligible for listing on the National Register of Historic Places. Even though existing sites area protected by federal regulations, an unknown number of these are being inadvertently destroyed. Certainly each year many are destroyed through vandalism, development, or natural causes.

It is clear that the few resources that could be affected by oil and gas development are a tiny fraction of the regional resource base. Therefore, it can be concluded that any of the proposed alternatives would have minor, if any, cumulative effects on the regional cultural resource base.

## **ADMINISTRATIVE SITES AND SPECIAL AREAS**

This section describes the environmental consequences of oil and gas exploration and development activities on recreation residences, administrative sites, Brian Head Ski Area, Research Natural Areas (RNAs), and the "# Management Areas.

### Effects of Alternatives

Under the Proposed Action and Alternatives 1 & 2, there would be no direct impacts from leasing, exploration, or development of oil and gas on special areas. However, oil and gas activities under any of the alternatives in adjacent areas could indirectly affect uses in special areas, alter recreation opportunities or degrade the quality of recreation experiences, or otherwise adversely effect the values associated with special areas. These effects would result where oil and gas activities would be visible, create noise, and generate dust that would effect uses or values in special areas.

**Recreation Residences and Administrative Sites** - There would be no direct impacts to recreation residences or administrative sites under any alternative, except Alternative 4. Leases under Alternative 4 would be granted with standard lease terms (SLT) which would potentially allow oil and gas exploration and development in these areas. There could be direct effects (i.e., noise, dust, visual intrusions) to recreation residences and administrative sites, as drill sites may be located in or near these sites. However, roads and oil and gas facilities may be relocated up to 200 meters (656 feet) or activities may be suspended for up to 60 days (i.e., during peak use periods) to minimize adverse effects.

**Brian Head Ski Area** - There would be no direct impacts to Brian Head Ski Area under any alternative, except Alternative 4. Leases under Alternative 4 would be granted with CSU stipulations which would potentially allow oil and gas exploration and development in these areas. There could be direct effects (i.e., noise, dust, visual intrusions, conflicts with users) to the ski area, as activity could occur in this area under Alternative 4. However, roads and oil and gas facilities may be relocated up to 200 meters (656 feet) or activities may be suspended for up to 60 days (i.e., during peak use periods) to minimize adverse effects.

**Research Natural Areas** - All alternatives would preclude surface occupancy in RNAs by either not leasing (NL) these areas or applying the NSO stipulation. There would be no direct impacts to RNAs under any alternative. However, all alternatives, except Alternative 1 (No Lease), could cause indirect impacts to RNAs, particularly those designated to preserve scenic values or wildlife. Noise could displace wildlife



populations during active drilling periods, and visual intrusions of drill rigs, equipment and surface disturbance near RNAs could degrade scenic values where activities may occur in adjacent areas.

**"#" Management Areas** - "#" Management Areas are areas designated in the Forest Plan (Forest Management Areas Figure 3-19) and include parts of seven different Management areas [the "#" designation requires no surface occupancy (NSO) for mineral activities]:

- 1A# Recreation Sites
- 2A# Semi Primitive Recreation Opportunities
- 2B# Rural and Roded Recreation Opportunities
- 4B# Wildlife Habitat Management (MIS)
- 5A# Big Game Winter Range (non-forest)
- 10A# Research Natural Areas
- 10B# Municipal Supply Watersheds

The Proposed Action and Alternatives 1 and 2 would have no direct impacts on "#" Management Areas. CSU stipulations or SLT that would be applied to leases under Alternatives 3 and 4, respectively, could result in direct impacts to "#" Management Areas. However, roads and oil and gas facilities may be relocated up to 200 meters (656 feet) or activities may be suspended for up to 60 days (i.e., during peak use periods) to minimize adverse effects under both of these stipulations. In addition, requirements under CSU stipulations would further minimize effects to affected areas by painting the facility to match the surrounding vegetation/landscape; using low-profile tanks and other production facilities; rehabilitating roads, well pads, and other disturbed areas; "feathering" vegetation along clearing edges; shaping cut and fill slopes to repeat adjacent landforms; and minimizing construction disturbance.

## **IRREVERSIBLE AND IRRETRIEVABLE COMMITMENT OF RESOURCES**

An irreversible commitment of resources refers to the loss of production or use of nonrenewable resource, or resources that cannot be replaced once lost or damaged. An irretrievable commitment of resources refers to losses of production or use of renewable resources.

There will be some irretrievable loss of big game habitat during the drilling and production that will last until the disturbed areas are reclaimed. The commitment is for the life of production which averages about 20 years. The loss of big game habitat is not an irreversible commitment beyond the life of a field development.

There will be an irretrievable loss of some old growth forests (mature stands). Once these mature stands are removed the use as old growth habitat is lost for the growing time of a mature stand of the particular tree species removed. The loss of the mature stands is not irreversible, because given enough time the old growth (mature stands) can be regrown once the disturbed area are reclaimed. The time frame to establish an old-growth stand from bare soil would require 200 to 400 years.

A portion (the amount depends on the alternative) of the roadless resource would be committed to oil and gas exploration and development. The Proposed Action and Alternatives 1 and 2 would result in no commitment of roadless resources or impacts on the roadless characteristics. Alternatives 3 and 4 would result in the potential commitment of approximately 730 acres gross (317 net) of roadless resources with associated impacts on the roadless characteristics. Once exploration and development have occurred, the roadless characteristics on the acres disturbed would be lost for up to 150 to 200 years. Future decisions could be made to change management allocation and not issue leases once these expire or the field development is completed. This subsequent termination of leasing activities and the reclamation of



disturbed areas would begin to retrieve the roadless characteristics on these well pads and roads in 150 to 200 years.

There will be no irreversible or irretrievable commitment of the riparian resources if the Forest Plan Standards are adhered to. There will be no net loss of wetlands under any of the alternatives because of the protection and replacement conditions required under Section 404 of the Clean Water Act. Therefore there will be no irreversible or irretrievable commitment of wetlands under any of the alternatives.

Some soil loss/displacement, particularly related to road, pipeline, well pad construction, and other field development facility construction, would occur. If soil and land surface disturbances are located in areas of high sensitivity some soil displacement/losses could occur due to existing hazardous soil conditions including steep slopes, areas of high erodability, landslide areas, and areas of high water yield. Wherever possible, such areas should be avoided for oil and gas development. Overall there would be some soil loss/displacement and slight increases in sedimentation when land disturbances are located close to the streams. These impacts to water quality would be kept within acceptable limits with implementation of Best Management Practices and adequate mitigation measures. There would be no irreversible or irretrievable commitments of the water resources as a result of implementing any of the alternatives. There would be no irreversible or irretrievable commitment of the fisheries resource by any of the alternatives.

There would be no irreversible commitment of recreation resources (beyond those mentioned above for roadless resources) due to the implementation of any of the alternatives. Any recreation resources lost would be regained over time through mitigation in the form of road closures and revegetation. There would be no irreversible or irretrievable comment of visual resources under any of the alternatives. Any resources lost as a result of oil and gas activity would be recovered through mitigation and time.

Effects to cultural and paleontological resources would be irreversible because the resources are nonrenewable and once destroyed, they cannot be recovered; however, no irreversible or irretrievable commitments are expected under any alternative.

The relatively small acreage, associated with oil and gas exploration and development is not expected to reduce the annual allowable timber harvest. The disturbance of these acres, even though considered long-term, would not be irreversible or irretrievable commitment of resource, since they could be returned to timber production when oil and gas activities are abandoned.

Once a lease is issued the opportunity to deny access is irreversible for the life of the lease or the life of the producing field. However, if the decision is made to issue no lease or lease with No Surface Occupancy, thus prohibiting access to the minerals, that decision is reversible at some future time. Once the oil and gas has been extracted it is not replaceable.

## **UNAVOIDABLE ENVIRONMENTAL EFFECTS**

Potential adverse impacts to wildlife are minimal under SLT (Alternative 4) and TL (Proposed Action and Alternative 3) stipulations. Construction activity within habitat for critical periods for big game would be avoided with TL stipulations and delayed action of up to 60 days under SLT. There would be some unavoidable loss of habitat if a field development occurs with identified big game ranges (wintering or calving/fawning) under SLT or TL stipulations. With the implementation of lease stipulations, impacts to big game would be reduced and would not be considered significant.

Not leasing of federal minerals (Alternative 1) or leases with the NSO stipulation (Alternative 2) would avoid impacts to old growth forests (mature stands). The CSU stipulation of the Proposed Action and Alternative



3 could potentially result in unavoidable adverse impacts if construction of facilities or roads requires the cleaning of old growth stands. Standard Lease Terms, as in Alternative 4, would result in unavoidable loss of old growth forests (mature stands) and designated old growth stands.

There would be unavoidable adverse impacts to roadless resources by implementing Alternatives 3 or 4. There would be the potential of directly impacting up to approximately 730 acres (317 net) under these alternatives. The total acres indirectly effected would be more, but they cannot be determined until a well location(s) is proposed.

There would be no net loss of jurisdictional wetlands. Impacts would be offset by enhancement or replacement as defined by Section 404. Therefore, unavoidable adverse impacts to wetlands would be minor.

Unavoidable adverse environmental impacts would not occur to riparian areas. Some riparian areas which are coincidental with wetlands are protected. Stipulations provide protection to riparian areas in all alternatives except Alternative 4, which if implemented could cause unavoidable environmental effects to riparian areas which are forty acres in size. Roads and pipelines which must cross riparian areas would include mitigation to avoid significant environmental effects.

Any disturbance to unstable land surfaces and sensitive soils would result in adverse effects that cannot be avoided. Significant unavoidable impacts would be highest in areas of limited reclamation potential. Sensitive reclamation areas would require more intensive construction design, mechanical erosion control measures, and revegetation practices in order to minimize impacts.

Some small soil displacement/losses would occur prior to implementation of reclamation measures during the construction phase if unforeseen adverse climatic conditions occur prior to or during reclamation efforts. In addition, some of the sensitive areas may require follow-up reclamation until stabilized.

Because the importance of prehistoric archaeological sites lies principally in their information potential, the effects of development on such sites can be largely, if not entirely, mitigated by retrieving the information from the sites by professional study and excavation. Although mitigative archaeological research cannot completely retrieve all data from affected sites, archaeologists routinely accept representative samples as adequate for research purposes, and the residual losses are unlikely to be determined to be adverse effects.

Historic sites and traditional cultural properties also may be important for their information potential, but in addition, they can qualify for listing on the National Register of Historic Places for other reasons. Because adverse effects to such properties cannot normally be mitigated entirely through data recovery, effects to historic resources and traditional cultural properties might result in some residual adverse effects. Negotiations including Memorandums of Agreement regarding measures to ameliorate such effects, as part of Section 106 consultations, are designed to minimize such residual effects.

There would be no significant unavoidable environmental impacts related to socioeconomics, geology, or mineral resources under any of the alternatives.

## **RELATIONSHIP BETWEEN SHORT-TERM USE AND LONG-TERM PRODUCTIVITY**

Short-term impacts could potentially impact the long-term productivity of some wildlife species. The proximity and density of surface disturbance and the near continuous potential for human harassment associated with oil-field development could result in long-term impacts on productivity of big game and



nongame populations. Stipulations (i.e., TL) that prevent construction during critical periods in the life cycle of big game (wintering and calving/fawning) would reduce the potential for long-term impacts to an insignificant level. There is the potential for impacts to long-term productivity as a result of Alternative 4.

Short-term impacts to old growth include sedimentation and increased erosion due to construction activities. Clearing of old growth forest would result in potential loss of community structure (strata) and species composition. This would potentially reduce long-term productivity associated with old growth forest and reduce opportunities for biological diversity. This reduced long-term productivity has the greatest potential under Alternative 4 and could occur to a lesser degree under the Proposed Action and Alternative 3.

Short-term impacts would potentially impact the long-term productivity of roadless resources under Alternatives 3 and 4. Road construction and surface disturbance associated with oil and gas activities under these alternatives would reduce the amount of roadless resource present in the Dixie National Forest.

Short-term effects for all alternatives, except Alternative 1, include water quality deterioration caused by sedimentation during initial construction activities. Long-term effects and loss of productivity would occur when vegetation is cleared for roads, well pads, other ancillary facilities, and if existing drainage patterns are changed by cut-and-fill.

In implementing the Proposed Action, short-term use is equated with exploration activities that would affect approximately 718 gross acres (284 net) of vegetation on the Dixie National Forest. For Alternatives 1 or 2, short-term use would affect 156 gross acres (69 net) and 317 gross acres (157 net) of vegetation on the Dixie National Forest, respectively. For Alternatives 3 or 4, short-term use would affect 733 gross acres (291 net) of vegetation on the Dixie National Forest.

Depending on the severity of the disturbance while implementing Alternative 4, vegetation production could be re-established in three to five years, although a longer period is required to re-establish habitat similar to predisturbance conditions. Development and production of a field is considered a long-term effect ranging in duration from 12 to 35 years. A concerted reclamation effort would be required to re-establish vegetation productivity and the habitat.

Short-term effects for all alternatives include soil removal for exploratory well pad operations and temporary road access. The soils should be stockpiled for replacement at the time of site restoration. Successful reclamation should restore the long-term productivity of these sites. Short-term use in areas with limited reclamation potential may result in a decreased or loss of long-term productivity. In such areas, where avoidance is not possible, site-specific reclamation plans should be prepared in order to maximize the probability of successful reclamation.

Activation or reactivation of unstable areas could result in long-term point-source pollution through mass movement exposure for all alternatives. Such areas should be avoided.

Soils and land surface disturbances for development fields may be long-term (from 12 to 35 years), particularly if access roads are used for more than one well pad or for other multiple uses. In such cases, long-term productivity would likely decrease and possibly be lost in areas of direct disturbance. This would be the case for all alternatives.

Cultural resources are nonrenewable. Those destroyed or removed during the construction of oil and gas facilities would be lost forever. Information retrieved through mitigation measures would represent short-term use of those cultural resources. However, this short-term use would forego future research opportunities that might benefit from improved research methods and techniques.



Short-term use would not adversely effect long-term use or productivity for water, recreation, visuals, geology, fisheries, transportation system, timber, range, or administrative sites and special areas.

## **POTENTIAL CONFLICTS WITH PLANS AND POLICIES OF OTHER JURISDICTIONS**

There are no known conflicts with plans and policies of other jurisdictions as a result of implementing any of the alternatives.

## **EFFECTS ON SOCIAL GROUPS**

There are no differences between the alternatives regarding effects on minorities, Native Americans, women, or the civil liberties of any American citizen. Any alternative could affect consumers if oil and gas prices are kept lower or higher due to increased or decreased supplies of these items. Alternative 1 would remove all Federal minerals from future leasing. The resultant loss of revenues could affect consumers (refer to Socioeconomics section ).

## **EFFECTS OF ALTERNATIVES ON PRIME FARM LAND, RANGE LAND, AND FOREST LAND**

The terms "prime" range land and "prime" forest land do not apply to the study area. None of the alternatives would affect prime farm land. Under all alternatives, National Forest System lands would be managed with a sensitivity to the effects on adjacent lands.

## **EFFECTS OF ALTERNATIVES ON WETLANDS AND FLOODPLAINS**

The management of wetlands and floodplains are subject to Executive Orders 11990 and 11988, respectively. The purpose of the executive orders are to avoid to the extent possible the long and short-term adverse impacts associated with the destruction or modification of wetlands and floodplains. Development of oil and gas wells in riparian areas would cause significant effects to the water quality and aquatic habitat. With the adherence to Forest Plans standards and guidelines there should be no significant adverse effects to wetlands and floodplains.

## **EFFECTS ON THREATENED AND ENDANGERED SPECIES**

There are a number of known threatened and endangered plant or animal species within the study area. Sensitive animal species are listed in Table 3-3 (in Chapter 3) and sensitive plant species are listed in Table 3-10, Chapter 3. Surveys for sensitive species would be conducted before any site-specific ground-disturbing activities would take place.

## **EFFECTS ON CULTURAL RESOURCES**

As discussed earlier in this chapter, all alternatives would meet legal requirements for protection of, or the mitigation of impacts to, significant cultural resources. Surveys would be required before any site-specific ground-disturbing activities take place under regulation 36 CFR Part 800, and would adequately protect any cultural resources present.



## ENERGY REQUIREMENTS

There are minimal energy requirements related to determining which lands would be administratively available for oil and gas leasing and under what conditions (Lease Stipulations). Subsequent activities such as exploration and development could involve substantial expenditures of energy and would be considered at the APD or field development stage.

The more exploration and development activities, the greater the expenditures of energy. However, the energy required to implement any of the action alternatives, in terms of petroleum products, is insignificant considering national and world-wide petroleum resources. If a productive well is encountered, it would produce far more petroleum than used in exploration and development by any single alternative.



## **CHAPTER 5**

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### ***CONSULTATION AND COORDINATION***







## CHAPTER 5 - CONSULTATION AND COORDINATION

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### INTRODUCTION

The Forest Service and the Bureau of Land Management (BLM) are conducting an environmental analysis with intent of identifying Federal lands with Federal mineral rights that are available and suitable for issuance of leases for potential oil and gas exploration, development, and production on the Dixie National Forest. In accordance with the National Environmental Policy Act of 1969 (NEPA), the Forest Service, as custodian of surface uses on national Forest System lands, in coordination with the BLM, manager of Federal subsurface minerals (including oil and gas), are responsible for identifying and assessing potentially significant environmental impacts and addressing issues associated with oil and gas leasing activities and subsequent exploration and development.

### NOTICE OF INTENT

In accordance with CEQ regulation 40 CFR 1508.22, a Notice of Intent (NOI) to prepare an EIS, initiating the 30-day scoping period, was published in the Federal Register on April 23, 1993. A scoping document in the form of a newsletter was sent to 210 parties on the project mailing list on April 26, 1993. The purpose of the newsletter was to inform the public of Forest Service and BLM's intent to conduct an environmental analysis and solicit public comments to identify specific issues that should be addressed during the analysis and documented in the EIS. The newsletter also contained information about the purpose and need of the project, an overview of how oil and gas leases are developed on National Forests, a description of the project including a general map of the area, a description of ensuing environmental studies, and a request for public comments. At the request of the Southern Utah Wilderness Alliance an amendment to the NOI which extended the preliminary scoping period from June 1, 1993 to June 21, 1993 was published in the Federal Register on May 18, 1993. Postcards were sent to all names on the mailing list notifying them of the change in the scoping time period.

### PUBLIC AND AGENCY SCOPING PROCESS

Soliciting comments from various federal, state, county, and local agencies as well as interested organizations and individuals is the first step in the EIS preparation process. The comments are used to obtain the most accurate and current environmental information and to incorporate public opinion into planning and decision making. Scoping is an information gathering process open to the public and agencies early in the course of the EIS preparation process, and is required by NEPA in CEQ regulation 40 CFR 1501.7, 1506.6 and 1508.25. The purpose of the scoping process is not only to characterize significant environmental issues that warrant study or evaluation, but also to identify issues that are not significant so that the environmental analysis and EIS will remain focused. Scoping is not a single, isolated activity, but instead an ongoing process throughout the preparation of the EIS.

The scoping process for this project consisted of early agency consultation, a public scoping meeting, and public notification to interested parties.



## Public Scoping Meetings

Two widely publicized scoping meetings were held:

<u>Date</u>	<u>Location</u>	<u>Time</u>
May 25, 1993	Cedar City, Utah Holiday Inn Aspen & Ponderosa Rooms 1575 West 200 North	7:00 PM to 9:00 PM
May 27, 1993	Salt Lake City, Utah Department of Natural Resources Building Main Conference Room 1636 West North Temple	7:00 PM to 9:00 PM

Comments were received from nine attendees at the two scoping meetings, and 35 parties provided written comment. Letters were received from the following agencies and organizations:

- Utah Association of Conservation Districts
- National Park Service, Rocky Mountain Regional Office
- Utah Division of Water Quality
- Five County Association of Governments
- USDI Fish and Wildlife Service
- Iron County
- National Parks and Conservation Association
- Rocky Mountain Oil & Gas Association
- Great Plains Resources, Inc.
- Utah Wilderness Association
- ARCO Oil and Gas Company
- Pioneer Oil & Gas
- Southern Utah Wilderness Alliance

Copies of these letters can be found in Appendix F of the Scoping Process Report (available at the Dixie National Forest).

Generally, the comments ranged widely from encouraging the Forest Service to allow oil and gas leasing and development in the entire area with application of appropriate stipulations, to the other end of the spectrum encouraging the Forest Service to allow no oil and gas leasing and development in an effort to protect and preserve the integrity of the Dixie National Forest.

A comprehensive summary of the comments received during the scoping period can be found in the Scoping Process Report (available at the Dixie National Forest). Comments were received on following categories: riparian values, soil erosion and water quality, wildlife, wild and scenic rivers, roadless areas, socioeconomic, oil and gas development, National Parks, National Monuments, Wilderness, visual resources, recreation resources, cultural resources, NEPA concerns, policy and process concerns, and general comments and concerns.

Aside from these issues and based on perception gained from the comments of project personnel, it is evident that the purpose, need, intent, and methods of the project are not clearly understood by the majority of the respondents. Many respondents did not understand the concept of staged analysis: (1) leasing and (2) later application processes. Many individuals assumed that the analysis would address specific sites



of the respondents. Many respondents did not understand the concept of staged analysis: (1) leasing and (2) later application processes. Many individuals assumed that the analysis would address specific sites to be developed (e.g., well pads and access roads). The amount and detail of data anticipated by some respondents is not in accordance with the intent of this project. Also, planning issues unrelated to the intent of this document arose.

As a result, this EIS documents the rationale for assumptions of the reasonable foreseeable development scenario (Appendix E) and describes the stages of the analysis and lease decision issuing process (Appendix D) to promote public understanding and to provide substantive support for the subsequent analysis of potential environmental consequences.

## **PUBLIC AND AGENCY REVIEW OF EIS**

Following publication of Notice of Availability in the Federal Register, distribution of the Draft EIS, and a 60-day public review period, the Forest Service will begin preparation of the Final EIS. Two formal public meetings will be held during the 60-day review period to provide the public with an opportunity to comment on the DEIS process. Oral comments received at the public meetings and written comments received prior to the close of the 60-day review period will be addressed in the Final EIS.

Following publication of a Notice of Availability in the Federal Register, distribution of the Final EIS and Record of Decision (ROD), the Forest Service will open a 45-day period for appeals on the ROD.

## **AGENCY CONSULTATION**

The agency consultation process began in mid-1993 when the Dixie National Forest announced its intent to begin studies for leasing lands for oil and gas exploration and development. Agencies were contacted by letters, meetings, and telephone by members of the ID Team and their contractors. The agencies contacted participated by providing information and data, recommending appropriate levels of detail for some of the environmental resource studies, and providing guidance on permitting requirements.

The agencies (and individuals) contacted during the EIS process include:

### **Federal**

U.S. Department of the Interior ✓

Bureau of Land Management  
(Cedar City District)  
Paul Carter, Geologist  
Gardener Daly, Archeologist

Fish and Wildlife Service  
Robert Williams, State Supervisor

Geological Survey —

National Park Service  
Michael Snyder, Associate Regional  
Director

U.S. Environmental Protection Agency

Region VIII



**State of Utah**

Department of Natural Resources

Division of Oil, Gas, Mining

Division of Wildlife Resources  
(Salt Lake City)

Catherine Quinn, Habitat Section

Wes Johnson, Wildlife Biologist

Glen Davis, Fisheries Biologist

Paul Birdseg

(Cedar City)

Pam Hill, Wildlife Biologist

Dale Hepworth, Fisheries Biologist

Bruce Bonebrake, Habitat Program  
Manager

Division of Air Quality

Division of Water Resources

**County**

Iron County

Roy Urie, Commissioner

Five County Association of Governments

Kenneth Sizemore, Director Community and Economic Development

Garfield County

Thomas Hatch, Commissioner

Kane County

Glen Martin, Commissioner

Washington County

Jerry Lewis, Commissioner

Department of Environmental Health

Division of Water Quality

Richard Denton, Manager Monitoring  
Section

Harry Judd, Environmental Studies

Natural Heritage Program

Ben Franklin, Botanist

State Historic Preservation Office

James Dykman, Archeologist

David Madsen, State Archeologist

Anasazi Village State Park

Todd Prince

The following are the significant consultations made with agencies, organizations and individuals during the preparation of this DEIS. The Bureau of Land Management (BLM) participated in the process as a cooperating agency because mineral resources on all public lands, including National Forest System lands, are managed by the BLM (refer to Appendix A).

Organization

USDI Fish and Wildlife Service

Paiute Indian Tribe of Utah

Utah State Historic Society

Utah Natural Heritage Program

USDI Fish and Wildlife Service

USDI National Park Service

USDI National Park Service

BLM Cedar City District

Person Contacted

Robert Williams

Alex O. Shepherd

James L. Dykman

Doug Stone

Robert Williams

Donald A. Falvey

Fred J. Fagergren

Paul Carter



**CHAPTER 6**

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*PREPARERS AND CONTRIBUTORS*







## CHAPTER 6 - PREPARERS AND CONTRIBUTORS

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### INTERDISCIPLINARY TEAM

<u>Name</u>	<u>Responsibility</u>
John Shochat	Project Leader & COR
Jim Bayer	Soil Scientist
Barry Burkhardt	Geologist (Wasatch-Cache National Forest)
Livia Crowley	Hydrologist
Janice Staats	Hydrologist
Dan Deiss	Forest Planner
Marian Jacklin	Archeologist
Max Molyneux	Landscape Architect
Ric Rine	Assistant Planner
Sarah Rinkevich	Mexican Spotted Owl Coordinator
Kate Grandison	Mexican Spotted Owl Coordinator
Ron Rodriguez	Wildlife Biologist
Steve Robertson	Fisheries Biologist
Brian Ferguson	Silviculturist

### DIXIE NATIONAL FOREST CONTRIBUTORS

Mark Van Every	Public Affairs Officer
Maggie Morris	GIS Coordinator
Arlean Heap	GIS Specialist
Sig Stavran	Forest Engineer
Joe Black	Civil Engineer
Ralph Rawlinson	Minerals Staff

### BUREAU OF LAND MANAGEMENT CONTRIBUTORS

Paul Carter	Geologist
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### Project Management

<u>Name</u>	<u>Responsibility</u>	<u>Education</u>	<u>Years of Experience</u>
Gregory Gault (May 1994-present)	Project Manager	B.S. Landscape Architecture	9
Neil Hunsaker (Jan. 1993-May 1994)	Project Manager Public Involvement	B.S. Landscape Architecture	32
John Everingham	Document Review	M.S. Systems Ecology B.S. Environmental Science B.A. Political Science	20

### Resource Report and EIS Section Preparation

Loren Hettinger	Wetlands, Riparian, Vegetation Resources, TES analysis,	PhD. Plant Ecology M.S. Plant Ecology B.S. Botany	15
Jeff Irvin	Water Resources (surface and ground ground water, water quality)	M.S.C.E. Water Resource Engineering M.S.C.S. Geotechnical Engineering B.S. U.S. Military Academy	15
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Linwood Smith	Wildlife & Fisheries (including TES biological evaluation, seasonal and critical habitat)	PhD. Zoology M.S. Zoology B.A. Zoology	20
Kim Otero	Wildlife & Fisheries (including TES biological evaluation, seasonal and critical habitat)	M.E.M. Environmental Management B.A. Biology	18

<u>Name</u>	<u>Responsibility</u>	<u>Education</u>	<u>Years of Experience</u>
Leslie Howell	Visual Resources, Recreation	M.S. Geography B.S. Geography	5



Neil Hunsaker	Transportation System Roadless and Wilderness Special Areas/Administrative Sites	B.S. Landscape Architecture	32
Robert Mott	Socioeconomics	M.A. Economics B.A. Economics	32
Barbara Murphy	Minerals, Geology, & Paleontology	B.A. Geology	16
Gene Rogge	Cultural Resources	PhD. Anthropology B.A. Anthropology	22
Everett Bassett	Cultural Resources	PhD. History (pending) B.A. History B.A. Biology	14
Pamela Hackley, OEA Research (subconsultant)	Soils (including steep slopes & unstable soils)		

**Technical Support**

Jeff Kosewski	Word Processing & Document Production
Bobbie Crouser	Word Processing
Kathy Manz	Word Processing







**CHAPTER 7**  
*REFERENCES*

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## CHAPTER 7 - REFERENCES

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### GENERAL

- Kilbourne, P., 1990b. Reasonable Foreseeable Development Scenario for the Environmental Impact Statement on Oil and Gas Leasing--Dixie National Forest. Report prepared by the U.S. Forest Service, Dixie National Forest, Utah.
- USDA Forest Service. 1988. Final Environmental Impact Statement for Oil & Gas Leasing in the Known Geologic Structure (KGS), Dixie National Forest, Utah.
- \_\_\_\_\_. 1993. Forest Ecosystem Management: An Ecological, Economic, and Social Assessment. Report of Forest Ecosystem Management Team. USDC NOAA and NMFS; USDI BLM, FWS, NPS; EPA. July 1993.
- \_\_\_\_\_. 1986a. Environmental Impact Statement for the Land and Resource Management Plan for the Dixie National Forest. Ogden, Utah.
- \_\_\_\_\_. 1986b. Land and Resource Management Plan for the Dixie National Forest. Ogden, Utah.

### WILDLIFE

- Anderson, D.E., O.J. Rongstad, and W.R. Mytton, 1989. Response of Nesting Red-tailed Hawks to Helicopter Overflights. *Condor* 91:296-299.
- American Ornithologist Union (AOU), 1983. Checklist of North American Birds. Prepared by the Committee on Classification and Nomenclature of the American Ornithologists' Union. Sixth Edition. Allen Press. Lawrence, KS.
- Autenreith, R., W. Molini and C. Braun, 1982. Western State Sage Grouse Committee, Sage Grouse Management Practices, Tech. Bull. No. 1. Twin Falls, ID. 42pp.
- Behle, W.H. and M.L. Perry, 1975. Utah Birds: Checklist, Seasonal and Ecological Occurrence Charts and Guides to Bird finding. Utah Museum of Natural History. Paragon Press. Salt Lake City, UT.
- Bent, A.C., 1939. Life Histories of North American Woodpeckers. Smithsonian Institute Press, U.S. National Museum Bulletin, Washington D.C., 174. 334pp.
- Brekke, E.B., 1988. Using GIS to Determine the Effects of CO<sub>2</sub> Development on Elk Calving in South Central Colorado. USDA, BLM Tech. Note 381. Denver, CO.
- Burbridge, W.R. and D.J. Neff. 1976. Coconino National Forest-Arizona Game and Fish Department Cooperative Roads-Wildlife Study. Proc. Elk-Logging-Roads Symp. Univ. of Idaho, Moscow.pp44-57.
- Burt, William H. and Richard P. Grossenheider, 1964. A Field Guide to Mammals. The Peterson Field Guide Series. Houghton Mifflin Co., Boston, MA



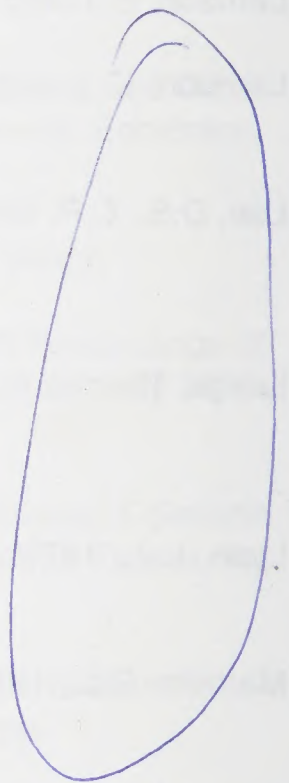
- Clark, T.W., 1987. Mammals in Wyoming. University of Kansas Museum of Natural History. Public Educations Series No. 10. University of Kansas, Lawrence,KS. 314pp.
- Collier, G.D., 1975. The Utah Prairie Dog: Abundance, Distribution, and Habitat Requirements. PhD Dissertation. Utah State University. 96pp.
- Collier, G.D. and J.J. Spillett, 1975. Factors Influencing the Distribution of the Utah Prairie Dog, *Cynomys parvidens* (Sciuridae). Southwest Nat. 20:2.
- Collier, G.D. and J.J. Spillett, 1973. The Utah Prairie Dog-Divine of a Legend. Utah Sci. 34:83-87.
- Easterla, D.A., 1973. Ecology of the 18 species of Chiroptera at Big Bend National Park, Texas. Northwest Missouri State University Studies 33.
- Federal Register, 1993. Endangered and Threatened Wildlife and Plants; Proposal to List the Southwestern Willow Flycatcher as Endangered with Critical Habitat. 50 CFR Part 17. Vol 58, No. 140 (39495-39522). Friday, July 23.
- Fyfe, R.W. and R.R. Olendorff, 1976. Minimizing the Dangers of Nesting Studies to Raptors and Other Sensitive Species. Occasional Paper No.23. Canadian Wildlife Service. Edmonton, Alberta. 17pp.
- Gabrielson, I.N. and S.G. Jewett, 1940. Birds of Oregon. Oregon State Univ. Corvallis. 650pp.
- Ganey, J.L., J.J. Johnson, R.P. Balda, and R.W. Skaggs, 1986. Mexican Spotted Owl. IN Proceedings of the Southwest Raptor Management Symposium and Workshop. 21-24 May 1986. University of Arizona. Tucson. pp145-150.
- Gill, R.B., 1965. Effects of Sagebrush Control on Distribution and Abundance of Sage Grouse. Colorado Game, Fish, and Parks Department. Fed. Aid Job Completion Report, Project No. W-37-R-17, No. 8. Ft. Collins, CO.
- Gillen, C.M. and L.L Irwin, 1985. Response of Elk to Seismograph Exploration in the Bridger-Teton National Forest, Wyoming. University of Wyoming. Laramie. 53pp.
- Hamilton, Ronald C.(comp./ed.), 1993. Characteristics of Old-Growth Forests in the Intermountain Region. USDA, Forest Service. Intermountain Region. April.
- Hayden-Wing Associates, 1990. Response of Elk to Exxon's Field Development in the Riley Ridge Area of Western Wyoming, 1979-1990. 33pp.
- Haywood, C. Lynn, Clarence Cottam, Angus M. Woodbury, and Herbert Frost, 1976. Birds of Utah. Great Basin Naturalist Memoirs No. 1. BYU. Provo, Utah.
- Hepworth, D., 1993. Personal Communication Between Dale Hepworth, Fisheries Biologist, UDWR and Kimberly Otero, Biologist, Dames & Moore.
- Hershey, T.J. and T.A. Leege, 1982. Influences of Logging on Elk on Summer Range in North-central Idaho. Proc. Elk-Logging-Roads Symp., Univ. of Idaho, Moscow. pp73-80.
- Hoffmeister, D.F., 1986. Mammals of Arizona. University of Arizona Press, Tucson, AZ. 602pp.



- Irwin, L.L. and J.M. Peek, 1983. Elk Habitat Use Relative to Forest Succession in Idaho. *J. Wildlife Mgt.* 47(3):664-672.
- Johnsgard, P.A., 199. *Hawks, Eagles, & Falcons of North America: Biology and Natural History.* Smithsonian Institute Press. Washington and London. 403pp.
- Johnson, B.K. and D. Lockman, 1980. Response of Elk Calving to Oil/Gas Drilling Activity in Snider Basin, Wyoming. District 1 Big Game Completion Reports, Piney Elk Herd. Wyoming Game and Fish Department. Cheyenne, WY. 14pp.
- Judd, H.L., 1989. Panguitch Lake Restoration Through Phosphorus Control. Division of Environmental Health, Bureau of Water Pollution Control. Grant #S008410-01-1. Salt Lake City.
- Knight, J.E., 1980. Effect of Hydrocarbon Development on Elk Movements and Distribution in Northern Michigan. PhD Dissertation, Univ. of Michigan. Ann Arbor. 79pp.
- Larrison, E.J. and D.R. Johnson, 1981. *Mammals of Idaho.* University of Idaho Press, Moscow.
- Larrison, E.J. and K.G. Sonnenberg, 1968. *Washington Birds: Their Location and Identification.* Seattle Audubon Society, Seattle, WA. 258pp.
- Lee, D.S., C.R. Gilbert, C.H. Hocutt, and R.E. Jenkins, 1980. *Atlas of North American Freshwater Fishes.* US Department of the Interior, Fish & Wildlife Service. North Carolina Biological Survey Pub. #1980-12. 867pp.
- Leege, Thomas A., 1984. Guidelines for Evaluating and Managing Summer Elk Habitat in Northern Idaho. A Cooperative Effort (USDI, BLM; Idaho Fish & Game; Univ. of Idaho; USDA, Forest Service; Plum Creek Timber Company, Inc.)
- Lyon, L.J., 1979. Influences of Logging and Weather on Elk Distribution in Western Montana. USDA, Forest Service, Res. Pap. INT-236, Ogden, UT. 11pp.
- Marcum, C.L., 1976. Habitat Selection and Use During Summer and Fall Months by a Western Montana Elk Herd. Proc. Elk-Logging-Roads Symp., Univ. of Idaho, Moscow. pp91-96.
- Marshall, D.B., 1969. Endangered Plants and Animals of Oregon. III. Birds. Agric. Exp. Stn. Spec. Rep. 278. Oregon State University, Corvallis, OR. 23pp.
- Martin, N.S., 1970. Sagebrush Control Related to Habitat and Sage Grouse Occurrence. *J. Wildlife Mgt.* Vol. 34, p. 313-320.
- Murie, O.J., 1951. *The Elk of North America.* Wildlife Mgt. Institute, Wash. D.C. and The Stackpole Co., Harrisburg, PA.
- National Geographic Society (NGS), 1985. *Field Guide to the Birds of North America.* Washington, D.C.
- Nowak, R.M. and J.L. Paradiso. *Walker's Mammals of the World.* Volumes I and II. The John Hopkins University Press. Baltimore.



- Perry, C. and R. Overly, 1976. Impacts of Roads on Big Game Distribution in Portions of the Blue Mountains of Washington. Proc. Elk-Logging-Roads Symp., Univ. of Idaho, Moscow. pp62-68.
- Player, R.L., 1980. Habitat Manipulation for the Reestablishment of the Utah Prairie Dog in Capitol Reef National Park. Master's Thesis. Utah State University, Logan. 59pp.
- Postovit, B.C. and H.R. Postovit, 1985. Assessing Impacts and Planning Mitigation. Page 16 in Raptor Res. Found. Annual Meeting 2: Abstract Only. Raptor Research Foundation, Sacramento, CA.
- Quinn, Catherine, 1991. Utah Division of Wildlife Resources, Habitat Section. Letter to Kimberly Otero, Dames & Moore, November 20.
- Ramakka, J.M., 1986. Impacts and Mitigation of Mineral Development on Raptors in the Southwest. IN Proceedings of the Southwest Raptor Management Symposium and Workshop. 21-24 May 1986. University of Arizona. Tucson. pp335-340.
- Reynolds, R.T., R.T. Graham, M.H. Reiser, R.L. Bassett, P.L. Kennedy, D.A. Boyce, G. Goodwin, R. Smith, and E.L. Fisher, 1991. Management Recommendations for the Northern Goshawk in the Southwestern United States. Prepared by the Northern Goshawk Scientific Committee. USDA, Forest Service, Southwestern Region. November 26.
- Rodriguez, R.L., 1994. Ronald Rodriguez, Forest Biologist, Dixie National Forest, Personal Communications, to Kimberly Otero, Biologist, Dames & Moore.
- Rodriguez, R.L., 1993. Ronald Rodriguez, Forest Biologist, Dixie National Forest, Personal Communications, to Kimberly Otero, Biologist, Dames & Moore.
- Rodriguez, R.L., 1993. Biological Evaluation for Sensitive Animal Species for the Tippets Valley Timber Sale. Dixie National Forest, Cedar City Ranger District. March 17.
- Rodriguez, R.L., 1993. Biological Assessment for Threatened, Endangered, and Proposed Species for the Tippets Valley Timber Sale. Dixie National Forest, Cedar City Ranger District. March 17.
- Rost, G.R. and J.A. Bailey, 1979. Distribution of Mule Deer and Elk in Relation to Roads. J. of Wildlife Mgt. 43(3):634-641.
- Ryser, F.A., Jr., 1986. Birds of the Great Basin: A Natural History. Max C. Fleischmann Series in Great Basin Natural History. University of Nevada Press, Reno. 604pp.
- Schwinn and Minden (eds.), 1979. Utah Reptile and Amphibian Latilong Distribution. UDWR. Salt Lake City.





- Skaggs, R.W., D.H. Ellis, W.G. Hunt and T.H. Johnson, No date. Peregrine Falcon. IN Proceedings of the Southwest Raptor Management Symposium and Workshop. 21-24 May 1986. University of Arizona. Tucson. pp127-136.
- Snyder, N.F.R. and H.A. Snyder, 1975. Raptors in Range Habitat. Pages 109-209 in D.R. Smith, tech. coord. Proceedings of the Symposium on Management of Forest and Range Habitats for Nongame Birds. USDA, Forest Service Gen. Tech. Rep. WO-1.
- Spahr, R., L. Armstrong, D. Atwood, and M. Rath, 1991. Threatened, Endangered, and Sensitive Species of the Intermountain Region. USFS. Ogden, UT.
- Spring, L. W., 1965. Climbing and Pecking Adaptations in some North American Woodpeckers. Condo 67(6):457-488.
- Stebbins, Robert C., 1985. A Field Guide to Western Reptiles and Amphibians. The Peterson Field Guide Series. Houghton Mifflin Co. Boston.
- Stewart, R.H., 1942. Mule Deer. New Mexico Wildlife Management, New Mexico Department of Game and Fish. Santa Fe. pp42-51.
- Trotter, P.C., 1987. Cutthroat: Native Trout of the West. Colorado Associated University Press.
- USDI Fish & Wildlife Service. 1993a. Final Rule to List the Mexican Spotted Owl as a Threatened Species. FWS. 50 CFR Part 17. Federal Register 58 (49): 14248-14271. Tuesday, March 16.
- \_\_\_\_\_. 1993b. Utah Prairie Dog Recovery Plan. Prepared by UDNR and FWS, Region 6. September 30.
- \_\_\_\_\_. 1984. American Peregrine Falcon Recovery Plan (Rocky Mountain/Southwest population). FWS. Denver, CO. 105pp.
- USDA Forest Service. 1993a. GIS Maps of Wildlife Resources. Compiled by Dixie National Forest.
- \_\_\_\_\_. 1993b. Dixie National Forest Old-Growth Management and Integration. Quality Improvement Team #3. 1993-1994.
- \_\_\_\_\_. 1982. Wildlife and Fish: Analysis of the Management Situation for Forest Planning. April 1982 (rev. February 1984). Wasatch-Cache National Forest.
- \_\_\_\_\_. 1979. Species List for the Dixie National Forest - Mammals, Birds, Reptiles and Amphibians. Xerox Handout from USFS. Cedar City.
- \_\_\_\_\_. 1977. Elk Habitat Coordinating Guidelines for Northern Idaho. Id. Panhandle National Forests. Coeur D'Alene. 66pp.
- Utah Division of Wildlife Resources. 1993a. GIS Print-outs of Wildlife Habitat on the Dixie National Forest.
- \_\_\_\_\_. 1993b. Native Utah Wildlife Species of Special Concern. DRAFT. Salt Lake City.
- \_\_\_\_\_. 1993c. Classification of Utah's Wildlife Habitats. Salt Lake City.



- \_\_\_\_\_. 1993d. Native Cutthroat Trout Management Plan. DRAFT. Utah Department of Natural Resources. January.
- Ward, A.L., 1985. Displacement of Elk Related to Seismograph Activity in South-central Wyoming. IN Issues and Technology in the Management of Impacted Western Wildlife. Thorne Ecological Institute. Boulder, CO. p. 246-254.
- Ward, A.L., 1973. Elk Behavior in Relation to Multiple Uses on the Medicine Bow National Forest. Proceedings Western Association of State Game and Fish Commissioners. 43:125-141.
- Watkins, L.C., 1977. *Euderma Maculatum*. Mammalian Series No.77. 4pp.
- White, C.M. and T.L. Thurow, 1985. Reproduction of Ferruginous Hawks Exposed to Controlled Disturbance. Condor 87:14-22.
- Williams, Richard, 1991. Supervisor's Office, Wasatch-Cache National Forest. Personal Communication to Kimberly Otero, Dames & Moore. October 17.
- Wright-Smith, M.A., 1978. The Ecology and Social Organization of *Cynomys parvidens* (Utah prairie dog) in south central Utah. M.s. Thesis. Utah State University, Logan. 59pp.
- Zeveloff, S.I. and F.R. Collett, 1988. Mammals of the Intermountain West. University of Utah Press. Salt Lake City.

## **WILDERNESS and ROADLESS**

- USDA Forest Service. 1986c. Pine Valley Mountain Wilderness Interim Management Plan - Pine Valley Ranger District, Dixie National Forest, Cedar City, Utah, Approved September 8, 1986.
- \_\_\_\_\_. 1986d. The Box-Death Hollow Wilderness Interim Management Plan, - Escalante Ranger District, Dixie National Forest, Cedar City, Utah, Approved November 25, 1986.
- \_\_\_\_\_. 1986e. Ashdown Gorge Wilderness Interim Management Plan, - Cedar City Ranger District, Dixie National Forest, Cedar City, Utah, Approved September 8, 1986.
- \_\_\_\_\_. 1993. Max E. Molyneaux, Forest Landscape Architect - Personal communications.

## **VEGETATION**

- Cowardin, L.M., V. Carter, F.C. Golet, and E.T. LaRoe, 1979. Classification of wetlands and deepwater habitats of the United States. FWS/OBS-79/31, U.S. Fish and Wildlife Service, Washington, D.C.
- USDA Forest Service. 1993. Characteristics of Old-Growth Forests in The Intermountain Region. Ogden, Utah



## WATER RESOURCES

- Carter, Paul, 1993. Geologist, BLM Cedar City District. Groundwater Hydrology/Subsurface Impacts on the Dixie National Forest
- Freethy, Geoffrey, 1993. Maps showing recharge areas and quality of ground water for the Navajo Aquifer, western Washington County, Utah, USGS WRI 92-4160.
- Gellis, Allen, Richard Hereford, S.A. Schumm, B.R. Hayes, 1990. Channel Evolution and Hydrologic Variations in the Colorado River Basin: Factors Influencing Sediment and Salt Loads. *Journal of Hydrology*, 124(1991) 317-344.
- Graf, Julia B., Robert H. Webb, Richard Hereford, 1991. Relation of Sediment Load and Flood-Plain Formation to Climatic Variability, Paria River Drainage Basin, Utah and Arizona. *Geological Society of America Bulletin*, v.103, p.1405-1415, ii figs., November 1991.
- Meier, Marvin C., 1968. Geology and Ground Water Relationships on the High Plateaus Area of the Dixie National Forest, March, 1968.
- Mundorff, J.C., 1971. Nonthermal Springs of Utah. Utah Geological and Mineralogical Survey affiliated with The College of Mines and Minerals Industries, University of Utah, Salt Lake City, Utah.
- Price, Don and Ted Arnow, 1974. Summary Appraisals of the Nations Ground-Water Resources-Upper Colorado Region, Geological Survey Professional Paper 813-C.
- Spangler, Freethy, and Green, 1993. Physical Extent, Recharge Areas, Relative Potential for Recharge and Contamination, and Quality of Water in the Principal Aquifers, Western Kane County, Utah USGS WRI 92-4070.
- State of Utah Water Quality Assessment for 1992. [Section 305 (b) Report] Division of Water Quality, Department of Environmental Quality.
- Todd, H.L., no date, Panguitch Lake Restoration Through Phosphorus Control.
- State of Utah. August 1990a. Virgin River Basin - Utah, Cooperative Study, Soil Erosion, Sedimentation and Flooding; United States Department of Agriculture, Soil Conservation Service and Utah Department of Natural Resources, Division of Water Resources.
- State of Utah. August 1990b. Virgin River Basin - Utah, Cooperative Study, Soil Water Supply; United States Department of Agriculture, Soil Conservation Service and Utah Department of Natural Resources, Division of Water Resources.
- USDA Forest Service. 1992. 5-Year Monitoring Technical Report for Dixie National Forest.
- Utah Division of Water Resources. 1991. Water Resources Data, Utah, Water Year 1991. U.S. Geological Survey Water-Data Report UT-91-1, prepared in Cooperation with the State of Utah and With Other Agencies.



- \_\_\_\_. 1976. Comprehensive Water Planning Program, Hydrologic Inventory of the Escalante River Basin, Utah
- \_\_\_\_. 1983. Utah Division of Water Resources - Comprehensive Water Planning Program, Hydrologic Inventory of the Virgin and Kanab Study Units.

Utah Department of Health. April 1982. Division of Environmental Health, Bureau of Water Pollution Control, State of Utah Clean Lakes Inventory and Classification.

Wilson, M.T., H.E. Thomas, Jeffrey L. Brown, 1992. Utah Climate. Published by Utah Climate Center, Utah State University, Logan, Utah 84322-4825

## SOILS

- Baver, L.D., W.H. Gardner, and W.R. Gardner, 1972. Soil Physics. John Wiley and Sons, Inc. New York. 498 pp.
- Bayer, J., Soil Scientist for the USDA, Forest Service, Dixie National Forest. Cedar City, Utah. Personal Communications, June 1993-March 1994.
- Blauer, A.C., E.D. McArthur, R. Stevens, and S.D. Nelson, 1993. Evaluation of roadside stabilization and beautification plantings in south-central Utah. USDA, FS Intermountain Research Station. Research Paper INT-462. Ogden, Utah. 65 pp.
- Brady, N.C., 1974. The Nature and Properties of Soils. MacMillan Publishing Co. New York. 637 pp.
- Christensen, M. and M.F. Allen, 1980. Effect of VA mycorrhizae on water stress tolerance and hormone balance in native western plant species. Final report submitted to the Industrial Fund of the Rocky Mountain Institute of Energy and Environment, College of Engineering, College of Arts and Sciences, University of Wyoming, Laramie, WY.
- Harley, J. L., 1969. The Biology of Mycorrhiza. Leonard Hill, London. 334 pp.
- Malloch, D.W., K.A. Pirozynski, and P.H. Raven, 1980. Ecological and evolutionary significance of mycorrhizal symbiosis in vascular plants. Proceedings: National Academy of Sciences (USA) 77: 2113-2118.
- Miller, R.M., and R.E. Cameron, 1976. Some effects on soil microbiota of topsoil storage during surface mining. in: Fourth Symposium on Surface Mining Reclamation, Conference and Exposition. II. Louisville, KY. pp. 184-200.
- Murphy, B., 1993. Geology and Minerals Background Report for Oil and Gas Leasing EIS, USDA, Forest Service, Dixie National Forest. Dames & Moore, Inc. Phoenix, Arizona. 34 pp. with appendices.
- Reeves, F.B., D. Wagner, T. Moorman, and J. Kiel, 1979. The role of endomycorrhizae in revegetation practices in the semi-arid west: I. A comparison of incidence of mycorrhizae in severely disturbed v.s. natural environments. American Journal of Botany. 66(1): 6-13.



- Schaller, F.W. and P. Sutton, 1978. Reclamation of Drastically Disturbed Lands. American Society of Agronomy. Madison, Wisconsin. 742 pp.
- Swenson and Bayer, 1990. Soil Survey of the Panguitch Area, Utah; parts of Garfield, Iron, Kane, and Piute Counties. USDA, Soil Conservation Service in cooperation with USDA, Forest Service, USDA, US Department of Interior, Bureau of Land Management and National Park Service; and Utah Agricultural Experiment Station. 354 pp. with maps.
- Trappe, J.M., 1981. Mycorrhizae and productivity of arid and semiarid rangelands. in: Advances in Food Producing Systems for Arid and Semiarid Lands. Academic Press, Inc., New York, New York. pp. 581-599.
- USDA Forest Service. 1993. GIS map data, Dixie National Forest Slopes >40%, Unstable lands including soils with high erosion potential, Oil and Gas potential regions. Cedar City, Utah.
- USDA Soil Conservation Service. 1983 with updates. National Soils Handbook. USGPO. Washington, D.C.

## **RECREATION**

- USDA Forest Service. 1974. Recreation Opportunity Inventory & Evaluation. Recreation and Lands Division of Natural Resource.
- \_\_\_\_\_. 1979. The Recreation Opportunity Spectrum: A Framework for Planning, Management, and Research. Pacific Northwest Forest and Range Experiment Station. General Technical Report PNW-98.
- \_\_\_\_\_. 1986. Recreation Opportunity Guide. US Government Printing Office.
- \_\_\_\_\_. 1982. ROS User's Guide. US Government Printing Office.

## **VISUAL RESOURCES**

- Fenneman, Nevin, 1931. Physiography of the Western United States. First Edition. McGraw-Hill Book Company, Inc. NY.
- USDA Forest Service. 1974. National Forest Landscape Management, Volume 2, Chapter 1, The Visual Management System. Agriculture Handbook Number 462, US Government Printing Office, Washington, D.C.

## **SOCIOECONOMICS**

- Barney, Brent, 1993. Socioeconomic Analyst, Manti-La Sal National Forest. Personal communication to Robert Mott, Socioeconomist, Dames & Moore. September 28.
- State of Utah. 1992. Economic Report to the Governor.



U.S. Department of Commerce, Bureau of Economic Analysis, REIS., 1993.

USDA Forest Service. 1992. Payments to States from Forest Service Receipts FY 1992. Intermountain Region.

\_\_\_\_. December 1992. Final Environmental Impact Statement for Oil and Gas Leasing on Lands Administered by the Manti-La Sal National Forest.

\_\_\_\_. 1992. Independent Auditors Report of General Purpose Financial Statements for Utah Counties. Intermountain Region, Ogden,

## MINERALS

Aigen, Allen A., 1981. Oil and Gas Potential, Dixie National Forest, in Billingsley, Owen F., May 1982, Analysis of the Management Situation (AMS), Dixie National Forest, Minerals Management Service, letter to Supervisor, Dixie National Forest. October 15, 1981

Baars, Donald L., 1983. The Colorado Plateau A Geologic History: University of the New Mexico Press, pages 82-84.

Bissel, Harold J., 1963. Pennsylvanian and Permian Systems of Southwestern Utah: in Guidebook to the Geology of Southwestern Utah, Intermountain Association of Petroleum Geologist, Twelfth Annual Field Conference.

Black, B. and G. Christenson, 1992. M<sub>L</sub>5.8 St. George Earthquake in Utah Geological Survey Notes. Utah Geological Survey, Vol. 25, Number 3-4.

Blackett, R.E., M.A. Shubat, D.S. Chapman, C.B. Forester, C.M. Shlinger, and C. E. Bishop, 1990. The Newcastle geothermal system, Iron County, Utah: Utah Geological and Mineral Survey Open File Report No. 189, 179 p.

Brandt, Cynthia J., 1989. Geology of Kane County, Utah (petroleum and carbon dioxide potential): Utah Geological and Mineral Survey, Bulletin 124, 115-125 pages.

Budding, K.E., and S.N. Sommer, 1986. Low-temperature geothermal assessment of the Santa Clara and Virgin River valleys, Washington County, Utah: Utah Geological and Mineral Survey Special Studies 67, 34p.

Chidsey, T. and M. Laine, 1991. Oil and Gas Drilling in Utah, 1989. Utah Geological Survey, Circulat 83.

Christenson, G. and S. Nava, 1992. Earthquake Hazards of Southwestern Utah in Engineering and Environmental Geology of Southwestern Utah. Utah Geological Association, Publication 21, p. 123-138.

Doelling, H., 1975. Geology and Mineral Resources of Garfield County, Utah. Utah Geological and Mineral Survey, Bulletin 107.

Doelling, H. and F. Davis, 1989. The Geology of Kane County, Utah. Utah Geological and Mineral Survey, Bulletin 124 and Map 121.



- Harty, Kim, 1992. Landslide Distribution and Hazards in Southwestern Utah in Engineering and Environmental Geology of Southwestern Utah. Utah Geological Association, Publication 21, p. 109-118.
- Hintze, Lehi F., 1988. Geologic History of Utah: Department of Geology, Brigham Young University, BYU Geology Studies, Special Publication 7.
- Hintze, Lehi F., 1980. Geologic Map of Utah. 1:500,000.
- Hunt, C.B., 1967. Physiography of the United States. W.H. Freeman and Co., 480 p.
- Irwin, C. Dennis, 1976. Permian and Lower Triassic Reservoir Rocks of Central Utah, in Symposium on Geology of the Cordilleran Hingeline, Rocky Mountain Association of Geologists, 1976 Symposium.
- Kiser, Clark L., 1976. Stratigraphy and Petroleum Potential of the Permian Kaibab Beta Member, East Central Utah, in Symposium on Geology of the Cordilleran Hingeline, Rocky Mountain Association of Geologists, 1976 Symposium.
- Lyons, T.R., 1983. Kaiparowits Basin-High Plateau Province, Southern Utah-Northern Arizona: unpublished report.
- Mabey, D.R. and K.E. Budding, 1987. High-temperature geothermal resources of Utah: Utah Geological and Mineral Survey Bulletin No. 123, 64p.
- Petroleum Information (PI), 1986. Oil and gas production report for Nevada and Utah: June, 1986.
- \_\_\_\_. 1984. Kaiparowits Basin, - an old frontier with new potential: Petroleum Frontiers, v. 1, p. 4-25.
- \_\_\_\_. Various dates. Information cards for wells drilled in townships in and around the Dixie National Forest (T28S to T43S and R16W to R15E SLM).
- Rauzi, Steven L., 1990. Distribution of Proterozoic Hydrocarbon Source Rock in Northern Arizona and Arizona Oil and Gas: Arizona Oil and Gas Conservation Commission, 35 pages.
- Smith, M.R., 1987a. Mineral Fuels and Associated Energy Resources. Utah Geological and Mineral Survey, MP 87-2.
- Smith, M.R., 1987b. Industrial Commodities: Non Metallic Resources of Utah. Utah Geological and Mineral Survey, MP 87-4.
- Stokes, W.L., 1986. Geology of Utah: Utah Geological and Mineralogical Survey and Utah Museum of Natural History, Occasional Paper Number 6 of the Utah Museum of Natural History.
- Stover, C.W., B.G. Reagor and S.T. Algermissen, 1986. Seismicity Map of the State of Utah. U.S. Geological Survey, Map MF-1856, 1:1,000,000.



USDA Forest Service. 1993a. Paleontological resource data in files.

\_\_\_\_. 1993b. GIS map data--Dixie National Forest.

\_\_\_\_. 1991. Map of Dixie National Forest--Pine Valley and Cedar City Ranger Districts.

\_\_\_\_. 1990. Map of Dixie National Forest--Powell, Escalante, and Teasdale Range Districts.

Utah Geological Survey (UGS), 1992. Summary of Utah Mineral Activity 1991. Survey Notes, Vol. 25, No. 3-4.

Welsh, John E. and H.J. Bissel, 1979. The Mississippian and Pennsylvanian (Carboniferous) System in the United States: USGS, Professional Paper, 1110 - Y1-Y35

## **TRANSPORTATION**

USDA Forest Service. 1992a. Personal communication, Sig Stavran, Forest Engineer, Dixie National Forest.

## **CULTURAL RESOURCES**

Aikens, C. Melvin, 1970. Hogup Cave. University of Utah Anthropological Papers No. 93. Salt Lake City.

Amsden, Charles, 1937. The Lake Mohave Artifacts. In The Archaeology of Pleistocene Lake Mohave. Southwest Museum Papers No. 11. Los Angeles.

Arrington, L.J., 1958. Great Basin Kingdom: Economic History of the Latter Day Saints, 1830-1900. Harvard University Press, Cambridge.

Bolton, H.E. (ed), 1972. Pageant in the Wilderness: The Story of the Escalante Expedition to the Interior Basin, 1776. Utah State Historical Society, Salt Lake City.

Brooks, Juanita, 1950. The Mountain Meadows Massacre. Stanford University Press, Palo Alto.

Campbell, Eugene E., 1988. Establishing Zion: The Mormon Church in the American West, 1847-1869. Signature Books, Salt Lake City.

Cline, G.G., 1974. Peter Skene Ogden and the Hudson's Bay Company. University of Oklahoma Press, Norman.

Dalley, Gardiner F., 1989. An Archaeological Research Design and Mitigation Plan for Data Recovery on the Lava Hills Exchange Tract, Washington County, Utah. Ms. on file, Bureau of Land Management, Cedar City, Utah.

Dalley, Gardiner F. and Douglas A. McFadden, 1985. The Archaeology of the Red Cliffs Site. Bureau of Land Management, Utah, Cultural Resource Series No. 17. Salt Lake City.

Davenport, Laura and Joel C. Janetski, 1983. Utah Prehistory. In Prehistoric and Historic Settlement in the Southeastern Great Basin. The MX secondary impact, edited by Richard



- Holmer. University of Utah Archaeological Center, Reports of Investigations No. 82-28. Salt Lake City.
- Hafen, LeRoy R. and Ann W. Hafen, 1954. The Old Spanish Trail. In *The Far West and Rockies Historical Series 1820-1875*. Arthur H. Clark Company, Glendale.
- Janetski, Joel C. and James D. Wilde, 1989. A Preliminary Report of Archaeological Excavations at Antelope Cave and Rock Canyon Shelter, Northern Arizona. *Utah Archaeology* 1989 2(1):88-106.
- Keller, Gordon N. and John D. Hunt, 1967. Lithic Materials from Escalante Valley, Utah. Miscellaneous Paper No. 17. University of Utah Anthropological Papers No. 89, pp. 51-59. Salt Lake City.
- Kelly, Isabel T. and Catherine S. Fowler, 1986. Southern Paiute. In *Great Basin*, edited by Warren L. D'Azevedo, pp. 368-397. *Handbook of North American Indians*, No. 11, William C. Sturtevant, general editor. Smithsonian Institution, Washington, D.C.
- Lister, Robert H., et. al., 1960. The Coombs Site Part II. University of Utah Anthropological Papers No. 41, Glen Canyon Series, No. 8. Salt Lake City
- Madsen, David B., 1982. Get It Where The Gettin's Good: A Variable Model of Great Basin Subsistence and Settlement Based on Data from the Eastern Great Basin. In *Man and Environment in the Great Basin*, SAA Papers No. 2 edited by David B. Madsen and James F. O'Connell, pp. 207-226. Society for American Archaeology, Washington, D.C.
- Bureau of Land Management, Utah, 1983. Black Rock Cave Revisited. Cultural Resource Series No. 14. Salt Lake City.
- Madsen, David B. and Michael S. Berry, 1975. A Reassessment of Northeastern Great Basin Prehistory. *American Antiquity* 40:391-405.
- Marwitt, John P., 1968. Pharo Village. University of Utah Anthropological Papers No. 91. Salt Lake City.
- Moffitt, Kathleen, Sandra Rayl, and Michael Metcalf, 1978. Archaeological Investigations along the Navajo-McCullough Transmission Line, Southern Utah and Northern Arizona. *Museum of Northern Arizona Research Paper*, 10. Flagstaff.
- Pratt, Timothy A. and Richard N. Holmer, (eds), 1983. The Intermountain Power Project Cultural Resource Survey: Intermountain-Adelanto Line 1 Right-of-way (Revised), Utah section, Dead Horse Junction to the Utah-Nevada border. Reports of Investigation No. 83-03, Archaeological Center, Department of Anthropology, University of Utah, Salt Lake City.
- Simms, Steven R., 1977. A Mid-Archaic Subsistence and Settlement Shift in the Northeastern Great Basin. In *Models and Great Basin Prehistory: A Symposium*, edited by Don D. Fowler, pp. 195-210. Desert Research Institute Publications in the Social Sciences 12. Reno.



- Simms, Steven R. and LaMar W. Lindsay, 1989. 42Md300, An Early Holocene Site in the Sevier Desert. Utah Archaeology 1989 1(1):56-66.
- Simms, Steven R. and Marilyn C. Isgreen, 1984. Archaeological Excavations in the Sevier and Escalante Deserts, Western Utah. Intermountain Power Project Transmission Line. University of Utah Archaeological Center, Reports of Investigation No. 83-12. Salt Lake City.
- Smithsonian Institution, 1986. Fremont Culture. In Great Basin, edited by Warren L. D'Azevedo, pp. 161-172. Handbook of North American Indians, Vol. 11, William C. Sturtevant, general editor. Washington, D.C.
- Snedeker, Rodney J., 1981. Cultural Resources of the Dixie National Forest. Ms. in possession of Marian Jacklin, Dixie National Forest, Cedar City, Utah.
- Stoffle, Richard W., Henry F. Dobyns, and Michael J. Evans. 1983. NUNGWU-UAKAPI: Southern Paiute Indians Comment on the Intermountain Power Project, Revised Intermountain - Adelanto Bipole I Proposal. University of Wisconsin, Parkside, Kenosha.

#### **ADMINISTRATIVE SITES AND SPECIAL AREAS**

- USDA Forest Service. 1993a. Personal communication, John Shochat, Minerals Staff, Dixie National Forest.
- \_\_\_\_\_. 1993b. Personal communication, Max Molyneux, Landscape Architect, Forest Supervisors Office, Dixie National Forest.
- \_\_\_\_\_. 1990. Research Natural Area Establishment Record, Timbered Cinder Cone Research Natural Area, Dixie National Forest, Iron County, Utah.
- \_\_\_\_\_. 1991. Research Natural Area Establishment Record, Table Cliff Research Natural Area, Dixie National Forest, Garfield County, Utah
- \_\_\_\_\_. 1987. Research Natural Area Establishment Record, Red Canyon Research Natural Area, Dixie National Forest, Garfield County, Utah



**CHAPTER 8**

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*GLOSSARY*







ACRONYMS AND ABBREVIATIONS

4WD	Four-wheel-drive vehicle
AADT	Average annual daily trips
AMS	Analysis of the Management Situation
AO	Approval Order
APD	Application for Permit to Drill
AQRVs	Air Quality Related Values
ASQ	Allowable Sale Quantity
ATV	All terrain vehicle
AUM	Animal Unit Month
BACT	Best Available Control Technology
BCI	Biological Condition Index
bg	Background
BLM	Bureau of Land Management
BMPs	Best Management Practices
BOD	Biochemical Oxygen Demand
BOP	Blowout preventer
BP	Before Present
BYU	Brigham Young University
CEQ	Council on Environmental Quality
CERCLA	Comprehensive Environmental Response, Compensation & Liability Act
CFR	Code of Federal Regulations
cfs	Cubic feet per second
COA	Conditions of Approval
CSU	Controlled Surface Use
dbh	Diameter at Breast Height
DEIS	Draft Environmental Impact Statement
EA	Environmental Assessment
eds	Editors
EIS	Environmental Impact Statement
EPA	Environmental Protection Agency
ESA	Endangered Species Act
FAN	Final Abandonment Notice
FEIS	Final Environmental Impact Statement
fg	Foreground
FLPMA	Federal Land Policy and Management Act
Forest Plan	Forest Land and Resource Management Plan
FP	Forest Plan
FR	Federal Regulation
FS	Forest Service
ft/d	Feet per day
ft <sup>3</sup> /d/ft	Cubic feet per day per foot
FWS	U.S. Fish and Wildlife Service
FY	Fiscal year
GIS	Geographic Information System



gpm	Gallons per minute
HCI	Habitat Condition Index
KGS	Know Geologic Structure
lbs/acre	Pounds per acre
LRMP	Land Resource Management Plan
Mcf	Thousand Cubic Feet
mg	Middleground
mg/l	Milligrams per liter
MIS	Management Indicator Species
NAAQS	National Ambient Air Quality Standards
NEPA	National Environmental Policy Act
NESHAP	National Emissions Standards for Hazardous Air Pollutants
NFMA	National Forest Management Act
NFMP	National Forest Management Plan
NIA	Notice of Intent to Abandon
NL	No Lease
NOI	Notice of Intent
NPDES	National Pollution Discharge Elimination System
NPS	National Park Service
NRHP	National Register of Historic Places
NSO	No Surface Occupancy
NSPS	National Standards of Performance for New Stationary Sources
NTL	Notice to Lessee(s)
OHV	Off-Highway Vehicle
ORV	Off-Road Vehicle
PSD	Prevention of Significant Deterioration of Air Quality
psi	Pounds per square inch
PUB3E	Palustrine, unconsolidated bed of mud, and seasonally saturated
PEM1F	Palustrine, emergent, persistent (upright plants), semipermanently flooded
PSD	Prevention of Significant Deterioration
RCRA	Resource Conservation and Recovery Act
R3RB2	Riverine, supper perennial, with rock bottom of boulders
RFDS	Reasonably Foreseeable Development Scenario
RN	Roaded Natural
RNA	Research Natural Areas
ROD	Record of Decision
ROS	Recreation Opportunity Spectrum
ROW	Right-of-Way
RPA	Resource Planning Act
RVD	Recreation Visitor Day
SHPO	State Historic Preservation Office
SIP	Utah State Implementation Plan
SLT	Standard Lease Terms
SPCC	Spill Containment and Contingency
SPM	Semi-primitive Motorized
SPNM	Semi-primitive Non-motorized
SRV	Subsequent Report of Abandonment
SUPO	Surface Use Plan of Operations
TCPs	Traditional Cultural Properties
TDS	Total Dissolved Solids



TES	Threatened, Endangered and Sensitive (Species)
TL	Timing Limitations
UDAQ	Utah Department of Environmental Quality, Division of Air Quality
UDES	Utah Department of Employment Security
UDNR	Utah Department of Natural Resources
UDWR	Utah Division of Wildlife Resources
UGS	Utah Geological Survey
UOPD	Utah Office of Planning and Development
USDA	U.S. Department of Agriculture
USDI	U.S. Department of Interior
USFS	U.S. Forest Service
USFWS	U.S. Fish & Wildlife Service
USGPO	U.S. Government Printing Office
USGS	U.S. Geological Survey
USLE	Universal Soil Loss Equation
UWQS	Utah Water Quality Standards
VAC	Visual Absorption Capability
VMS	Visual Management System
VQO	Visual Quality Objective
VRM	Visual Resource Management



## DEFINITIONS

Abandonment	Termination of operations for production from a well. Permanent abandonment involves plugging the well and removal of installations.
Acre Foot	The amount of water it would take to cover an acre of land to a depth of one foot.
Administrative Facilities	Those facilities, such as Ranger Stations, work centers and cabins, which are used by the Forest Service in the management of the National Forest.
Affected Environment	Surface or subsurface resources (including social and economic elements) within or adjacent to a geographic area that could potentially be affected by oil and gas activities. The environment of the area to be affected or created by the alternatives under consideration. (40 CFR 1502.15)
Air Quality Classes	Classifications established under the Prevention of Significant Deterioration portion of the Clean Air Act that limit the amount of air pollution considered significant within an area. Class I applies to areas where almost any change in air quality would be significant, Class II applies to areas where the deterioration normally accompanying moderate well-controlled growth would be permitted, and Class III applies to areas where industrial deterioration would generally be allowed.
Airshed	Basic geographic units in which air quality is managed.
Allotment	See Range Allotment.
Allotment Management Plan	The document that contains the action program needed to manage the range resource for livestock, grazing with consideration given to soil, watershed, recreation, timber, and other resources on lands within a range allotment or on a wild horse or burro territory. Allotment management plans, territory plans, and where appropriate, coordinated resource management plans identify prescriptions and practices for the management of grazing and browsing lands for livestock and wild horses and burros.
Alluvial Material	Material, transported and deposited by running water in riverbeds, lakes, alluvial fans and valleys. It includes clay, silt, sand, gravel, and mud.
Alluvial Soil	A soil developing from recently deposited alluvium and exhibiting essentially no horizon development or modification of the recently deposited materials.



Alluvium	Clay, silt, sand, gravel, or other rock materials transported by flowing water. Deposited in comparatively recent geologic time as sorted or semisorted sediment in riverbeds, estuaries, floodplains, lakes and shores, and in fans at the base of mountain slopes.
Alternative	A combination of management prescriptions applied in specific amounts and locations to achieve a desired management emphasis as expressed in goals and objectives. One of several policies, plans, or projects proposed for decision making. An alternative need, not substitute, for another in all respects.
Alternative, No Action	An alternative that maintains established trends or management direction.
Analysis Area	A delineated area of land subject to analysis of (1) responses to proposed management practices in the production, enhancement, or maintenance of forest and rangeland outputs and environmental quality objectives, and (2) economic and social impacts.
Animal Unit Month (AUM)	The amount of forage necessary to sustain one cow and one calf or its equivalent for one month.
Anticline	A fold, generally convex upward, whose core contains the stratigraphically older rocks.
Apparent Naturalness	Roadless area characteristic defined as an indicator of whether an area appears natural to most people who are using the area. It is a measure of importance of visitors' perception of human impacts to the area. There may be some human impact, but it would not be obvious to the casual observer and the area would have the appearance of being affected only by the forces of nature.
Application	A written request, petition, or offer to lease lands for the purpose of oil and gas exploration and/or the right of extraction.
Application for Permit Drill (APD)	An application to drill a well submitted by a lessee or operator to the BLM. The APD consists of a Drilling Plan that discusses downhole specifications and procedures (reviewed by the BLM) and a Surface Use Plan of Operations (SUPO) that examines surface uses, including access roads, well site layout, cut and fill diagrams, reclamation procedures, production facility locations, etc. (reviewed by the Forest Service). The approved APD is a contract between the operator and the Federal government and cannot be changed or modified unless authorized by the BLM and the Forest Service.
Aquatic Ecosystem	All organisms in a water-based community plus the associated environmental factors.



Aquifer	<ol style="list-style-type: none"> <li>1. A layer of material that contains water.</li> <li>2. The part of a water-drive reservoir that contains the aquifer.</li> </ol>
Arboreal	Of or pertaining to trees.
AUM	See Animal Unit Month.
Authorized Officer	The Forest Service employee delegated Officer given the authority to perform a duty described in these rules. Generally, a Regional Forester, Forest Supervisor, District Ranger, or Minerals Staff Officer, depending on the scope and level of the duty to be performed.
Background	One of the distance zones of a landscape being viewed. Extends from middleground to infinity. Texture is seen as groups or patterns of trees.
Basin	(A) A depressed area with no surface outlet. (B) A low in the Earth's crust of tectonic origin in which sediments have accumulated.
Best Available Control Technology purpose as (BACT)	The best available air-pollution-control technology for a given stipulated by the U.S. Environmental Protection Agency.
Best Management Practices (BMPs).	The set of practices in the Forest Plan that, when applied during implementation of a project ensures that water-related beneficial uses are protected and that State water quality standards are met. BMPs can take several forms. Some are defined by State regulation or memoranda of understanding between the Forest Service and the States. Others are defined by the Forest interdisciplinary planning team for application Forest-wide. Both of these kinds of BMPs are included in the Forest Plan as Forest-wide Standards. A third kind of BMPs is identified by the interdisciplinary team for application to specific management areas; these are included as Management Area Standards in the appropriate management areas. A fourth kind, project-level BMPs, is based on site-specific evaluation and represent the most effective and practicable means of accomplishing the water quality and other goals of the specific area involved in the project. These project level BMPs can either supplement or replace the Forest Plan standards for specific projects.
Big Game	Larger species of wildlife that are hunted, such as elk, deer, bighorn sheep, and pronghorn antelope.
Big Game Winter Range	The area available to and used by big game (large mammals normally managed for sport hunting) through the winter season.
Biological Diversity.	The diversity or numbers of species that collectively represent the living plants and animals within a local, regional, or continental landscape.



Biological Evaluation.	A documented Forest Service review of Forest Service activities in sufficient detail to determine how an action or proposed action may affect any threatened, endangered, proposed, or sensitive species.
Blowout	An uncontrolled explosion of gas, oil, or other fluids from a drilling well. A blowout or "gusher" occurs when formation pressure exceeds the pressure applied to it by the column of drilling fluid and when blowout prevention equipment is absent or fails.
Brackish Water	Water that contains relatively moderate concentrations of any soluble salts. Brackish water is saltier than fresh water, but not as salty as salt water or brine water.
Brine	Water containing relatively large concentrations of dissolved salts, particularly sodium chloride. Brine has higher salt concentrations than ordinary ocean water.
Brine Pit	An excavated pit used to hold brine produced from a well.
Browse	That part of the current leaf and twig growth of shrubs, woody vines, and trees available for animal consumption.
Buffer Zone	An area between two different land uses that is intended to resist, absorb, or otherwise preclude developments or intrusions between the two use areas.  A strip of undisturbed vegetation that retards the flow of runoff water, causing deposition of transported sediment
Bureau of Land Management	The Department of the Interior agency responsible for managing most federal-government subsurface minerals. It has surface-management responsibility for federal lands designated under the Federal Land Policy and Management Act of 1976.
Candidate Species	Any species not yet officially listed but that are undergoing a status review or are proposed for listing according to Federal Register notices published by the Secretary of the Interior or the Secretary of Commerce.
Casing	Steel pipe placed in an oil or gas well to prevent the hole from caving.
CEQ	See Council on Environmental Quality.
CFR	Code of Federal Regulations.
Christmas Tree	The control valves, pressure gauges, and chokes assembled at the top a well to control the flow of oil and gas after the well has been completed.



Cirque (geology)	Semicircular, concave, bowl-like areas that have steep faces primarily resulting from glacial ice and snow abrasion.
Class II Injection Well	A well defined by the U.S. Environmental Protection Agency, that injects fluids: <ul style="list-style-type: none"> <li>a. that have been brought to the surface in connection with oil or natural gas production (produced waters)</li> <li>b. for enhancing recovery of oil or natural gas, or</li> <li>c. for storing liquid hydrocarbons.</li> </ul>
Climax	Potential natural vegetation community, the last stage in plant succession, the stage where vegetation is in equilibrium with its environment (climate, soil, aspect, etc.), excellent ecological condition.
Closed Mud System	A drill mud system that reuses or reclaims all the drilling fluid used. Oil-based mud systems are often closed mud systems.
Closure.	The administrative order that does not allow specified uses in designated areas or on Forest development roads or trails.
Completion	The activities and methods to prepare a well for production. Includes installation of equipment for production from an oil or gas well.
Condition of Approval (COA)	Conditions or provisions (requirements) under which an Application for a Permit to Drill or a Sundry Notice is approved.
Congressionally Designated Areas	Areas established by Congressional legislation, such as National Wildernesses, National Wild and Scenic Rivers, and National Recreation Areas.
Contrast	The effect of a striking difference in the form, line, color, or texture of an area being viewed.
Controlled Surface Use (CSU)	Allowed use and occupancy (unless restricted by another stipulation) with identified resource values requiring special operational constraints that may modify the lease rights. CSU is used as an operating guideline, not as a substitute for No Surface Occupancy (NSO) or Timing Lease (TL) stipulations.
Corridor (Utility Corridor)	A linear strip of land that has ecological, technical, economic, social, or similar advantages over other areas for the present or future location of transportation or utility routes.
Council on Environmental Quality (CEQ)	An advisory council to the President established by the National Environmental Policy Act of 1969. It reviews Federal programs for their effort on the environment, conducts environmental studies, and advises the President on environmental matters.



Critical Habitat	Specific areas within the geographical area occupied by the species on which are found those physical and biological features (1) essential to the conservation of the species and (2) which may require special management considerations or protection. Critical habitat shall not include the entire geographic area which can be occupied by the threatened and endangered species.
Crucial Habitat	A biological feature that, if lost, would adversely affect the species.
Cultural Resources	Those fragile and nonrenewable remains of human activity, occupation, or endeavor reflected in districts, sites, structures, buildings, objects, artifacts, ruins, works of art, architecture, and natural features that were of importance in human events.
Cultural Resources Inventory Classes Class 1	A survey of existing data. This is an inventory of a study area to (1) provide a narrative overview of cultural resources by using existing information, and (2) compile existing cultural resources site record data on which to base the development of the Forest's site record system.
Class II	A sampling, field inventory designated to locate, from surface and exposed profile indications, all cultural resource sites within a portion of an area so that an estimate can be made of the cultural resources for the entire area.
Class III	An intensive field inventory (survey) designed to locate, from surface and exposed profile indications, all cultural resource sites in an area. Upon its completion, no further cultural resources inventory work normally is needed.
Cumulative Impact	The impact on the environment which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (federal or non-federal) or person undertakes such other actions. Cumulative impacts can result from individually minor, but collectively significant actions taking place over a period of time.
Deepen	To increase the depth of a well. Deepening is generally a workover operation carried out to produce from a deeper formation or to control excessive gas found in the upper levels of a reservoir.
Developed Recreation	Recreation that occurs at man-made developments, such as campgrounds, picnic grounds, resorts, ski areas, trailheads, etc.
Developed Recreation Sites	Relatively small, distinctly defined areas where facilities are provided for concentrated public use (i.e., campgrounds, picnic areas, and swimming areas).
Development Well	A well drilled in proven territory (usually within one mile of an existing well).



Directional Drilling	The intentional deviation of a wellbore from vertical to reach subsurface areas off to one side from the drilling site.
Distance Zone	The divisions of a landscape being viewed. Three zones are used to describe a landscape: foreground, middleground, background.
Dispersed Recreation	That portion of outdoor recreation use that occurs outside of developed sites in the unroaded and roaded Forest environment (i.e., hunting, backpacking, and berry picking).
Displacement	As applied to wildlife, forced shifts in the patterns of wildlife use, either in location or timing of use.
Disposal Well	A well into that produced water from other wells is injected into and underground formation for disposal.
District Ranger	The official responsible for administering the National Forest System lands on a Ranger District.
Diversity	(1) The relative abundance of wildlife species, plant species, communities, habitats, or habitat features per unit of area. (2) The distribution and abundance of different plant and animal communities and species within the area covered by a Land and Resource Management Plan (36 CFR Part 219.3(g)).
Drainage	The uncompensated loss of hydrocarbons from federal lands from wells on adjacent nonjurisdictional lands or jurisdictional lands with lower participation, allocation, royalty rate, or distribution of funds, resulting in revenue losses to the federal lessor.
Drill Pipe	The heavy seamless tubing used to rotate the drill bit and circulate the drilling fluid. The standard drill pipe section is 30 feet long (a joint).
Drill Rig	The mast, drawworks, and attendant surface equipment of a drilling or workover unit.
Dry Hole	Any well incapable of producing oil or gas in commercial quantities. A dry hole may produce water, gas, or even oil, but not enough to justify production.
Duration	The length of time management activity and its impacts will be taking place.
Ecogroup	Ecosystems grouped on the basis of capabilities for the type of land uses that occur.
Ecosystem	All organisms in a community plus the associated environmental factors.
Effects (also see Impacts)	



Direct Effects	Caused by the action and occur at the same time and place.
Indirect Effects	Caused by the action later in time or farther removed in distance, but still reasonably foreseeable. Indirect effects may include growth inducing effects and other effects related to induced changes in the pattern of land use, population density or growth-rate, and related effects on air and water and other natural systems, including ecosystems.
Elevated Flares	The use of piping and a burn stack to elevate the flare that burns unusable petroleum vapors. Elevated flares may include an ignitor to ensure continuous burning or an incinerator where gas is added to ensure complete combustion of petroleum products.
Endangered Plants	Any plant species in danger of extinction through all or a significant portion of its range.
Endangered Species	Any species in danger of extinction throughout all or a significant portion of its range. Identified by DWR or U.S. Fish and Wildlife Service.
Enhanced Recovery	The use of artificial means to increase the amount of hydrocarbons that can be recovered from a reservoir. A reservoir depleted by normal extraction practices usually can be restored by secondary or tertiary methods of enhanced recovery.
Enhancement	A short-term visual resource management objective aimed at increasing positive visual variety where little variety now exists.
Environmental Analysis	An analysis of alternative actions and their predictable short and long-term environmental effects that include physical, biological, economic, social, and environmental design factors and their interactions.
Environmental Assessment (EA)	A concise public document prepared to provide sufficient evidence and analysis for determining whether to prepare an environmental impact statement or a finding of no significant impact. It includes a brief discussion of the need for the proposal, alternatives considered, environmental impact of the proposed action and alternatives, and a list of agencies and individuals consulted.
Environmental Impact	A formal public document prepared to Statement (EIS) analyze the impacts on the environment of the proposed project or action and released for comment and review. An EIS must meet the requirements of NEPA, CEQ guidelines, and directives of the agency responsible for the proposed project or action.
Environmental Impact Statement, Draft	A detailed written statement as required by Section 102(2)(c) National Environmental Policy Act (NEPA).
Environmental Impact Statement,	The final version of the public document required by NEPA (see



Final	FEIS above).
Erosion	(1) The wearing away of the land surface by running water, wind, ice, or other geological agents, including such processes as gravitational creep. (2) Detachment and movement of soil or rock fragments by water, wind, ice, or gravity.
Erosion Hazard	The probability of soil loss resulting from complete removal of vegetation and litter. It is an interpretation based on potential soil loss in relation to tolerance values. Soil loss tolerance rate: an estimate of erosion that could occur over a short period of time (one year) without causing irreparable damage to the long-term productivity of the soil.
Ratings:	
Slight	Potential soil loss rates do not exceed tolerance soil loss. Loss in soil production potential from erosion is of low probability.
Moderate	Potential soil loss rates exceed tolerance soil loss. Loss in soil production potential from erosion is probable and significant if unmitigated. On-site investigation by watershed specialists may be needed for activities on such areas.
Severe	Potential soil loss rates exceed tolerance soil loss. Loss in soil production potential from erosion is inevitable and irreversible if unmitigated. These soils may require expensive measures to control erosion and sedimentation when activities are planned for such areas. On-site investigation by watershed specialists is highly recommended.
Existence Area: A	A use area where the documented occurrence on a regular basis for any species of "high interest wildlife" can be shown. These areas have lower intensity of use than "intensive use areas".
Exotic	Foreign, not native.
Facies	The aspect, appearance, and characteristics of a rock unit, usually reflecting the conditions of its origin; especially as differentiating the unit from adjacent or associated units.
Federal Land Policy Management Act of 1976 (FLPMA)	Public Law 94-579 signed by the President on October 21, and 1976. Established public land policy for management lands administered by the Bureau of Land Management (BLM). FLPMA specifies several key directions for the BLM, notably (1) management on the basis of multiple-use and sustained yield, (2) land use plans prepared to guide management actions, (3) public lands for the protection, development, and enhancement of resources, (4) public lands retained in federal ownership, and (5) public participation used in reaching management decisions.



Fines	A ground or powdered substance, as ore; a collection of minute particles of different sizes.
Flare	The piping and burners used to dispose (by burning) of unusable vapors from a well or collection plant.
Floodplain	The lowland and relatively flat area adjoining inland waters, including at a minimum, that area subject to a one percent or greater chance of flooding in any given year.
Fold	A curve or bend of a planar structure such as rock strata, bedding planes, foliation, or cleavage. A fold is usually a product of deformation, although its definition is descriptive and not genetic and may include primary structures.
Forage	All browse and herbaceous foods that are available to grazing animals.
Foreground	One of the distant zones of a landscape being viewed. Distance at that details can be perceived, normally within .25 to .5 mile of the viewer. Must be determined on a case by case basis.
Foreground View	The landscape area visible to an observer in the near view.
Forest Management	The application of business methods and technical forestry principles to the operation of a forest property.
Forest Service (FS)	The agency of the United States Department of Agriculture responsible for managing National Forests and Grasslands under the Multiple Use and Sustained Yield Act of 1960.
Form	The mass of an object or objects that appear unified.
Formation	A body of rock identified by lithic characteristics and stratigraphic position; it is prevailingly, but not necessarily tabular, and is mappable at the earth's surface or traceable in the subsurface (NACSN, 2984, Art.24).
Fossil	The remains or traces of an organism or assemblage of organisms that have been preserved by natural processes in the earth's crust exclusive of organisms that have been buried since the beginning of historical time. Minerals, such as oil and gas, coal, oil shale, bitumen, lignite, asphaltum, and tar sands, phosphate, limestone, diatomaceous earth, uranium and vanadium, while they may be of biologic origin, are not here considered "fossils". Fossils of scientific value may occur within or in association with such materials.
Fracture Treatment	A method of stimulating well production by increasing the permeability of the producing formation. Under extremely high hydraulic pressure, the fracturing fluid (water, oil, dilute



hydrochloric acid, or other fluid) is pumped into the formation and parts or fractures it. Proppants or propping agents such as sand or glass beads are pumped into the formation as part of the fracturing job. The proppants become wedged in the opened fractures, leaving channels for oil to flow into the well after the hydraulic fracture pressure is released. This process is often called a "frac job". When high concentrations of acid are used, it may be called an "acid-frac job".

Fragile Soil

A soil that is especially vulnerable to erosion or deterioration due to its physical characteristics and/or location. Disturbance to the surface or the vegetative cover can initiate a rapid cycle of loss and destruction of the soil material, structure, and ability to sustain a biotic community.

Game Species

Any species of wildlife or fish for that seasons and bag limits have been prescribed, and that are normally harvested by hunters, trappers, and fishermen under state or federal laws, codes, and regulations.

Grazing Allotment

See Range Allotment.

Glacial Till

Unsorted, nonstratified glacial drift consisting of soil material and boulders transported and deposited by glacial ice.

Habitat

A specific set of physical conditions that surround a single species, a group of species, or a large community. In wildlife management, the major components of habitat are considered to be food, water, cover, and living space.

Habitat Type

An aggregation of all land areas potentially capable of producing similar plant communities at climax.

Habitat Type Group

A logical grouping of habitat types to facilitate resource planning and public presentations.

Hiding Cover

Trees of sufficient size and density to conceal animals from view at 300 feet.

High Interest Wildlife

All wildlife species classified as game species, any economically important species (from either a consumptive or non-consumptive perspective) and any species of special aesthetic, scientific, or education significance, which may include all protected wildlife. It should be noted that threatened and endangered wildlife species are not included as high interest wildlife.

High Seral

The last seral stage before a vegetation community becomes climax; good ecological condition.

High Value Habitat

High value habitats are "intensive use areas" for one or more species of historic or existing "high interest wildlife".



Highly Sensitive Habitats	Habitats existing on fragile soils that are limited in development due to climatical conditions. Generally speaking, these habitat areas are relatively low in diversity of species for flora or fauna and biological productivity.
Human Environment	The factors that include, but are not limited to biological, physical, social, economic, cultural, and aesthetic factors that interrelate to form the environment.
Hydrocarbon	Any organic compound, gaseous, liquid, or solid, consisting solely of carbon and hydrogen.
Impact (See Effects)	The effect, influence, alteration, or imprint caused by an action.
Indicator Species	A species of animal or plant whose presence is a fairly certain indication of a particular set of environmental conditions. Indicator species serve to show the effects of development actions on the environment.
Indirect Effects	Secondary effects that occur in locations other than the initial action or significantly later in time.
Injection Well	A well used to inject fluids into an underground formation to increase reservoir pressure.
Intensive Grazing	Grazing management that controls distribution of cattle and duration of use on the range, usually by fences, so parts of the range are rested during the growing season.
Intensive Use Areas	A seasonal use area for one or more species of "high interest wildlife" that does not represent a critical requirement in an individual animal's life cycle or a biologically critical area for a wildlife population. Examples are normal and severe big game winter ranges; important feeding areas for avifauna; areas of high animal diversity and/or high animal density (Note: Areas that annually experience concentration of wildlife use by one or more species are defined as "sensitive use areas") and any other area that shows intensive biological use by "high interest wildlife."
Invertebrate	An animal lacking a spinal column.
Key Wildlife Area	Any area that is critical to wildlife during at least a portion of the year. This importance may be due to vegetative characteristics such as residual nesting cover, or behavioral aspects of the animals such as lambing areas. Key areas include: winter ranges, lambing/fawning/calving areas, dancing/strutting grounds, nesting areas, breeding grounds, elk wallows, riparian and woody draws, and roosting areas.



Land Exchange	The conveyance of non-federal land or interests to the United States in exchange for National Forest System land or interests in land.
Land Treatment	All methods of artificial range improvement and soil stabilization such as reseeded, brush control (chemical and mechanical), pitting, furrowing, water spreading, etc.
Landscape Character Type	The arrangement of a particular landscape as formed by the variety and intensity of the landscape features and the four basic elements of form, line, color, and texture. These factors give the area a distinct quality which distinguishes it from immediate surroundings.
Leasable Minerals.	Minerals acquired only by lease and include oil, gas, oil shale, sodium, potassium, phosphate, native asphalt, solid and semi-solid bitumin, and deposits of sulfur (Cummins and Given 1973).
Lease	1 A legal document that conveys to an operator the right to drill for oil and gas. 2 The tract of land on that a lease has been obtained, where producing wells and production equipment are located.
Lease Stipulations	Additional specific terms and conditions that change the manner in that operation may be conducted on a lease, or modify the lease rights granted.
Limited Value Habitat	Limited value areas are "occasional use areas" for one or more species of existing "high interest wildlife".
Locateable Minerals.	Valuable mineral deposits that include precious metals, base metals, refractory metals (White 1990) and by special enactment building stone and saline deposits (Cummins and Given 1973).
Long-Term	Describes impacts that would occur over a 20-year period.
Low Seral	The earliest stage of plant succession; very poor ecological condition; the stage where pioneer plants inhabit a community.
Manageability/Boundaries	Relates to the ability of the Forest Service to manage an area to meet the size criteria for wilderness consideration (at least 5,000 acres).
Management Area	An area with similar management objectives and a common management prescription.
Management Direction	A statement of multiple use, other goals, and objectives; and associated management prescriptions, standards, and guidelines for attaining them (36 CFR Part 219.3).



Management Indicator Species	Those wildlife species selected in the planning process to monitor the effects of planned management activities of viable populations of all wildlife and fish species including those species that are socially or economically important.
Mass Wasting.	General term for a variety of processes by which large masses of earth material are moved by gravity either slowly or quickly from one place to another (Trowbridge 1962).
Mid Seral	The middle stage of plant succession; average ecological condition.
Middleground	One of the distance zones of a landscape being viewed. This zone extends from the limit of the foreground to three to five miles from the observer. Texture is characterized by masses of trees.
Mineral Rights	<p>Mineral rights outstanding are third party rights, an interest in minerals not owned by the person or party conveying the land to the United States. It is an exception in the deed which is the result of a prior conveyance separating title of certain minerals from the surface estate.</p> <p>Reserved mineral rights are the retention of ownership of all or part of the mineral rights by a person or party conveying land to the United States. Conditions for the exercising of these rights have been defined in the Secretary's "Rules and Regulations to Govern Exercising of Mineral Rights Reserved in Conveyance to the United States" attached to and made a part of deeds reserving mineral rights.</p>
Mitigation	<p>Includes:</p> <ul style="list-style-type: none"> <li>(a) Avoiding the impact altogether by not taking a certain action or parts of an action.</li> <li>(b) Minimizing impacts by limiting the degree of magnitude of the action and its implementation.</li> <li>(c) Rectifying the impact of repairing, rehabilitating, or restoring the affected environment.</li> <li>(d) Reducing or eliminating the impact over time by preservation and maintenance operations during the life of the action.</li> <li>(e) Compensating for the impact by replacing or providing substitute resources or environments.</li> </ul>
Moderately Sensitive Habitats	Habitats existing on moderate or well-developed soils. Generally speaking, these habitats are moderate to high in diversity of species for flora and fauna and biological productivity.
Modification (VQO)	See Visual Quality Objective (VQO)



Multiple-use	Management of the surface and subsurface resources so that they are jointly used in the manner that will best meet the present and future needs of the public without permanent impairment of the productivity of the land or the quality of the environment.
National Environmental Act of 1969 (NEPA)	Public Law 91-190. Establishes environmental policy for the Policy nation. Among other items, NEPA requires federal agencies to consider environmental values in decision-making processes.
National Forest Management Act (NFMP)	A law passed in 1976 as amendments to the Forest and Rangeland Renewable Resources Planning Act that requires the preparation of Regional and Forest plans and the preparation of regulations to guide that development.
National Forest System	All National Forest System lands reserved or withdrawn from the public domain of the United States; all National Forest System lands acquired through purchase, exchange, donation, or other means the National Grasslands and land use projects administered under Title III of the Bankhead-Jones Farm Tenant Act (7 U.S.C. 1010 et seq.); and other lands, waters, or interests therein which are administered by the Forest Service or are designated for administration through the Forest Service as a part of the system (16 U.S.C. 1609).
National Register of Historic Places (NRHP)	A listing of architectural, historical, archaeological, and cultural sites of local, state, or national significance, established by the Historic Preservation Act of 1966 and maintained by the National Park Service.
Natural Integrity	Roadless area characteristic defined as the extent to which long-term ecological processes are intact and operating. Impacts to natural integrity are measured by the presence and magnitude of human-induced change to an area. This change includes physical developments as well as activity in the area.
No Action Alternative	No decision would be made and no leases would be offered.
No Surface Disturbance	Defined on a case-by-case basis when the activity plan for an area is developed. In general, an activity would be allowed if it would not interfere with the management objectives of the area.
No Surface Occupancy (NSO)	A fluid mineral leasing stipulation that prohibits occupancy of disturbance on all or part of the land surface to protect special values or uses. The NSO stipulation includes stipulations that may have been worded as "No Surface Use/Occupancy," "No Surface Disturbance," "Conditional NSO," and "Surface Disturbance and Surface Occupancy Restriction by location." The stipulation does not apply to roads and other linear facilities (pipelines, powerlines) that typically extend beyond the lease boundary. Lessees may use the oil and gas or geothermal



resources under leases restricted by this stipulation through use of directional drilling from sites outside the NSO area.

Nongame	Species of animals that are not managed as a sport hunting resource.
Nonpoint Source Pollution	Sources from which the pollutants discharged are: (1) induced by natural processes, including precipitation, seepage, percolation, and runoff; (2) not traceable to any discrete or identifiable facility and (3) better controlled through the use of Best Management Practices, including process and planning techniques. This includes natural pollution sources not directly or indirectly caused by man.
Noxious Weeds.	Rapidly spreading plants that cause a variety of major ecological impacts to both agriculture and wild lands.
Occasional Use Area	A use area where the sporadic or unpredictable occurrence of any species of "high interest wildlife" could be expected. These areas have a lower intensity of use than "existence use areas."
Off-Road Vehicle (ORV)	Any motorized vehicle designed for or capable of cross-country travel on or immediately over land, water, snow, ice, marsh, swampland or other natural terrain. It includes, but is not limited to, four-wheel drive or low-pressure-tire vehicles, motorcycles and related two-wheel vehicles, amphibious machines, ground-effect or air-cushion vehicles.
Operations	Surface disturbing activities that are conducted on a leasehold on National Forest System lands pursuant to a current approved surface use plan of operations, including but not limited to, exploration, development, and production of oil and gas resources and reclamation of surface resources.
Overstory	That portion of a plant community consisting of the taller plants on the site; the forest or woodland canopy.
Paleontological Resource	A site containing evidence of nonhuman life of past geological periods, usually in the form of fossil remains.
Partial Retention (VQO)	See Visual Quality Objective (VQO)
Particulates	Small particles suspended in the air and generally considered pollutants.
Permitted Grazing	Use of a National Forest range allotment under the terms of a grazing permit.
Pioneer Plants	Plants that first inhabit a denuded area (secondary plant succession) or a newly formed area. (Primary plant succession)



Pit Flaring	The burning of unusable petroleum vapors in an excavated pit.
Plant Community	A group of individual plants of one or more species growing in a specific area in association with one another and with a complex of other plants and animals.
Plant Succession	Plants that are more adapted to present environmental conditions replacing plants that are less adapted.
Policy	A guiding principle upon which is based a specific decision or set of decisions.
Prehistoric Site	Archaeologic sites associated with American Indians and usually occurring before contact with Europeans.
Preservation (VQO)	See Visual Quality Objectives (VQO)
Prevention of Significant Deterioration (PSD)	A classification established to preserve, protect, and enhance the air quality in National Wilderness Preservation System areas in existence prior to August 1977 and other areas of National significance, while ensuring economic growth can occur in a manner consistent with the preservation of existing clean air resources. Specific emission limitations and other measures, by class, are detailed in the Clean Air Act (42 U.S.C. 1875, et 15q.).
Primary Plant Succession	Plant succession that occurs on a newly formed piece of land.
Primary Range	Areas that animals prefer to use and over that they will graze when management is limited. The area on which overuse will occur before secondary range is used when animals are allowed to shift for themselves.
Primitive (P)	those recreation activities which occur in areas characterized by an essentially unmodified natural environment of fairly large size.
Primitive Roads	Roads constructed with no regard for grade control or designed drainage, sometimes merely repeatedly driving over an area. These roads are single land, usually with native surfacing and sometimes passable with four-wheel-drive vehicles only, especially in wet weather.
Range Allotment	A designated area of land available for livestock grazing upon which a specified number and kind of livestock may be grazed under an allotment management plan. It is the basic land unit used to facilitate management of the range resource on National Forest System lands administered by the Forest Service.
Raptors	Birds of prey with sharp talons and strongly curved beaks (e.g., hawks, owls, vultures, eagles).



Rare plants	A plant species, or subspecies, that is limited to a restricted geographic range, or one that occurs sparsely over a wider area.
Reclamation	Returning disturbed lands to a form and productivity that will be ecologically balanced and in conformity with a predetermined land management plan.
Record of Decision (ROD).	A document separate from, but associated with, an environmental impact statement that publicly and officially discloses the responsible official's decision on the proposed action.
Recreation Capacity	The number of people that can take advantage of a recreation opportunity at any one time without substantially diminishing the quality of the experience sought after.
Recreation Opportunity Spectrum (ROS)	Land delineations that identify a variety of recreation experience opportunities in six classes along a continuum from primitive to urban. Each class is defined in terms of natural resource settings, activities and experience opportunities. The six classes are: Urban, Rural, Roaded Natural, Semiprimitive Motorized, Semiprimitive Nonmotorized, and Primitive.
Recreation Visitor Day (RVD)	An RVD is 12 hours of recreation for one person or one hour of recreation for 12 persons or any combination thereof.
Reform Act of 1987	The Federal Onshore Oil and Gas Leasing Reform Act of 1987.
Rehabilitation	A short-term visual resource management objective used to restore landscapes containing undesirable visual or other resource impacts to the desired visual or other acceptable quality level.
Remoteness	Roadless area characteristic defined as the perceived condition of being secluded, inaccessible, and "out of the way." Topography, vegetative screening, distance from human impacts, distance from sights and sounds of man, and difficulty of travel all contribute to remoteness.
Research Natural Area	An area is as near a natural condition as possible, that exemplifies typical or unique vegetation and associated biotic, soil, geologic, and aquatic features. The area is set aside to preserve a representative sample of an ecological community primarily for the scientific and educational purposes; commercial and general public is not allowed.
Reserve pit	1 Usually an excavated pit that may be lined with plastic, that holds drill cuttings and waste mud. 2 Term for the pit that holds the drilling mud.



Restore	To bring back landscape to a former or original condition or appearance.
Retention	See Visual Quality Objectives (VQO)
Revegetation	The reestablishment and development of self-sustaining plant cover. On disturbed sites, this normally requires human assistance such as seed bed preparation, reseeding, and mulching.
Revegetation Potential	The probable success and ease in establishment of native grass and shrub species. This rating is influenced by climate, topography, and soil type. Stratification by climate yields limitations that are not normally economical to mitigate. Ratings relate to use of a rangeland drill, broadcast seeding, and aerial seeding with no consideration for site preparation (removal of trees, etc.).
Ratings:	
Slight	Potential is not restricted by properties in the rating, and sites offer optimum conditions for establishment of plants.
Moderate	Potential is restricted by properties in the rating that can be reasonably or economically mitigated.
Severe	Potential is restricted by properties in the rating that severely restrict reasonable or economical means of mitigation.
Rig	Short for "drill rig". The mast, drawworks, and attendant surface equipment of a drilling or workover unit.
Riparian	Riparian areas consist of terrestrial and aquatic ecosystems, those lands in a position to directly influence water quality and water resources, whether or not free water is available. This would include all lands in the active flood channel and lands immediately upslope of stream banks. These areas may be associated with lakes, reservoirs, estuaries, hotholes, marshes, streams, bogs, wet meadows, and intermittent or permanent streams where free and unbound water is available.
Riparian Ecosystem	A transition between the aquatic ecosystem and the adjacent terrestrial ecosystem; identified by soil characteristics or distinctive vegetation communities that require free or unbound water.
Roaded, Natural Appearing	A recreation opportunity classification term for describing a land area that has predominately a natural appearing environment with moderate evidence of sights and sounds of humans. Concentration of users is moderate to low. Roads of better than primitive class are usually within 0.5 mile. A broad range of motorized and nonmotorized activity opportunities are available. Management activities including timber harvest are present and harmonize with the natural environment.



Roadless	Refers to the absence of roads that have been constructed and maintained by mechanical means to ensure regular and continuous use.
Roads	Vehicle routes that have been improved and maintained by mechanical means to ensure relatively regular and continuous use. (A way maintained strictly by the passage of vehicles does not constitute a road.)
Rural Recreation Setting	A classification on the recreation opportunity spectrum that is characterized by substantially modified natural environment. Resource modification and use practices are to enhance specific recreation activities and to maintain vegetative cover and soil. Sights and sounds of humans are readily evident, and the interaction between users is often moderate to high.
Saleable Minerals.	Minerals that are sold and include common varieties of sand, gravel, building stone, limestone, pumice, pumicite, and cinders (Cummins and Given 1973).
Salinity	Refers to the solids such as sodium chloride (table salt) and alkali metals that are dissolved in water. Often in nonsaltwater areas, total dissolved solids is used as an equivalent.
Scenic Byway	State highways that have been designated as significantly scenic, culturally, or historically unique with road conditions that standard vehicles can travel on.
Scenic Backway	Roads designated by the state as significantly scenic, culturally, or historically unique, however, the road is not necessarily paved or open year round. It may not be possible for a standard vehicle to travel the backways.
Scenic Quality Class	The designation (A, B, or C) assigned a scenic quality rating unit to indicate the visual importance or quality of a unit relative to other units within the same physiographic province.
Seen area	That portion of the landscape which can be viewed from one or more observer positions. The extent or area that can be viewed is normally limited by landform, vegetation, structures, or distance.
Seldom seen area	Areas that are either beyond the furthest extent of the background zone (of the area or travel routes) or that are seen from areas or travel routes of low volume use.
Scoping Process	An early and open public participation process for determining particular issues to be addressed in an environmental document and for identifying the significant issues related to a proposed action.



Secondary Plant Succession	Plant succession that occurs when an area of land is denuded or degraded by the loss higher seral or climax vegetation.
Security Habitat	Hiding cover modified by open roads. The greater the density of open roads within an area, the less effective the area is in providing security for large animals.
Sediment	Solid mineral or organic material that is transported by air, water, gravity, or ice.
Sediment Yield	The amount of sediment produced in a watershed, expressed as tons, acre-feet, or cubic yards of sediment per unit of drainage area per year.
Seismic Exploration	Seismic exploration is used to map underground geological features to obtain information on the earth's subsurface and to locate areas where accumulations of oil and gas might occur.
Semiprimitive	A recreation opportunity classification term for describing land areas that have very few management controls lying between .5 mile and 3 miles from the nearest point of motor vehicle access, excepting four-wheel drive roads and trails, with mostly natural landscapes and some evidence of other people.
Semi-Primitive Motorized (SPM)	A land area classified as semiprimitive that may have primitive roads present and where motorized use is permitted. Settings, activities and opportunities are affected accordingly though there is still a moderate probability of experiencing isolation from sights and sounds of humans.
Semi-Primitive Non-Motorized (SPNM)	A land area classified as semiprimitive that has a natural environment and motorized use is not permitted. Nonmotorized status increases the probability of experiencing isolation, independence, and closeness to nature. Challenge and risk are generally high. Resource management may be present; however, natural appearance is still maintained.
Senescent	Growing old, aging.
Sensitive Species	Those plant or animal species that are susceptible or vulnerable to activity impacts or habitat alterations.
Sensitive Use Area	A use area for one or more species of "high interest wildlife" that represents a critical requirement for an individual animal's life cycle or biologically important area for a wildlife population. Examples are areas of big game winter ranges that are experiencing concentration of use; critical corridors for movement of wildlife; display, breeding and rearing areas for avifauna (i.e., strutting grounds, booming grounds, and wetlands); spawning sites; fawning, lambing, or calving areas; communities or ecosystems that represent unique aesthetic, scientific or education values such as riparian zones, wetlands, or limited habitats.



Sensitivity Levels	A measure of people's concern for the scenic quality of the Forest. Sensitivity levels are developed for visitors viewing the Forest as a result of traveling by car, hiking, camping, fishing, or boating. Some degree of sensitivity is established for all National Forest System lands. Three levels of sensitivity are used, with one being most sensitive and three the least.
Seral	A biotic community that is developmental; a transitory stage in an ecologic succession.
Significant	An effect that is analyzed in the context of the proposed action to determine the importance of the effect, either beneficial or adverse. The degree of significance is related to other actions with individually insignificant but cumulatively significant impacts. Significance exists if it is reasonable to anticipate a cumulatively significant impact on the environment and when the effects on the quality of the human environment are likely to be highly controversial.
Skid Roads	Cleared areas used for dragging logs to a flume.
Slope	The amount or degree of deviation from the horizontal or vertical. Landscape is categorized into three slope classes: 0 to 15 percent, 16 to 40 percent, and greater than 40 percent. Concerning visual resources, as slope increases, views into a site and the size of the disturbance increase. Generally, the steeper slopes are more visible due to their location in the landscape.
Small Game	Birds and small mammals normally hunted or trapped.
Soil Fertility	The quality of a soil that enables it to provide nutrients in adequate amounts and in proper balance for the growth of specified plants when other growth factors are favorable.
Soil Productivity	The capacity of a soil to produce a specific crop such as fiber and forage, under defined levels of management. It is generally dependent on available soil moisture and nutrients and length of growing season.
Soil Texture	The relative proportions of sand, silt, and clay particles in a mass of soil. Basic textural classes, in order of increasing proportion of fine particles, are: sand, loamy sand, sandy loam, loam, silt loam, silt, sandy clay loam, clay loam, silty clay loam, sandy clay, silty clay, and clay.
Solitude	Is a personal, subjective value and roadless area characteristic defined as isolation from the sights, sounds, presence of others, and the developments of man. A primitive recreation experience includes the opportunity to experience solitude, a sense of remoteness, closeness to nature, serenity, and spirit of adventure.



Sour Well	In an oil or gas well, a condition caused by the presence of hydrogen sulfide or another sulfur compound.
Special Features	Are unique geological, biological, ecological, cultural, or scenic features located in a roadless area. Unique fish and species, unique plants or plant communities, potential Research Natural Areas, outstanding landscape features such as unique rock formations, and significant cultural resource sites are some of the items that should be considered when analyzing this element.
Special Stipulations	Terms and conditions of use attached to leases where needed to protect specific resources or uses on National Forest System lands.
Stand	An aggregation of forested vegetation occupying a specific area and sufficiently uniform in species composition, age arrangement, and conditions as to be distinguishable from adjoining stands.
Step-Out Well	A well drilled adjacent to or near a proven well to ascertain the limits of the oil or gas reservoir. An outpost is a well drilled a further distance from a step-out but still on the same structural trend. (Distance could be a couple of miles).
Stipulation	A provision that modifies standard lease rights and is attached to and made a part of the lease.
Stream Bank (and Channel) Erosion	The removal, transport, deposition, recutting, and bed-load movement of material in streams by concentrated water flows.
Strutting Grounds	Areas used by sage grouse for displays during the mating season.
Substantial Value Habitat	Habitats that are "existence areas" for one or more species of existing "high interest wildlife".
Suitability	As used in the Wilderness Act and in the Federal Land Policy and Management Act, refers to a recommendation by the Secretary of the Interior or the Secretary of Agriculture that certain Federal lands satisfying the definition of wilderness in the Wilderness Act have been found appropriate for designation as wilderness on the basis of an analysis of the existing and potential uses of the land.
Sundry Notice	Standard form to notify of or propose change of approved well operations subsequent to APD in accordance with 43 CFR 3162.3-2 BLM and Forest Service regulations.
Surface Use Plan of Operations (SUPO)	A plan for surface use, disturbance, and reclamation.
Sweet Well	An oil or gas well lacking sulfur and any significant amount of hydrogen sulfide or mercaptans.



Tank Battery	A group of production tanks that store crude oil in the field.
Taxa	Classifications of plants or animals; i.e., species, genus, family; singular taxon.
Tectonics	A branch of geology dealing with the broad architecture of the outer part of the earth; that is, the regional assembling of structural or deformative features and a study of their mutual relations, origin, and historical evolution.
Terrestrial	Living or growing in or on the land.
Terrestrial Ecosystem	All organisms in a land-based community plus the associated environmental factors.
Texture	Detail of landscape that varies with distance.
Threatened And Endangered Species	Any species likely to become an endangered species within the foreseeable future throughout all or a significant portion of its range and that has been designated in the Federal Register by the Secretary of the Interior as a threatened species.

#### Definitions

#### **Federal codes are defined as follows:**

Endangered (E): Any species that is in danger of extinction throughout all or a significant portion of its range other than a species of the Class Insecta determined by the Secretary to constitute a pest whose protection under the Endangered Species Act would present an overwhelming and overriding risk to man.

Threatened (T): Any species that is likely to become an endangered species within the foreseeable future throughout all or a significant portion of its range.

Category 1 Candidate Species (C1): Status review taxa for which the FWS currently has on file substantial information on biological vulnerability and threat(s) to support the appropriateness of proposing to list the taxa as an endangered or threatened species.

Category 2 Candidate Species (C2): Status review taxa for which information now in possession of the FWS indicate that proposing to list the taxa as an endangered or threatened species is possibly appropriate, but for which substantial data on biological vulnerability or threat(s) are not currently known or on file to support proposed rules,

Category 3 (C3): Taxa for which the FWS has persuasive evidence of extinction (Group 3A); taxa does not meet the Endangered Species Act's definition of a species (Group 3B); or



taxa that have proven to be more abundant or widespread than previously believed and/or those that are not subject to an identifiable threat (Group 3C).

**Forest Service Sensitive:** Those plant and animal species identified by a Regional Forester for which population viability is a concern, as evidenced by: (a) significant current or predicted downward trends in population numbers or density or (b) significant current or predicted downward trends in habitat capability that would reduce a species' existing distribution.

State of Utah Codes are defined as follows:

Extinct: Any wildlife species that has disappeared in the world.

Extirpated: Any wildlife species that has disappeared, as a part-time or full-time resident, from the state of Utah since 1800.

Endangered: Any species, subspecies, or subpopulation which is threatened with extinction resulting from very low to declining numbers, alteration and/or reduction of habitat, detrimental environmental changes, or any combination of the above. Continued survival is unlikely without implementation of special measures.

Threatened: Any species which is likely to become an endangered species within the foreseeable future throughout all or a significant portion of its range.

Sensitive: Any species which, although still occurring in numbers adequate for survival, has been greatly depleted or occurring in limited areas and/or numbers due to a restricted or specialized habitat. A management program, including protection or habitat manipulation, is needed.

Threatened Plant

Any species that is likely to become an endangered species within the foreseeable future throughout all or a significant portion of its range.

Thrust Fault

A fault with a dip of 45 degrees or less over much of its extent, on which the hanging wall (overlying side) appears to have moved upward relative to the footwall (underlying side).

Timber Production

The purposeful growing, tending, harvesting, and regeneration of regulated crops of trees to be cut into logs, bolts, or other round sections for industrial or consumer use. For planning purposes, the term "timber production" does not include production of fuelwood (36 CFR Part 219.3).



Timing Limitation (Seasonal Restriction)	Prohibits surface use during specified time periods to protect identified resource values. The stipulation does not apply to the operation and maintenance of production facilities unless the findings of analysis demonstrate the continued need for such mitigation and that less stringent, project-specific mitigation measures would be insufficient.
Total Dissolved Solids (TDS)	Salt, or an aggregate of carbonates, bicarbonates, chlorides, sulfates, phosphates, and nitrates of calcium, magnesium, manganese, sodium, potassium, and other cations that form salts.
Trailhead	Developed recreation sites with parking, signing, and other facilities designated to provide a take-off point for trail users at a major access point and terminus of a trail.
Understory	That portion of a plant community growing underneath the taller plants on the site.
Upper Low Seral	The vegetation stage between low and mid-seral, the stage of plant succession where pioneer plants are mostly replaced by other plants, poor ecological condition.
Use Volume	The total volume of visitor use each segment of a travel route or use area receives.
Utility Corridor	See Corridor.
Variety Class	A designation (A, B, or C) assigned to a homogeneous area of the landscape to indicate the visual importance or quality relative to other landscape areas within the same physiographic province.
Vertebrate	An animal having a spinal column.
Viewer Position	The relationship of the viewer to a specific site or structure (that is; whether a person is looking up at, down at, or across). Viewer position is classified as superior, normal, or inferior.
Visual Absorption Capability (VAC)	The relative ability of a landscape to accept management practices without affecting its visual characteristic. The capability to absorb visual change. A prediction of how difficult it will be for a landscape to meet recommended VQOs.
Visual Management System (VMS)	A management system that establishes the "visual landscape" as a basic resource, treated as an essential part of the land. The visual management system provides a framework to inventory the visual resource and provides measurable standards for its management. Inventory and planning to identify visual resource values and establish objectives for managing those values, and the management actions taken to achieve those objectives.
Visual Management Objectives	The term used in this study to generally define VQO classes (FS).



Visual Quality Objectives (VQO)

Based upon variety class, sensitivity, level, and distance zone determinations. Each objective describes a different level of acceptable alteration based on aesthetic importance. The degree of alteration is based on contrast with the surrounding landscape.

Preservation: In general, human activities are not detectable to the visitor.

Retention: Human activities are not evident to the casual Forest visitor.

Partial Retention: Human activities may be evident, but must remain subordinate to the characteristic landscape.

Modification: Human activity may dominate the characteristic landscape, but must, at the same time, use naturally established form, line, color, and texture. It should appear as a natural occurrence when viewed in middle-ground or background.

Maximum Modification: Human activity may dominate the characteristic landscape, but should appear as a natural occurrence when viewed as background.

Enhancement: A short-term management alternative that is completed with the express purpose of increasing positive visual variety where little variety now exists.

Visual Resource

The composite of basic terrain, geologic features, water features, vegetative patterns, and land use effects that typify a land unit and influence the visual appeal of the unit.

Wetlands

Lands where saturation with water is the primary factor determining the nature of soil development and the kinds of animal and plant communities living under or on its surface.

Wildcat Well

An exploratory well drilled in an area where there is no oil or gas production (see exploratory well).

Wilderness

An area of undeveloped Federal land designated Wilderness by Congress, retaining its primeval character and influence, without permanent improvements or human habitation, protected and managed to preserve its natural conditions and that (1) generally appears to have been affected primarily by the forces of nature with the imprint of man's work substantially unnoticeable, (2) has outstanding opportunities for solitude or primitive and unconfined recreation, (3) has at least 5,000 acres or is of sufficient size to make practical its preservation and use in an unimpaired



condition, and (4) also may contain features that are of ecological, geological, scientific, educational, scenic, or historical value. These characteristics were identified by Congress in the Wilderness Act of 1964.

#### Wilderness Management

Policy document prescribing the general objectives, policies, and specific activity guidance applicable to all designated Forest wilderness areas. Specific management objectives, requirements, and decisions implementing administrative practices and visitor activities in individual wilderness areas are developed and described in the wilderness management plan for each unit.







**CHAPTER 9**

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*DEIS DISTRIBUTION*







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Bryce Canyon National Park, Richard Bryant  
Capitol Reef National Park, Superintendent  
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**APPENDIX A**

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***LEASE DECISION ISSUING PROCESS***







## APPENDIX A - LEASE DECISION ISSUING PROCESS

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In many places in the United States, National Forests lie over geological formations which do, or may, contain oil or natural gas. Private firms purchase "leases" on many of these lands to search for oil or gas, to drill exploratory wells, and to extract any oil or gas located below them.

### LEASE

Individuals, associations of citizens, and corporations organized under the laws of the United States or any state, are entitled to lease Federal lands for these purposes under authority of the Mineral Leasing Act of 1920, as amended, and by the Mineral Leasing Act for Acquired Lands of 1947 unless the lands have been specifically withdrawn by the Department of the Interior. Leases also may be issued to a legal guardian or trustee on behalf of a minor. Aliens, whose country of origin does not deny similar privileges to United States citizens, may hold interest in leases, but only through stock ownership of United States corporations that hold leases. Aliens may not hold interest in Federal oil and gas leases through units in publicly traded limited partnerships.

The issuance of a lease grants to the lessee the exclusive right to use so much of the leased lands as is necessary to explore for, drill for, mine, extract, remove, and dispose of all the oil and gas (except helium) in the leasehold subject to stipulations attached to the lease; restrictions deriving from specific, nondiscretionary statutes; and such reasonable measures as may be required by the authorized officer to minimize adverse impacts to other resource values, land uses or users not addressed in the lease stipulations at the time operations are proposed. To the extent consistent with lease rights granted, such reasonable measures may include, but are not limited to, modification to siting or design of facilities, timing of operations, and specifications of interim and final reclamation measures. At a minimum, measures shall be deemed consistent with the lease rights granted provided that they do not require relocation of proposed operations by more than 200 meters, require that operations be sited off the leasehold, or prohibit new surface disturbing operations for a period in excess of 60 days in a lease year (43 CFR 3102.1-2).

### Competitive and Noncompetitive Leases

Competitive and **noncompetitive** leases may be obtained for oil and gas exploration and development on lands owned or controlled by the Federal government. The Leasing Reform Act of 1987 requires all public lands available for oil and gas leasing to be offered first by competitive leasing at an oral auction. Noncompetitive leases may be issued only if the competitive process results in no bids. Competitive and noncompetitive leases are issued for a ten-year period. Both are extended for the duration that they are producing oil and gas in paying quantities. The maximum competitive lease size is 2,560 acres in the "lower" 48 states and 5,760 in Alaska. The maximum noncompetitive lease size is 1,060 acres in all states.

### Competitive Leases

The Bureau of Land Management (BLM) conducts oral auctions for oil and gas leases on at least a quarterly basis, when there are available parcels of land. A Notice of Competitive Lease Sale lists lease parcels to be offered at auction. The Sale Notice is published at least 45 days before the date of the auction. The Sale Notice identifies any lease stipulations to uses or restrictions on surface occupancy. There are three sources for Federal lands available for lease:



- existing leases that have expired, and leases that have been terminated, canceled, or relinquished
- parcels identified by informal expressions of interest from either the public or BLM for management reasons
- lands included in offers filed for noncompetitive leases (effective January 3, 1989).

On the day of the auction, successful bidders must submit a properly executed lease bid form and make a payment consisting of an administrative fee (\$75 per parcel), one-year advance rental (\$1.50 per acre), and not less than the \$2.00 per acre minimum bonus. The balance of the bonus bid must be received within ten working days of the auction. The bid form constitutes the legally binding lease offer.

### **Noncompetitive Leases**

Noncompetitive leases may be issued only for parcels that have been offered competitively and failed to receive a bid. Lands in expired, terminated, cancelled, or relinquished leases are not available for noncompetitive leasing until they have been offered competitively. After an auction, all lands that were offered competitively without receiving a bid are available for filing of noncompetitive offers for a period of two years.

Noncompetitive offers must be submitted on a BLM-approved form, and they must include a \$75 filing fee, and one-year advance rental (\$1.50 per acre).

Noncompetitive lease offers filed on the first business day following the auction are considered as having been filed simultaneously. The priority among multiple offers received on the first business day for the same parcel are determined by drawings open to the public.

### **Lease Restrictions**

A lease does not convey an unlimited right to explore or an unlimited right to develop any oil or gas resources found under the land. Leases are subject to terms and conditions. These are restrictions derived from legal statutes and measures to minimize adverse impacts to other resources and are generally characterized in a lease as stipulations. Stipulations modify the rights the government grants to a lessee. The stipulations are known by potential lessees prior to any sale and must be applied at the time of the Application for Permit to Drill (APD).

### **Standard Lease Terms**

The Standard Lease Terms are contained in Form 3100-11, Offer to Lease and Lease for Oil and Gas, United States Department of the Interior, BLM, June 1988 or later addition (see Appendix B). The Standard Lease Terms provide the lessee the right to use the leased land as needed to explore for, drill for, extract, remove and dispose of oil and gas deposits located under the leased lands. Operations must be conducted in a manner that minimizes adverse impacts to the land, air, water, cultural, biological, and visual elements of the environment, as well as other land uses or users. Federal environmental protection laws such as the Clean Water Act, Endangered Species Act, and Historic Preservation Act, will be applied to all lands and are included in the standard lease stipulations. If threatened or endangered species; objects of historic, cultural, or scientific value; or substantial unanticipated environmental effects are encountered



during construction, all work affecting the resource will stop and the land management agency will be contacted. Surface-disturbing operations that would destroy or harm these species or objects are prohibited.

Standard Lease Terms provide for reasonable measures to minimize adverse impacts to surface resources. These include, but are not limited to, modifications to the siting or design of facilities, timing of operations, and specifications of interim and final reclamation measures. Standard Lease Terms may *not* require the lessee to relocate drilling rigs or supporting facilities by more than 200 meters, require that operations be sited off the leasehold, or prohibit new surface-disturbing operations for more than 60 days each year (43 CFR part 3101.1-2).

The lease requires that the lessee meet stipulation conditions or avoid activities within all, or an identified part, of the leasehold. All leases on National Forest System lands contain the "Stipulation for Lands of the National Forest System Under Jurisdiction of Department of Agriculture," requiring the lessee to comply with the rules and regulations of the Department of Agriculture. All leases are subject to regulations and formal orders of the Secretaries of the Interior and Agriculture in effect at the time of issuance.

### Supplemental Stipulations

The Standard Lease Terms can be modified by special or supplemental stipulations attached to the lease (43 CFR 3101.1-2 through 3101.1-4). Additional special stipulations can be developed specifically to meet resource concerns that cannot be mitigated by existing stipulations. All stipulations that may be applied when implementing the Forest Supervisor's decisions are detailed in Appendix B.

## Federal Oil and Gas Leasing Process

### **Prior to the 1987 Leasing Reform Act**

The Secretary of the Interior, through the BLM, was responsible for authorizing the sale of leases for all available Federal lands, including the lands of the National Forest System. The Mineral Leasing Act of 1920 and the Mineral Leasing Act for Acquired Lands of August 7, 1947 (USC 351-359), provided for oil and gas leases on mineral deposits of coal, phosphate, oil, oil shale, gas, sodium, potassium, and sulphur that are owned or may be acquired by the United States and that are within the lands acquired by the United States National Grasslands were authorized by the Bankhead-Jones Farm Tenant Act.

Individuals and firms wishing to lease parcels of the National Forests or Grasslands would make a "Request For Lease" for a specific parcel of land to the BLM. The BLM would then ask the Forest Service to make a recommendation regarding sale of the lease subject to provisions of the 1920 Mineral Leasing Act or the 1947 Act for Acquired Lands. Officers of the Forest Service would determine the stipulations necessary to protect the resources. However, only the Secretary of the Interior possessed the authority to determine which stipulations to place on the lease for minerals reserved from public domain. The final decision was appealable to the BLM.

### **After the Reform Act**

In 1987, Congress passed the Federal Onshore Oil and Gas Leasing Reform Act (P.L. 100-203). Referred to as the "Leasing Reform Act" throughout this document.) The Leasing Reform Act makes leasing on public domain lands very similar to that of acquired lands, the Forest Service could deny consent on public domain and acquired lands. The Act made two significant changes in the way leasing decisions are



reached. First, the role of the Secretary of Agriculture in the leasing decision process was expanded. The Secretary was authorized to identify the National Forest System lands for which leases could be sold. Also, the Secretary, or designated representative, were authorized to determine the appropriate stipulations to apply to a lease to protect the surface resources.

The Leasing Reform Act also established a statutory requirement for processing the Surface Use Plan of Operation (SUPO) prior to ground-disturbing activities. This established a staged decision process for sale of a lease and approval of a permit to drill and operate. That is, before a company can drill an exploratory well or extract oil or gas from National Forest System lands, the Forest Service must first authorize sale of a lease, and then must approve or disapprove a detailed SUPO at the time of an APD. The lease decision is based on, among other things, an environmental analysis in accord with the requirements of the National Environmental Policy Act (NEPA) (40 CFR part 1502) that identifies stipulations needed to protect the environment. The approval of drilling also is based on an environmental analysis in accord with NEPA, which is specific to the proposed plan of operation.

### **The Regulations Implementing the Reform Act**

The Leasing Reform Act modified the authorities of the Secretaries of the Interior and Agriculture and established the foundation for staged decision-making, but the procedures to be used were defined in implementing regulations. The Forest Service developed those regulations over a two-year period and published the "Final Rule" in the **Federal Register** on March 21, 1990 (36 Code of Federal Regulations, Part 228, 100 *et. seq.*; 55 FR 10423).

In the implementing regulations, the Secretaries of Agriculture and Interior determined that the **leasing decision** to be made based on a level of information appropriate to the speculative nature of oil and gas exploration. The regulations describe this decision process as follows:

(c) *Leasing Analyses: ... the authorized Forest officer shall:*

(1) *Identify on maps those areas that will be:*

(i) *Open to development subject to the terms and conditions of the standard oil and gas lease form (including an explanation of the typical standards and objectives to be enforced under the Standard Lease Terms);*

(ii) *Open to development but subject to constraints that will require the use of lease stipulations such as those prohibiting surface use on areas larger than 40 acres or such other standards as may be developed in the plan for stipulation use (with discussion as to why the constraints are necessary and justifiable) and;*

(iii) *Closed to leasing, distinguishing between those areas that are being closed through exercise of management direction, and those closed by law, regulation, etc.*

(2) *Identify alternatives to the areas listed in paragraph (c)(1) of this section including that of not allowing leasing.*

(3) *Project the type/amount of post-leasing activity that is reasonably foreseeable as a consequence of conducting a leasing program consistent with that described in the proposal and for each alternative.*



(4) *Analyze the reasonable foreseeable impacts of post-leasing activity projected under paragraph (c)(3) of this section.*

(d) *Area or Forest-wide Leasing decisions (Lands Administratively Available For Leasing)*

*Upon completion of the leasing analysis, the Forest Supervisor [as designated by the Regional Forester] shall promptly notify the Bureau of Land Management as to the area or Forest-wide leasing decisions that have been made, that is, identify lands which have been found administratively available for leasing.*

(e) *Leasing Decisions for Specific Lands*

*At such time as specific lands are being considered for leasing, the Forest Supervisor shall review the area or Forest-wide leasing decision and shall authorize the BLM to offer specific lands for lease subject to:*

(1) *Verifying that oil and gas leasing on the specific lands has been adequately addressed in a NEPA document, and is consistent with the Forest land and resource management plan.*

(2) *Ensuring that conditions of surface occupancy identified in section 228.102(c)(1) are properly included as stipulations in resulting leases.*

(3) *Determining that operations and development could be allowed somewhere on each proposed lease, except where stipulations will prohibit all surface occupancy.*

*36 Code Of Federal Regulations, part 228.102 Leasing Analysis and Decisions.*

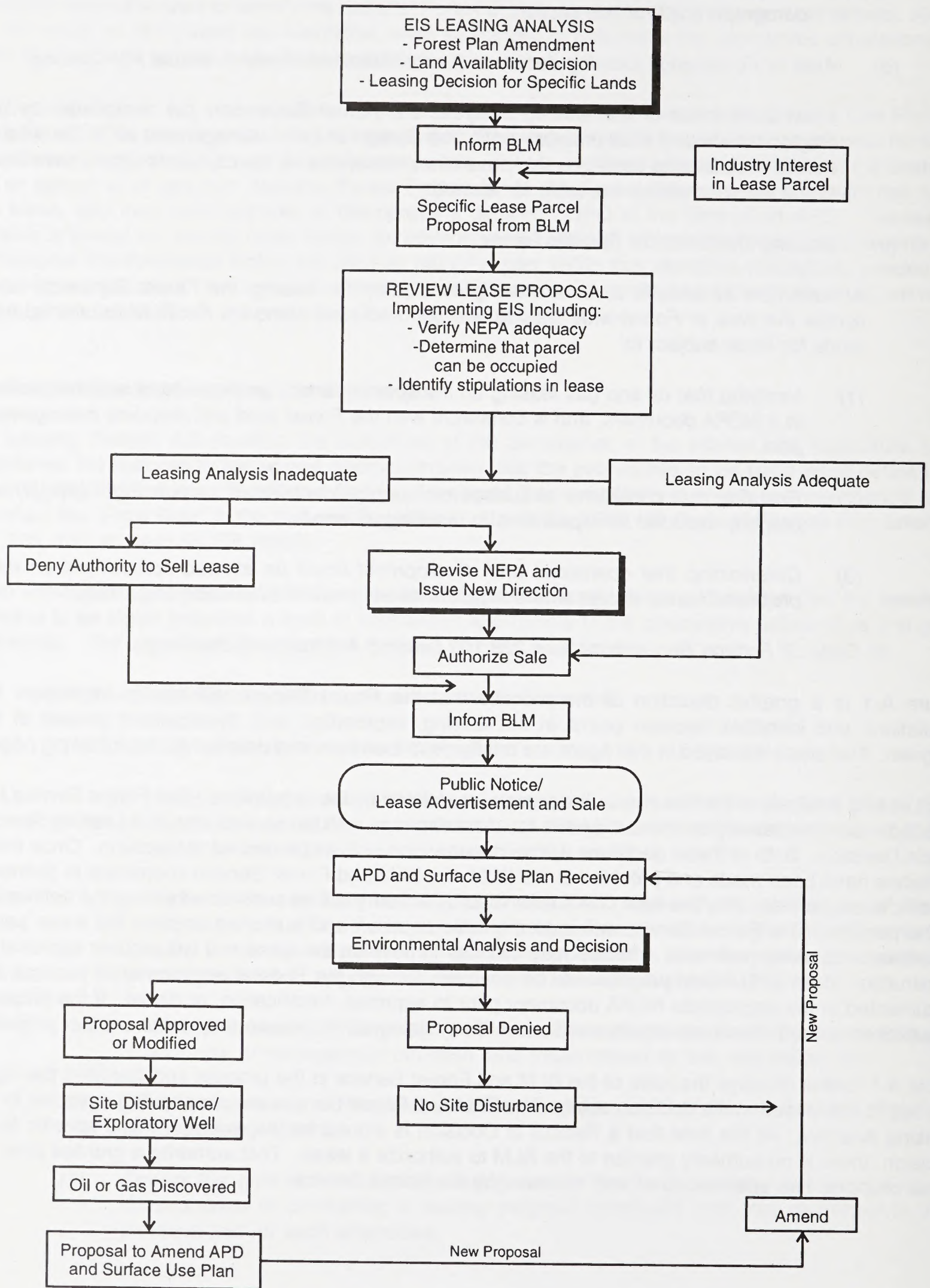
Figure A-1 is a graphic depiction of the process that the Forest Service will use to implement the regulations and identifies decision points in the leasing, exploration, and development phases of the program. The steps displayed in that figure are briefly described here and detailed on the following pages.

The Leasing Analysis is the first step in the process mandated by the regulations. The Forest Service has decided to administratively combine it, and its resultant decision, with the second step, the Leasing Specific Lands Decision. Both of these decisions will be documented in a single Record of Decision. Once these decisions have been made and provided to the BLM, the BLM and Forest Service coordinate to delineate specific lease parcels. Any pre-sale offers submitted by industry will be considered during the delineation of the parcels. The Forest Service will implement the decision and authorize or deny the lease parcel advertisement. After purchase, a lessee may propose to develop the lease and will request approval for construction in an APD. That proposal will be analyzed through the Federal environmental process and documented in the appropriate NEPA document prior to approval, modification, or denial. If the proposal is approved ground-disturbing activities will occur, if not approved the lessee may make another proposal.

Table A-1 further displays the roles of the BLM and Forest Service in the process and identifies the rights granted to the lessee at the decision points. The BLM and Forest Service are cooperating agencies in the Leasing Analysis. At the time that a Record of Decision is signed for the availability and specific lands decision, there is no authority granted to the BLM to authorize a lease. That authority is granted after the lease proposal has been received and reviewed by the Forest Service.



FIGURE A-1  
LEASING PROCESS FLOW CHART





**Table A-1  
Lessee Rights Granted in the Process**

**MANAGEMENT ROLES AND RESPONSIBILITIES**

<b>Forest Service</b>	<b>Bureau of Land Management (BLM)</b>	<b>The Decisions</b>	<b>Rights Conferred</b>
Cooperating agency	Cooperating agency	Leasing Analysis	None
Environmental analysis	Provides input and review through the analysis	Availability Decision 40 CFR 228.102(0)(d)	None
Decides which lands to authorize, with what stipulations  Notifies BLM but does not authorize	N/A	Specific Lands Authorized For Lease 40 CFR 228.102(e)	None
Reviews adequacy of previous decision and authorizes BLM to lease identified parcels	Proposes lease parcel	Implementation of (e) Specific Lands Decision	None
	Advertises authorized parcel	Firm purchase lease	Exclusive right to drill, extract oil and gas and build and maintain support facilities subject to lease terms, and identified special stipulations and approval of the APD
Analyzes SUPO in a site specific environmental analysis	Perform on-site review and prepare permit conditions with Forest Service and operator.  Geologic and Engineering review and analysis of SUPO and Drilling Plan	Review of Proposed Surface Use Plan of Operations (SUPO) 40 CFR 228.107	None
Approve SUPO	Approve APD	Approval granted	Right to construct based on SUPO



## The Staged Decision Process

The legally required, staged-decision process is designed to accommodate the tentative nature of oil and gas exploration and development. Exploration for oil and gas resources is costly and speculative. Firms must commit costly equipment, purchase a variety of land rights and use expensive environmental protection technologies to begin exploration for oil or gas. Driven by pressures to be efficient and minimize risk, the nature of the enterprise has evolved over decades into a form in which exploration and development requires long-term planning by many loosely associated, mutually dependent industries. There is no guarantee that the expensive commitment of exploratory resources will result in a discovery of oil or gas, as only about 15 percent of exploratory wells drilled in the United States result in a paying discovery of oil or gas.

Consequently, companies or individuals pursuing oil and gas must be able to plan in advance to most efficiently use their exploratory resources. One tactic they rely on to stage commitments of their own resources is the purchase of public land leases. Developers want to know what lands are available for exploration and development and they want to be assured of continued future opportunities. Leasing of public lands is a way to do this.

However, companies purchasing leases do not automatically or immediately drill exploratory wells on these leaseholds. In any given time period, exploration firms must match geologic characteristics with the commitment of technology, capital, available equipment, and market conditions in a decision to risk a drilling operation. As a result, Federal land leases are bought, relinquished, expire, and may be bought and sold again many times without ever being drilled upon. This demonstrates a major distinction between oil and gas leasing and other activities that are authorized by the Forest Service. Most activities are reasonably certain to proceed to development after the permit or contract is issued. Even though there is great uncertainty at the time of lease authorization as to whether a well will be drilled, the effects of a typical well in a given location can be estimated reliably on the basis of past experience.

The Federal government wants to respond to industry concerns, but must ensure that future activities will neither unduly harm the environment or interfere with other uses of these public lands. A regulatory framework has been created to meet industry's needs while protecting resources. The regulations include staged permitting of oil and gas exploration and development. Those stages include public disclosure at the following decision points:

- The determination of lands available for leasing
- The leasing specific lands decision
- Application for Permit to Drill
- Analysis of field development if production is established.

The staged process is designed to minimize the risk of making a decision that could lead to undisclosed irreversible or irrevocable environmental impacts. Each decision is based on environmental analysis and disclosure of the probable effects in accord with NEPA. Each decision is appealable to the responsible Federal agency.

The United States Supreme Court in **Robertson v. Methow Valley Citizens Council**, 104 L.Ed.2d 351 (1989), upheld the use of more than one stage of NEPA compliance after a Forest Plan is issued. In the Methow Valley situation, there was a permit stage (which allowed no ground-disturbing activities) and a faster development plan stage that involved another NEPA process and decision by the Government before environmental effects would be experienced. This is very similar to the situation that is involved here.



## **Stage One - Lands Available for Leasing**

The decision regarding lands available for leasing is based on disclosure and analysis provided in a "Leasing Analysis." No rights are granted by the government to other parties when the Leasing Analysis is completed and the decision described in 36 CFR 228.102(d) is made. This EIS was prepared to satisfy the requirements of NEPA for the Leasing Analysis.

The decision will identify which, if any, lands will be available for leasing. The Forest Plan will be amended, if necessary, at the same time so that the decisions made on the basis of this EIS will be consistent with the Forest Plan.

## **Stage Two - Leasing Decisions for Specific Lands**

The Leasing Reform Act also provides for consent by the Forest Service for the issuance of oil and gas leases for specific lands. The regulations implementing the Leasing Reform Act require the following before consent can be given for one or more leases to be issued by the BLM:

- Verifying that oil and gas leasing on the specific lands has been adequately addressed in a NEPA document, and is consistent with the Forest Plan
- Ensuring that conditions of surface occupancy identified in section 228.102(c)(1) are properly included as stipulations in resulting leases
- Determining that operations and development could be allowed somewhere on each proposed lease, except where stipulations would prohibit all surface occupancy

## **Stage Three - Application for Permit to Drill (APP)**

This document, and its Record of Decision, do not authorize any ground-disturbing activities. Subsequent to lease award, the activities will be proposed through an APD and SUPO submitted to the Forest Service for approval. The Forest Service will analyze environmental effects of the proposed operations and issue a decision document. The Forest Service decision to approve or not approve the SUPO is forwarded to the BLM for incorporation into their decision of whether or not to approve the APD.

If modifications or changes in the APD are needed, based on drilling conditions encountered or some other unforeseen circumstance, the operator submits a Sundry Notice to the BLM for review and approval. If the change involves surface disturbance or potential affects on surface resources, a copy is forwarded to the Forest Service for approval or comment. Depending on the extent and nature of the change additional NEPA analysis may be necessary.

## **Stage Four - Field Development Plan**

If economically recoverable quantities of oil and gas resources are found through exploratory drilling, industry may submit a field development plan after evaluation of the discovery well and available geologic information. The Forest Service in cooperation with the BLM would analyze the predicted environmental effects associated with the proposed field development and identify reasonable and necessary mitigation measures. Specific well sites and access routes may not be known at the time the field development plan



is analyzed in which case additional NEPA analysis tiered to the field development plan may be necessary once a specific well is proposed.

### Impacts of a Lease

The authorization of a lease grants rights to explore for and develop oil and gas within the terms and stipulations of the lease. The exercise of these rights results in environmental effects. The regulations direct the Forest Service to consider the subsequent actions that would be authorized by a lease, and their potential environmentally disturbing effects, as **connected actions**. This includes all activities described earlier in this appendix. These actions also meet the definition of connected actions in the procedural requirements for NEPA (40 CFR 1502).

These expected actions are the basis of the environmental analysis from which the leasing decisions will be made. The decision on the lands that will be administratively available, and the subsequent decision authorizing leases, are based upon analysis of the likely environmental effects of the connected actions.



**APPENDIX B**

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***LEASE STIPULATIONS AND STANDARD  
LEASE TERMS (BLM FORM 3100-11)***







## APPENDIX B - LEASE STIPULATIONS AND STANDARD LEASE TERMS (BLM Form 3100-11)

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### INTRODUCTION

The following information pertaining to lease stipulations is taken from the booklet, "Uniform Format For Oil And Gas Lease Stipulation," prepared by the Rocky Mountain Regional Coordinating Committee in March, 1989. These guidelines were developed by the Bureau of Land Management (BLM) and the Forest Service.

Stipulations are conditions, promises, or demands to be part of a lease only when the environmental and planning record demonstrates the necessity for the stipulations. Stipulations, as such, are neither "standard" nor "special", but rather a necessary modification of the terms of the lease. The forms, given at the end of this appendix, provide for standardized structure, wording, and usage. In order to accommodate the variety of resources encountered on Federal lands, these stipulations are categorized as to how the stipulation modifies the lease rights, not by the resource(s) to be protected. What, why, and how this mitigation/protection is to be accomplished is determined by the land management agency through land use planning and National Environmental Policy Act (NEPA) analysis.

### IMPLEMENTATION

If upon weighing the relative resource values, uses, and/or users identified that conflict with oil and gas operations and cannot be adequately managed and/or accommodated on other lands, a lease stipulation is necessary. Land use plans serve as the primary vehicle for determining the necessity for lease stipulations (BLM Manual 1624). Documentation of the necessity for a stipulation is disclosed in planning documents or through site-specific analysis. Land use plans and/or NEPA documents also establish the guidelines by which future waivers, exceptions, or modifications may be granted. Substantial modification or waiver subsequent to lease issuance is subject to public review for at least a 30-day period in accordance with Section 5102.f of the Federal Onshore Oil and Gas Leasing Reform Act of 1987.

Stipulations may be necessary if the authority to control the activity on the lease does not already exist under laws, regulations, or orders. It is important to recognize that the authorized officer has the authority to modify the site location and design of facilities, control the rate of development and timing of activities as well as require other mitigation under Sections 2 and 6 of the standard lease terms (BLM Form 3100-11) and 43 CFR 3101.1-2.

The necessity for individual lease stipulations is documented in the lease-file record with reference to the appropriate land use plan or other leasing analysis document. The necessity for exceptions, waivers, or modifications also will be documented in the lease-file record through reference to the appropriate plan or other analysis. The uniform format for stipulations should be implemented when amendments or revisions of land use plans are prepared or by other appropriate means.

The uniform format for stipulations is designed to accommodate most existing stipulations by providing space to record the local mitigation objectives. The stipulations have been developed for the categories of:

- no surface occupancy (NSO)
- timing or seasonal limitations (TL)
- controlled surface use (CSU).



This guidance also includes the use of lease notices. Also, there is provision for special or unique stipulations, such as those required by prior agreements between agencies when the standardized forms are not appropriate. In all cases, use of the uniform forms for stipulations require identification of specific resource values to be protected and description of specific geographical area covered. Stipulations attached to noncompetitive leases require the applicant's acceptance and signature.

## Definitions

**Conditions of Approval (COA)** Conditions or provisions (requirements) under which an Application for a Permit to Drill or a Sundry Notice is approved.

**Controlled Surface Use (CSU)** Use and occupancy is allowed (unless restricted by another stipulation), but identified resource values require special operational constraints that may modify the lease rights. CSU is used for operating guidance, not as a substitute for the NSO or timing stipulations.

**Exception** Case-by-case exemption from a lease stipulation. The stipulation continues to apply to all other sites within the leasehold to which the restrictive criteria apply.

**Lease Notice** Provides more detailed information concerning limitations that already exist in law, lease terms, regulations, or operational orders. A Lease Notice also addresses special items the lessee should consider when planning operations, but does not impose new or additional restrictions. Lease Notices attached to leases should not be confused with Notices to Lessees (NTL). (See 43 CFR 3160.0-5)

**Modification** Fundamental change to the provisions of a lease stipulation, either temporarily or for the term of the lease. Therefore, a modification may include an exemption from or alteration to a stipulated requirement. Depending on the specific modification, the stipulation may or may not apply to all other sites within the leasehold to which the restrictive criteria apply.

**No Surface Occupancy (NSO)** Use or occupancy of the land surface for fluid mineral exploration or development is prohibited to protect identified resource values. The NSO stipulation includes stipulations that may have been worded as No Surface Use/Occupancy, No surface disturbance, Conditional NSO, and Surface Disturbance or Surface Occupancy Restriction (by location).

**Notice to Lessees (NTL)** The NTL is a written notice issued by the authorized officer. NTLs implement regulations and operating orders, and serve as instructions on specific item(s) of importance within a State, District, or Area.

**Stipulation** A provision that modifies standard lease rights and is attached to and made a part of the lease.

**Timing Limitation (Seasonal restriction)** Prohibits surface use during specified time periods to protect identified resource values. This stipulation does not apply to the operation and maintenance of production facilities unless the findings of analysis demonstrate the continued need for such mitigation and that less stringent, project-specific mitigation measures would be insufficient.

**Waiver** Permanent exemption from a lease stipulation. The stipulation no longer applies anywhere within the leasehold.



## STIPULATION GUIDANCE

### No Surface Occupancy Stipulation Guidance

The No Surface Occupancy (NSO) stipulation is intended for use only when other stipulations are determined insufficient to adequately protect the public interest. The land use plan/NEPA document prepared for leasing must show that less restrictive stipulations were considered and determined by the authorized officer to be insufficient. The planning/NEPA record must also show that consideration was given to a no-lease alternative when applying an NSO stipulation. An NSO stipulation is not needed if the desired protection would not require relocation of proposed operations by more than 200 meters (43 CFR 3101.1-2).

The legal subdivision, distance, location, or geographic feature, and resource value of concern must be identified in the stipulation and be tied to a land use plan and/or NEPA document. Land description may be stated as;

- The "Entire Lease"
- Distance from resources and facilities such as rivers, trails, campgrounds, etc.
- Legal description
- Geographic feature such as a 100-year floodplain
- Municipal watershed, percent of slope, etc.
- Special areas with identified boundaries--area of critical environmental concern, wild and scenic river, etc.
- Other description that specifies the boundaries of the lands affected.

The estimated percent of the total lease area affected by the restriction must be given if no legal or geographic description of the location of the restriction is given. In other cases the estimated percent is optional (see Example B-1).

Land use plans and/or NEPA documents should identify the specific conditions for providing waivers, exceptions, or modifications to lease stipulations. Waivers, exceptions, or modifications must be supported by appropriate environmental analysis and documentation, and subject to the same test used to initially justify the imposition of this stipulation. Language may be added to the NSO stipulation form to provide the lessee with information or circumstances under which waivers, exceptions, or modifications would be considered. A waiver, exception, or modification may be approved if the record shows that circumstances or relative resource values have changed or that the lessee can demonstrate that operations can be conducted without causing unacceptable impacts, and that less restrictive stipulations will protect the public interest. Waivers, exceptions or modification can only be granted by the authorized officer. If the waiver, exception, or modification is inconsistent with the land use planning document, that document must be amended or the change disallowed.

If the authorized officer determines, prior to lease issuance, that a stipulation involves an issue of major concern, modification or waiver of the stipulation will be subject to public review (43 CFR 3101.1-4). The land use plan also may identify other cases when a public review is required for a waiver, exception, or modification. In such cases, wording such as the following should be added to the stipulation form to inform the lessee of the required public review: "A 30-day public notice period is required prior to modification or waiver of this stipulation."



**EXAMPLE B-1**

Serial Number \_\_\_\_\_

**NO SURFACE OCCUPANCY STIPULATION**

No surface occupancy or use is allowed on lands described below (legal subdivision or other description).

- a. T2N, R10E SLM  
Section 26, NE1/4 SW1/4
- b. T2N, R14E  
Section 30: W1/2

For the purpose of:

- a. Avoidance of steep slopes exceeding 40 percent to avoid mass slope-failure and erosion (North Slope Oil and Gas EIS).
- b. Protection of riparian area as discussed in Forest Plan (page \_\_) and EIS (page \_\_).

Any changes to this stipulation will be made in accordance with the land use plan and/or the regulatory provisions for such changes. (For guidance on the use of this stipulation, see BLM Manual 1624 and 3101 or Forest Service Manual 1950 and 2820.)

Form #/Date



## Timing Limitation Stipulation Guidance

The Timing Limitation Stipulation (often called seasonal restrictions) prohibits fluid mineral exploration and development activities for time periods less than yearlong. When using this stipulation, assure that date(s) and location(s) are as specific as possible. A limitation involves the prohibition of new surface-disturbing operations for periods of less than 60 days (43 CFR 3101.1-2).

The land use plan/NEPA document prepared for leasing must show that less restrictive stipulations were considered to be insufficient. The environmental effects of exploration, development, and production activities may differ markedly from each in scope and intensity. If the effects of reasonably foreseeable production activities necessitate timing limitation requirements, this need should be clearly documented in the record. The record also should show that less stringent, project-specific mitigation may be insufficient. In such cases the stipulation language should be modified on a case-by-case basis to clearly document that the timing limitation applies to all stages of activity.

The legal subdivision, distance, location, or geographic feature, and resource value of concern must be identified in the stipulation and be tied to a land use planning and/or NEPA document. The timing limitations for separate purposes may be written on separate forms or as combined stipulation (see Example B-2.) During the review and decision-making process for Application for Permit to Drill (APD) and Sundry Notices, the date(s) and locations(s) should be refined based on current information.

Land use plans and/or NEPA documents should identify the specific conditions for providing waivers, exceptions, or modifications to lease stipulations. Waivers, exceptions, or modifications of this stipulation, such as continuing drilling operations into a restricted time period, must be supported with appropriate environmental analysis and documentation, and would be subject to the same test used to initially justify the imposition of this stipulation. Language may be added to the stipulation form to provide the lessee with information or circumstances under which waiver, exception, or modification would be considered. The need for one-time, case-by-case exceptions of timing limitation stipulation may arise from complications or emergencies during the drilling program. The need for timely review and decision making is great in such cases. For this reason, it is desirable that land use plans/NEPA documents clarify what review procedures and other requirements, if any, would apply in such cases.

A waiver, exception, or modification may be approved if the record shows that circumstances or relative resource values have changed or that the lessee can demonstrate that operations can be conducted without causing unacceptable impacts, and that less restrictive stipulations would protect the public interest. Waivers, exceptions or modifications can only be granted by the authorized officer. If the waiver, exception or modification is inconsistent with the land use planning document, and that document does not disclose the conditions under which such changes would be allowed, the plan or NEPA document must be amended as necessary, or the change disallowed.

If the authorized officer determines, prior to lease issuance, that a stipulation involves an issue of major concern, modification or waiver of the stipulation would be subject to public review (e.g., 43 CFR 3101.1-4). The land use plan also may identify other cases when a public review is required for waiver, exception, or modification. In such cases, wording such as the following should be added to the stipulation form to inform the lessee of the required public review: "A 30-day public notice period is required prior to modification or waiver of this stipulation."



## EXAMPLE B-2

Serial Number \_\_\_\_\_

### TIMING LIMITATION STIPULATION

No surface use is allowed during the following time period(s); this stipulation does not apply to operation and maintenance of production facilities.

- a. May 1 to June 30
- b. November 15 to April 30

On the lands described below:

- a. T3N, R14E, Section 3, E1/2
- b. T2N, R17E, Section 2: All

For the purpose of:

- a. protect elk calving area; Forest Plan (page \_\_) and EIS (page \_\_).
- b. protect elk winter range. This does not apply to operation and maintenance of production facilities; North Slope Oil and Gas EIS (page \_\_).

Any changes to this stipulation will be made in accordance with the land use plan and/or the regulatory provisions for such changes. (For guidance on the use of this stipulation, see BLM Manual 1624 and 3101 or Forest Service Manual 1950 and 2820.)

Form #/Date



## Controlled Surface Use Stipulation Guidance

The Controlled Surface Use (CSU) stipulation is intended to be used when fluid mineral occupancy and use are generally allowed on all or portions of the lease area year-round, but because of special values, or resource concerns, lease activities must be strictly controlled. This stipulation replaces stipulations commonly referred to as Limited Surface Use stipulations. The CSU stipulation is used to identify constraints on surface use or operations that may otherwise exceed the mitigation provided by Section 6 of the standard lease terms and the regulations and operating orders. The CSU stipulation is less restrictive than the NSO (No Surface Occupancy) or Timing Limitation stipulations, which prohibit all occupancy and use on all or portions of a lease for all or portions of a year. The CSU stipulation should not be used in lieu of an NSO or Timing Limitation stipulation. The use of this stipulation should be limited to areas where restrictions or controls are necessary for specific types of activities rather than all activity.

The stipulation should explicitly describe the activity that is to be restricted or controlled or the operation constraints required, and must identify the applicable area and the reason for the requirement. The record must show that less restrictive stipulations were considered and determined to be insufficient. The legal subdivision, distance, location, or geographic feature, and resource value of concern must be identified in the stipulation and be tied to a land use plan and/or NEPA document (see Example B-3).

Land use plans and/or NEPA documents should identify the specific conditions providing waivers, exceptions, or modifications to lease stipulations. Waivers, exceptions, or modifications of this stipulation must be supported with appropriate environmental analysis and documentation, and will be subject to the same test used to initially justify the imposition of this stipulation. Language may be added to the stipulation form to provide the lessee with information or circumstances under which waiver, exception, or modification would be considered. A waiver, exception, or modification may be approved if the record shows that circumstances or relative resource value have changed or that the lessee can demonstrate that operations can be conducted without causing unacceptable impact, and that less restrictive stipulations would protect the public interest. Waivers, exceptions, or modifications can only be granted by the authorized officer. If the waiver, exception, or modification is inconsistent with the land use planning document, that document must be amended as necessary or the change disallowed.

If the authorized officer determines, prior to lease issuance, that a stipulation involves an issue of major concern, modification or waiver of the stipulation would be subject to public review (e.g., 43 CFR 3101.1-4). The land use plan also may identify other cases when a public review is required for waiver, exception, or modification. In such cases, wording such as the following should be added to the stipulation form to inform the lessee of the required public review: "A 30-day public notice period is required prior to modification or waiver of this stipulation."



**EXAMPLE B-3**

Serial Number \_\_\_\_\_

**CONTROLLED SURFACE USE STIPULATION**

Surface occupancy or use is subject to the following special operating constraints.

- a. Any operations within this lease must be designed or located to enable the visual quality objective of partial retention to be met within one year of commencing operations.

On the lands described below:

- a. The entire lease.

For the purpose of:

- a. To meet visual quality objectives; North Slope Oil and Gas Leasing EIS.

Any changes to this stipulation will be made in accordance with the land use plan and/or the regulatory provisions for such changes. (For guidance on the use of this stipulation, see BLM Manual 1624 and 3101, Forest Service Oil and Gas Regulations, 36 CFR, Sec. 228.104.)

Form #/Date



## Special Administration Stipulation Guidance

There is no required or suggested uniform format for special administration stipulations. They are usually provided by another agency or organization. However, other agencies are to be encouraged to use the uniform stipulation format.

Special Administration stipulations are used in situations where the three uniform stipulation forms or lease notices do not adequately address the concern. Special Administration stipulation should be used only when special external conditions, such as pre-existing agreements with other agencies, require use of a one-of-a-kind stipulation that is not used in any other area or situation. The resource use or value, location, and specific restrictions must be clearly identified. In addition, the external agency, agreement, or pre-existing use, which dictates the special restrictions, must be identified. The stipulation should state if and under what circumstances a waiver, exception, or modification may be allowed.

Examples of Special Administration stipulations are contained in the document, "Uniform Format For Oil And Gas Lease Stipulations," available through the Forest Service or BLM.

## Lease Notice Guidance

Lease Notices are attached to leases to transmit information at the time of lease issuance to assist the lessee in submitting acceptable plans of operation or to assist in administration of leases. Lease Notices are attached to leases in the same manner as stipulations; however, there is an important distinction between Lease Notices and Stipulations. Lease Notices do not involve new restrictions or requirements. Any requirements contained in a Lease Notice must be fully supported in either a law, regulation, standard lease terms, or onshore oil and gas orders. A Lease Notice is not signed by the lessee. Guidance in the use of Lease Notices is found in BLM Manual 3101 and 43 CFR 3101.1-3.

A lease notice should contain the following elements:

- the resource/use/value
- the lands affected, if applicable
- the reason(s)
- the effect on lease operations or what may be required
- a reference to the lease term, regulation, law or order from which enforcement authority is derived.

If a situation or condition is known to exist that could affect lease operations, there should be full disclosure at the time of lease issuance via a Lease Notice. If a lessee may be prevented from extracting oil and gas through a prohibition mandated by a specific nondiscretionary statute, such as the Endangered Species Act, then a stipulation may be used even though a Lease Notice would be sufficient. It is at the discretion of the authorized officer whether a situation is sufficiently sensitive to warrant the use of a lease stipulation. Example B-4 illustrates a Lease Notice.



**EXAMPLE B-4**

Serial Number \_\_\_\_\_

**LEASE NOTICE**

This lease was issued based on limited information regarding the water resources that may be affected by oil and gas operations. No activities can be approved that would violate the "Clean Water Amendments Act of 1972 as amended and the associated Federal and State regulations. In order to assure compliance with the applicable laws and regulations regarding the protection and non-degradation of water quality, the lessee may be required to collect flow and quality baseline information for any surface and subsurface waters that could be adversely affected, prior to approval of proposed operations. The lessee will be required to establish a monitoring program capable of identifying and measuring any affects to water flow and quality that may occur as a result of operations.

Requirements for baseline data collection and water monitoring will be determined on a site-specific basis.

Form #/Date



The following section lists the stipulations that will be applied (by resource by stipulation type by site specific resource area), and a short explanation of the reasons for the stipulation. This is mandated by section 102(c)(1)(ii) of the oil and gas regulations found in 36 CFR Part 228 Subpart E - Oil and Gas Resources, where it states: "As part of the analysis, the authorized Forest Officer shall identify on maps those areas that will be open to development but subject to constraints that will require the use of lease stipulations such as those prohibiting surface use on areas larger than 40 acres or such other standards as may be developed in the plan for stipulation use (WITH DISCUSSION AS TO WHY THE CONSTRAINTS ARE NECESSARY AND JUSTIFIABLE)." Section 102(e)(2) also reiterates this direction in its discussion of leasing decisions for specific lands. Forest Service policy states (FSM 2822.42) that the stipulations should be "held to a minimum consistent with those purposes", meaning that the least restrictive stipulation should be applied which protects the target resource. This section will also discuss guidelines by which future waivers, exceptions, or modifications may be granted.

When a request to modify, waive, or grant an exception to lease stipulations is received, the authorized Forest officer shall review the request as provided for in 36 CFR 228.104. As part of the review, the authorized Forest officer will ensure compliance with the NEPA and other applicable laws, and may authorize the BLM to modify, waive, or grant an exception to a stipulation if:

- 1) the action would be consistent with applicable Federal laws
- 2) the action would be consistent with the current forest land and resource management plan
- 3) the management objectives which lead to the Forest Service to require the inclusion of the stipulation in the lease can be met without restricting operations in the manner provided for by the stipulation given the change in the present condition of the surface resource involved, or given the nature, location, timing, or design of the proposed operation
- 4) the action is acceptable to the authorized Forest officer based upon a review of the environmental consequences.

## **TEPS**

**RESOURCE: Sensitive Species (Plant & Animal)**

Stipulation: No Surface Occupancy

Objective: To preclude any activities which could affect the viability of a sensitive plant/animal species.

Waiver: A waiver may be granted if surveys and research show that potential habitat for sensitive species does not exist within the area or a species is removed from this status.

Exception: Same

Modification: Same



**RESOURCE: Sensitive Species (Plant & Animal)**

Stipulation: Controlled Surface Use - A survey would be required prior to surface disturbing activities to determine the possible presence of any sensitive plant/animal species and operations would be designed or located so as to not adversely affect the viability of these species if present.

Objective: To ensure that proposed activities do not adversely affect the viability of sensitive plant/animal species.

Waiver: A waiver may be granted if surveys and research shows that potential habitat for sensitive species does not exist within the area or a species is removed from this status.

Exception: Same

Modification: Same

**WILDLIFE**

**RESOURCE: Critical Deer Fawning Range**

Stipulation: No Surface Occupancy

Objective: To preclude new surface disturbing activities within the critical deer fawning area (Figure 3-6) on a yearlong basis.

Waiver: A waiver may be granted if new habitat studies in coordination with the applicable state wildlife agency concludes that the area affected by this stipulation is no longer used as a fawning area. A waiver may also be granted if, after consultation with the applicable state wildlife agency, it is determined that activities within the area would help temporarily disperse the deer from areas of intensive use and provide a tool for herd management.

Exception: An exception may be granted if seasonal conditions are such (i.e., an early spring and snowmelt) that the deer have moved out of and are not using the general area during the particular year.

Modification: A modification of the stipulation may be granted if new habitat studies show that a portion of the area is not used as a fawning area.

**RESOURCE: Critical Deer Fawning Range**

Stipulation: Timing Limitation

Objective: To preclude new surface disturbing activities within the critical deer fawning area (Figure 3-6) which could cause increased stress and/or displacement during the critical time period (May 16 to July 1).

Waiver: A waiver may be granted if new habitat studies in coordination with the applicable state wildlife agency concludes that the area affected by this stipulation is no longer used as a fawning area. A waiver may also be granted if, after consultation with the applicable state wildlife agency, it is determined that activities within the area would help temporarily disperse the deer from areas of intensive use and provide a tool for herd management.

Exception: An exception may be granted if seasonal conditions are such (i.e., an early spring and snowmelt) that the deer have moved out of and are not using the general area during the particular year.

Modification: A modification of the stipulation may be granted if new habitat studies show that a portion of the area is not used as a fawning area.



**RESOURCE: Critical Deer Winter Range**

Stipulation: No Surface Occupancy

Objective: To preclude new surface disturbing activities within the critical deer winter range (Figure 3-6) on a yearlong basis.

Waiver: A waiver may be granted if new habitat studies in coordination with the applicable state wildlife agency concludes that the area affected by this stipulation is no longer used as a winter range. A waiver may also be granted if, after consultation with the applicable state wildlife agency, it is determined that activities within the area would help temporarily disperse the deer from areas of intensive use and provide a tool for herd management.

Exception: An exception may be granted if seasonal conditions are such (i.e., an early spring and snowmelt) that the deer have moved out of and are not using the general area during the particular year.

Modification: A modification of the stipulation may be granted if new habitat studies show that a portion of the area is not used as a winter range.

**RESOURCE: Critical Deer Winter Range**

Stipulation: Timing Limitation

Objective: To preclude new surface disturbing activities within the critical deer winter range (Figure 3-6) which could cause increased stress and/or displacement of animals during the critical time period (November 1 to April 15).

Waiver: A waiver may be granted if new habitat studies in coordination with the applicable state wildlife agency concludes that the area affected by this stipulation is no longer used as a winter range. A waiver may also be granted if, after consultation with the applicable state wildlife agency, it is determined that activities within the area would help temporarily disperse the deer from areas of intensive use and provide a tool for herd management.

Exception: An exception may be granted if seasonal conditions are such (i.e., an early spring and snowmelt) that the deer have moved out of and are not using the general area during the particular year.

Modification: A modification of the stipulation may be granted if new habitat studies show that a portion of the area is not used as a winter range.

**RESOURCE: Critical Elk Calving Range**

Stipulation: No Surface Occupancy

Objective: To preclude new surface disturbing activities within the critical elk calving area (Figure 3-5) on a yearlong basis.

Waiver: A waiver may be granted if new habitat studies in coordination with the applicable state wildlife agency concludes that the area affected by this stipulation is no longer used as a calving area. A waiver may also be granted if, after consultation with the applicable state wildlife agency, it is determined that activities within the area would help temporarily disperse the elk from areas of intensive use and provide a tool for herd management.

Exception: An exception may be granted if seasonal conditions are such (i.e., an early spring and snowmelt) that the elk have moved out of and are not using the general area during the particular year.



Modification: A modification of the stipulation may be granted if new habitat studies show that a portion of the area is not used as a calving area.

**RESOURCE: Critical Elk Calving Range**

Stipulation: Timing Limitation

Objective: To preclude new surface disturbing activities within the critical elk calving area (Figure 3-5) which could cause increased stress and/or displacement during the critical time period (May 1 to July 1).

Waiver: A waiver may be granted if new habitat studies in coordination with the applicable state wildlife agency concludes that the area affected by this stipulation is no longer used as a calving area. A waiver may also be granted if, after consultation with the applicable state wildlife agency, it is determined that activities within the area would help temporarily disperse the elk from areas of intensive use and provide a tool for herd management.

Exception: An exception may be granted if seasonal conditions are such (i.e., an early spring and snowmelt) that the elk have moved out of and are not using the general area during the particular year.

Modification: A modification of the stipulation may be granted if new habitat studies show that a portion of the area is not used as a calving area.

**RESOURCE: Critical Elk Winter Range**

Stipulation: No Surface Occupancy

Objective: To preclude new surface disturbing activities within the critical elk winter range (Figure 3-5) on a yearlong basis.

Waiver: A waiver may be granted if new habitat studies in coordination with the applicable state wildlife agency concludes that the area affected by this stipulation is no longer used as a winter Range. A waiver may also be granted if, after consultation with the applicable state wildlife agency, it is determined that activities within the area would help temporarily disperse the elk from areas of intensive use and provide a tool for herd management.

Exception: An exception may be granted if seasonal conditions are such (i.e., an early spring and snowmelt) that the elk have moved out of and are not using the general area during the particular year.

Modification: A modification of the stipulation may be granted if new habitat studies show that a portion of the area is not used as a winter range.

**RESOURCE: Critical Elk Winter Range**

Stipulation: Timing Limitation

Objective: To preclude new surface disturbing activities within the critical elk winter range (Figure 3-5) which could cause increased stress and/or displacement of animals during the critical time period (November 1 to April 15).

Waiver: A waiver may be granted if new habitat studies in coordination with the applicable state wildlife agency concludes that the area affected by this stipulation is no longer used as a winter Range. A waiver may also be granted if, after consultation with the applicable state wildlife agency, it is determined that activities within the area would help temporarily disperse the elk from areas of intensive use and provide a tool for herd management.



Exception: An exception may be granted if seasonal conditions are such (i.e., an early spring and snowmelt) that the elk have moved out of and are not using the general area during the particular year.

Modification: A modification of the stipulation may be granted if new habitat studies show that a portion of the area is not used as a winter range.

**RESOURCE: Sage Grouse Leks**

Stipulation: No Surface Occupancy

Objective: To preclude new surface disturbing activities within sage grouse lek areas (Figure 3-5) on a yearlong basis, which could eliminate these important reproductive areas from use in the future.

Waiver: A waiver may be granted if new habitat studies in coordination with the applicable state wildlife agency concludes that the area affected by this stipulation is no longer used as a lek area.

Exception: Same

Modification: Same

**RESOURCE: Sage Grouse Leks**

Stipulation: Timing Limitation

Objective: To preclude new surface disturbing activities within sage grouse lek areas (Figure 3-5) which could cause increased stress and/or displacement of animals during the critical time period (March 15 to June 1).

Waiver: A waiver may be granted if new habitat studies in coordination with the applicable state wildlife agency concludes that the area affected by this stipulation is no longer used as a lek area.

Exception: An exception may be granted if seasonal conditions are such (i.e., an early spring) that the sage grouse have moved out of and are not using the general area that particular year.

Modification: None

## **ROADLESS**

**RESOURCE: RARE II AREAS (OWENS 11/89)**

Stipulation: No Surface Occupancy

Objective: To maintain roadless characteristics of these lands .

Waiver: None

Exception: None

Modification: None

**RESOURCE: RARE II AREAS (OWENS 11/89)**



Stipulation: Controlled Surface Use

Objective: To allow occupancy of these lands for exploration, but only by means which do not require road construction (e.g. helicopter). If production is established and field development is requested, further analysis would be conducted and could consider roaded access.

Waiver: None

Exception: None

Modification: None

## **VEGETATION**

**RESOURCE: Riparian & Wetland Areas >40 acres**

Stipulation: No Surface Occupancy

Objective: To preclude surface disturbing activities which could impact riparian and jurisdictional wetlands relative to Executive Order 11990. To meet State water quality standards by maintaining and improving surface and groundwater quality, to provide habitats to maintain viable populations of fish and riparian dependent wildlife, maintain long term soil productivity, minimize man-caused soil erosion, and to maintain the integrity of associated ecosystems.

Waiver: None

Exception: An exception may be granted if the operator can demonstrate in a surface use plan of operations that adverse effects can be minimized, there are no practicable alternatives, a 404 permit is obtained (wetlands), and the area can be fully reclaimed.

Modification: A modification may be granted if an on-the-ground inspection shows that the area of the proposed activity is not riparian or a wetland.

**RESOURCE: Riparian & Wetland Areas >40 acres**

Stipulation: Controlled Surface Use

Objective: Activities would be designed and located to insure function and value of riparian and wetland areas, aquatic habitat, and surface and groundwater quality.

Waiver: None

Exception: None

Modification: A modification may be granted if an on-the-ground inspection shows that the area of the proposed activity is not riparian or a wetland.

## **WATERSHEDS & SOILS/GEOLOGIC HAZARDS**

**RESOURCE: Streams and Lakes >40 acres**



Stipulation: No Surface Occupancy

Objective: To preclude activities which could degrade surface and ground water quality, alter required habitat of viable populations of fish and riparian dependent wildlife, degrade long term soil productivity, increase man-caused soil erosion, and which would further isolate the integrity the integrity of associated ecosystems.

Waiver: None

Exception: None

Modification: A modification may be granted if an on-the-ground inspection shows that the area of the proposed activity is not a stream or lake.

**RESOURCE: Streams and Lakes >40 acres**

Stipulation: Controlled Surface Use

Objective: Activities would be designed and located to insure protection of function and values of riparian/wetlands/floodplains, aquatic habitat, and surface and groundwater quality.

Waiver: None

Exception: None

Modification: A modification may be granted if an on-the-ground inspection shows that the area of the proposed activity is not a stream or lake.

**RESOURCE: Municipal Watersheds**

Stipulation: No Surface Occupancy

Objective: To preclude activities which could disrupt or degrade water developed or managed for municipal purposes.

Waiver: A waiver may be granted if the area is no longer used as a municipal watershed.

Exception: None

Modification: None

**RESOURCE: Municipal Watersheds**

Stipulation: Controlled Surface Use

Objective: To locate and/or design activities to protect the quantity and quality of surface and groundwater.

Waiver: A waiver may be granted if the area is no longer used as a municipal watershed.

Exception: None

Modification: None



**RESOURCE: Rockfall & Landslide Areas**

Stipulation: No Surface Occupancy

Objective: To maintain or improve water quality, to meet State water quality standards, maintain long term soil productivity, and minimize man-caused soil erosion.

Waiver: None

Exception: None

Modification: A modification may be granted if, after field inspection, the area is determined to not be a rockfall or landslide area.

**RESOURCE: Slopes >40%**

Stipulation: No Surface Occupancy

Objective: To maintain or improve water quality, to maintain State water quality standards by maintaining and improving surface and ground water quality, maintain long term soil productivity, minimize man-caused soil erosion, maintain the integrity of associated ecosystems, and to preclude construction of well sites and related facilities such as tank batteries on slopes over 40% which would involve relatively large cut and fill slopes and would be difficult to rehabilitate.

Waiver: None

Exception: An exception may be granted if the operator can demonstrate in a surface use plan of operations that adverse effects can be minimized and activities safely conducted.

Modification: An modification may be granted if an on-the-ground review of a proposed well site or facility shows that an area of less than 40% slope exists or that engineering design of the site can mitigate erosion, habitat, and reclamation concerns.

**RESOURCE: Slopes > 40%**

Stipulation: Controlled Surface Use

Objective: To design and locate facilities to insure that slope stability can be maintained, State water quality standards will not be exceeded, and that reclamation of the site can be accomplished.

Waiver: None

Exception: None

Modification: None

**RESOURCE: Areas of High Erosion Potential**

Stipulation: No Surface Occupancy

Objective: To maintain or improve water quality, to meet State water quality standards, maintain long term soil productivity, minimize man-caused soil erosion, maintain the integrity of associated ecosystems, and maintain habitat for viable fish populations.



Waiver: None

Exception: An exception may be granted if the operator can demonstrate in a surface use plan of operations that adverse effects can be minimized and activities safely conducted.

Modification: A modification may be granted if, after field inspection, the area is determined to not have high erosion potential.

**RESOURCE: Areas of High Erosion Potential**

Stipulation: Controlled Surface Use

Objective: To design and locate facilities to insure that soil erosion is minimized, State water quality standards will not be exceeded, and that reclamation of the site can be accomplished.

Waiver: None

Exception: None

Modification: A modification may be granted if, after field inspection, the area is determined to not have high erosion potential.

**RESOURCE: Marginally Unstable Soils**

Stipulation: Controlled Surface Use

Objective: To warrant that activities are designed and located to insure that slope stability can be maintained, to insure State water quality standards will not be exceeded, to insure fish habitat is maintained or improved, and that reclamation of the site can be accomplished.

Waiver: None

Exception: An exception may be granted if the operator can demonstrate in a surface use plan of operations that adverse effects can be minimized and activities safely conducted.

Modification: A modification may be granted if an on site inspection demonstrates that unstable soils do not exist on the specific site.

**RECREATION**

**RESOURCE: Developed Recreation Sites**

Stipulation: No Surface Occupancy

Objective: To preclude surface occupancy and new surface disturbing activities within campgrounds and trailheads which would impact the site, facilities and the recreational experience.

Waiver: A waiver may be granted if the campground or trailhead is moved or eliminated.

Exception: Same

Modification: Same



**RESOURCE: Developed Recreation Sites**

Stipulation: Controlled Surface Use, <40 acres

Objective: To minimize disturbance and activities within campgrounds and trailheads which would impact the site, facilities and the recreational experience.

Waiver: A waiver may be granted if the campground or trailhead is moved or eliminated.

Exception: Same

Modification: Same

**RESOURCE: Semi-Primitive Non-Motorized**

Stipulation: No Surface Occupancy

Objective: To protect the recreational values and natural setting within the area designated as semi-primitive non-motorized (SPNM).

Waiver: None

Exception: An exception may be granted if development on adjacent private minerals creates a drainage situation as determined by the BLM.

Modification: None

**RESOURCE: Semi-Primitive Non-Motorized**

Stipulation: Controlled Surface Use

Objective: To allow occupancy of these lands for exploration, but only by means which do not require road construction (e.g. helicopter). If production is established and field development is requested, further analysis would be conducted and could consider roaded access.

Waiver: None

Exception: None

Modification: None

**RESOURCE: HUNTING SEASON**

Stipulation: Timing Limitation

Objective: To provide for a quality hunt by not allowing commencement of any activities within 5 days of the opening of a big game hunt through the end of the hunt (as shown in the State's annual big game regulations). This will minimize big game disturbance.



Waiver: None

Exception: None

Modification: None

**RESOURCE: HIGH RECREATION**

Stipulation: No Surface Occupancy

Objective: To preclude activities which would not maintain the integrity of these important recreational areas and their viewsheds.

Waiver: None

Exception: None

Modification: None

***VISUAL RESOURCES***

**RESOURCE: Retention Visual Quality Objective**

Stipulation: No Surface Occupancy

Objective: To preclude any activities which could impact these important viewing zones to less than a visual quality objective (VQO) of Retention.

Waiver: None

Exception: None

Modification: A modification may be granted if it can be shown that a portion of the stipulated area is screened adequately by topography or vegetation and that operations could be conducted with no visual impacts.

**RESOURCE: Retention Visual Quality Objective**

Stipulation: Controlled Surface Use - proposed activities would be required to be located or designed to meet the visual quality objective of retention within one year of commencing operations.

Objective: To insure that the visual quality of the area is maintained as Retention.

Waiver: None

Exception: An exception may be granted if for unforeseen circumstances, such as drilling problems, or other resource concerns, such as not being able to reclaim an area due to wet soil conditions, the visual quality objective can not be met within one year.

Modification: A modification may be granted if it can be shown that a portion of the stipulation is screened adequately by topography or vegetation and that operations could be conducted with minimal visual impacts. The visual quality objective of meeting retention within one year must still be met.



**RESOURCE: Partial Retention Visual Quality Objective**

Stipulation: Controlled Surface Use - proposed activities would be required to be located or designed to meet the visual quality objective of partial retention within one year of commencing operations.

Objective: To maintain the highly valued scenic quality of the area as Partial Retention.

Waiver: None

Exception: An exception may be granted if for unforeseen circumstances, such as drilling problems, or other resource concerns, such as not being able to reclaim an area due to wet soil conditions, the visual quality objective can not be met within one year.

Modification: A modification may be granted if it can be shown that a portion of the stipulated area is screened adequately by topography or vegetation and that operations could be conducted with minimal visual impacts. The visual quality objective of meeting partial retention within one year must still be met.

**SPECIAL AREAS**

**RESOURCE: Recreation Residences**

Stipulation: No Surface Occupancy

Objective: To preclude surface occupancy and new surface disturbing activities which could impact the facilities and recreational experience.

Waiver: A waiver may be granted if the recreation residence area is moved or determined to no longer be needed.

Exception: Same

Modification: Same

**RESOURCE: Research Natural Areas**

Stipulation: No Surface Occupancy

Objective: To preclude any activities which could impact these areas for the purposes they were established.

Waiver: None

Exception: None

Modification: None

**RESOURCE: Ski Area**

Stipulation: No Surface Occupancy

Objective: To preclude surface disturbing activities that would impact the site, facilities, and recreational experience.

Waiver: None



Exception: None

Modification: A modification may be granted if activities are conducted in such a way that the site, facilities, and recreational experience are not affected.

**RESOURCE: Ski Area**

Stipulation: Controlled Surface Use

Objective: To allow use to those portions of the ski area which are not currently cleared for ski slopes and which limits activities to the non-skiing months.

Waiver: None

Exception: None

Modification: None

**RESOURCE: # Management Areas**

Stipulation: No Surface Occupancy

Objective: To preclude occupancy of these areas for any mineral activity.

Waiver: None

Exception: None

Modification: None

**RESOURCE: # Management Areas**

Stipulation: Controlled Surface Use

Objective: To allow exploration only by means which do not require road construction, e.g. helicopter. This does not apply to 1A# and 2B# areas.

Waiver: None

Exception: None

Modification: None







**APPENDIX C**

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***ACTS OF AUTHORITY AND MANDATES FOR  
THE FOREST SERVICE AND BUREAU  
OF LAND MANAGEMENT***







## APPENDIX C - ACTS OF AUTHORITY AND MANDATES FOR THE FOREST SERVICE AND BUREAU OF LAND MANAGEMENT

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The authority of the Authorized Officer to make these decisions is conferred by the Leasing Reform Act of 1987. The implementing regulations gave the authority to make these decisions to Regional Foresters. The Regional Forester has delegated that authority to the Supervisors of the Wasatch-Cache and Ashley National Forests. Other acts are mandates to the Forest Supervisors that must be carried while implementing any activities on the ground.

### BACKGROUND ACTS

A series of statutes prior to the Leasing Reform Act further establish and define the authority of the Supervisor to make these decisions. These are:

#### General Mining Law of 1872 (later amended by the Mineral Leasing Act of 1920)

Public lands, including National Forest System lands, valuable for oil deposits were open to entry and placer mining claims under the General Mining Law. (See Act of February 11, 1872, 29 Stat. 526.) The General Mining Law of 1872 (30 USC 22-54) preceded the Organic Act and the establishment of the Forest Reserves and National Forests. The General Mining Law governs mining activity on public lands and National Forest System lands.

So many claims were filed under the General Mining Law that the President issued a Proclamation in 1909 withdrawing public lands from such entry, pending the enactment of legislation to protect such lands. (See U.S. v. Midwest Oil Co., 59 L.Ed. 673 (1915), and Udall v. Tallman, 13 L.Ed. 2d 616, 628 (1965)). However, protective legislation was not enacted until the Mineral Leasing Act of 1920. (See Boesche v. Udall, 373 US 472, 10 L.Ed. 2d 491, 497 (1963).) This Act authorizes the Secretary of the Interior to issue leases for disposal of certain minerals (currently applies to coal, phosphate, sodium, potassium, oil, oil shale, gilsonite, and gas). The Act applies to National Forest System lands reserved from the public domain.

#### Mineral Resources on Weeks Law Lands

The Act of March 4, 1917 (39 Stat. 1150, as supplemented; 16 U.S.C. 520); this act authorizes the Secretary of the Interior to prescribe general regulations to permit prospecting, development, and use of the mineral resources of the lands acquired under the Act of March 1, 1911, known as the Weeks Law, for the best interests of the United States.

#### Reorganization Plan No. 3 of 1946

Part IV, Section 402 (60 Stat. 1097, 1099; 5 USC Appendix). This Plan provides that development of mineral deposits in certain lands pursuant to provisions of the Mineral Resources on Weeks Law Lands Act of March 4, 1917 (Ch. 179, 39 Stat. 1134, 1150, 16 USC 520) shall be authorized by the Secretary of the Interior only when he is advised by the Secretary of Agriculture that such development will not interfere



with the primary purposes for which the land was acquired and only in accordance with such conditions as may be specified by the Secretary of Agriculture in order to protect such purposes.

### Energy Security Act of June 30, 1980

The Energy Security Act (P.L. 96-294, 94 Stat. 611; 42 USC 8801 (note), 8854, 8855) directs the Secretary of Agriculture to process applications for leases and permits to explore, drill, and develop resources on National Forest System lands, notwithstanding the current status of the land and resource management plan.

## ACTS OF AUTHORITY

### Mineral Leasing Act for Acquired Lands of August 7, 1947

The Mineral Leasing Act (Ch. 513, 61 Stat. 913; 30 USC 351, 352, 354, 359) provides that all deposits of coal, phosphate, oil, oil shale, gas, sodium, potassium, and sulphur that are owned or may be acquired by the United States and that are within the lands acquired by the United States may be leased by the Secretary of the Interior under the same conditions as contained in the leasing provisions of the mineral leasing laws. No mineral deposit covered by this section shall be leased except with the consent of the head of the executive department, independent establishment, or instrumentality having jurisdiction over the lands containing such deposit, or holding a mortgage or deed of trust secured by such lands that is unsatisfied of record, and subject to such conditions as that official may prescribe to ensure the adequate use of the lands for the primary purposes for which they have been acquired or are being administered.

### The Federal Onshore Oil and Gas Leasing Reform Act Of December 22, 1987

The 1987 Leasing Reform Act (30 USC 181, et seq.; P.L. 100-203) expanded the authority of the Secretary of Agriculture in the management of oil and gas resources on National Forest System lands and directed the Secretary to issue rules on bonding and reclamation standards. Under the Act, leases for oil and gas on National Forest System lands cannot be issued by the BLM without the approval of the Forest Service. All surface-disturbing activities on National Forest System lands must be approved by the Forest Service before operations commence. The Act also provides for inspections and enforcement of operations once commenced. Regulations implementing this statute were published in the **Federal Register by the Forest Service on March 21, 1990 (55 FR 10423, et. seq.)**. **The regulations were codified in 36 CFR 228.100 et. seq.**

### Mineral Leasing Act of February 25, 1920

"The Bureau of Land Management, Department of the Interior, is responsible for leasing under this Act. Technical administration of leases and permits is the responsibility of the U.S. Geological Survey. By interdepartmental agreement all applications to lease lands under Forest Service Jurisdiction are referred to the Forest Service for review, recommendation, and special stipulations to protect the surface and surface functions."



## **MANDATES**

### **Organic Act**

The Organic Act of June 4, 1897 (16 USC 475) established the system of Forest Reserves, which later became the National Forest System. This act defines and describes the basic purposes for which National Forests (and later, National Grasslands) are to be managed.

The Act provides in part that *"...it is not the purpose or intent of these provisions, or of said section, to authorize the inclusion therein of lands more valuable for the mineral therein, or for agricultural purposes, than for forest purposes"* (Chpt. 2, Sec. 1, (30 Stat. 34)). Provision is made for regulations allowing free use of timber and stone for bona fide miners and prospectors in 16 USC 477. Authority for regulations providing access for prospecting, locating, and developing mineral resources is found in 16 USC 478.

The General Mining Law of 1872 (30 USC 22-54) preceded the Organic Act and the establishment of the Forest Reserves and National Forests.

### **Multiple-Use Sustained-Yield Act of 1960**

The Multiple-Use Sustained-Yield Act of 1960 (16 USC 528) extended the purposes for which lands of the National Forest System could be managed. It also declared that these lands be managed for multiple uses, rather than for individual uses in individual places. Management of the individual natural resources of the lands is declared to be according to the principle of sustained yield in perpetuity.

This Act provides, in part, that *"Nothing herein shall be construed so as to affect the use or administration of the mineral resources of national forest lands ..."*

### **National Forest Management Act of 1976**

This statute (16 USC 1600, et. seq.) and its implementing regulations (36 CFR Part 219) define additional principles for management of the lands and resources of the National Forest System. This Act also directs the Forest Service to create Land and Resource Management Plans for each administrative unit of the National Forest System. The Plans are *"to provide for multiple use and sustained yield of goods and services from the National Forest System in a way that maximizes net public benefits in an environmentally sound manner"* (36 CFR 219.1(a)). The Act describes required management of renewable resources, but indicates that mineral exploration and development must be considered in the planning and management relating to the renewable resources (36 CFR 219.22).

These authorities, and the discretion of the Forest Supervisor in making these decisions, are conditioned by several other statutes. The basic laws that limit the discretion of the Supervisor to make these decisions are described below.

### **National Environmental Policy Act**

This statute (40 USC 4331 et. seq.) and its implementing regulations (40 Part 1500) apply to Federal actions relating to oil and gas leasing. This statute requires the Federal Authorized Officers in the Forest Service and other Federal Agencies to perform an environmental analysis and disclose the effects of their decisions on the quality of the human environment. The law further requires the Federal Officers to identify



and describe the significant environmental issues associated with his/her decision and to develop alternatives to his proposed action (including the alternative of no action). Federal Officers must disclose the direct, indirect, and cumulative effects of the decisions, and adverse environmental effects that cannot be avoided, the relationship between short-term uses of man's environment and the maintenance of long-term productivity, and any irreversible or irretrievable commitments of resources made by the decision.

### **The Clean Air Act of 1970**

The Clean Air Act (91 Stat. 685; 42 U.S.C. 7401 et. seq.) provides that each State is responsible for ensuring achievement and maintenance of air quality standards within its borders so long as such standards are at least as stringent as Federal Standards established by the U.S. Environmental Protection Agency (EPA).

### **The Endangered Species Act of 1973**

The Endangered Species Act (Public Law 93-204; 16 USC 15311, et. seq.), as amended, requires special protection and management on Federal lands for threatened or endangered species. The U.S. Fish and Wildlife Service (FWS) is responsible for administration of this act. Federal agencies proposing an action or processing an action proposed by a third party which "may affect", in any way, the existence of an identified species must consult with the FWS to determine if, and how, the proposed action will affect those species. Mitigation measures will be developed through the consultation process and are put forth as suggested conservation measures included a formal "FWS Biological Opinion" as to whether or not the proposed action would jeopardize the continuous existence of any officially listed endangered or threatened species.

### **Clean Water Act**

Clean Water Amendments ("Federal Water Pollution Control Act Amendments of 1972"); Act of October 18, 1972 (P.L. 92-500, 86 Stat. 816, as amended; 33 USC 1251, et seq.)-the act puts forth national standards to restore and maintain chemical, physical and biological integrity of the Nation's waters. Upon passage of Environmental Quality Acts and adoption of water quality standards, state agencies were empowered to enforce water quality standards as long as they are at least as stringent as Federal standards established by the EPA.

### **National Historic Preservation Act**

The National Historic Preservation Act is Public Law 89-665, 80 Stat. 915 (16 USC 470) as amended. Section 106 of the Act requires a Federal agency planning an undertaking to consider the effects of the action on cultural resources eligible to, or listed on, the National Register of Historic Places. Prior to the approval of the undertaking the agency must afford the Advisory Council on Historic Preservation a reasonable opportunity to comment on the undertaking.

### **Energy Policy Act of 1992**

Changed the primary term of competitive leases from five years to ten years.



**Federal Land Policy and Management Act of 1976**

This statute (43 USC 1700; et. seq.) and its implementing regulations define principles for management of public lands and their resources. This act directs the Secretary of Interior to develop, maintain, and, when appropriate, revise Land Use Plans which provide for the use of public lands and that management be on the basis of multiple use and sustained yield unless otherwise specified by law.







**APPENDIX D**

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***OIL AND GAS EXPLORATION, DEVELOPMENT,  
AND PRODUCTION***







## APPENDIX D - OIL AND GAS EXPLORATION, DEVELOPMENT, AND PRODUCTION

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Once an oil and gas lease is issued, the lessee or operator may enter upon the leasehold to conduct oil and gas operations unless otherwise limited by special stipulations. The following depicts what can be expected to occur and, therefore, assumed will occur for the purposes of this analysis when oil and gas is discovered and development of a lease is undertaken. It also is assumed that the technology of oil and gas exploration and development will not change significantly during the life of this document. This section is an integral part of the assumptions made in Chapter 2 and Appendix E.

Successful oil and gas exploration and development generally progresses through five basic operational phases. These include (1) preliminary investigation (includes geophysical exploration), (2) exploratory drilling, (3) development, (4) production, and (5) abandonment. Several operational phases can occur in the same area at the same time. One company may drill an exploratory well on a lease, while nearby, another company conducts preliminary investigations. However, if only one company is conducting operations in an area, normally only one phase of the operation will take place at a time. A lapse of several months or perhaps years may occur between the preliminary investigation and exploratory drilling phases. A lapse of several weeks or months also may occur between the exploratory drilling and development phases. The development and production phases may occur simultaneously, especially if a large field has been discovered. On an average, only 15 percent of the wildcat (exploratory) wells drilled in the United States are successful.

It may take several years to determine whether an exploratory well is a financial success. If it is a success, the operations progress through the three remaining phases over a time span ranging up to 50 years.

The lapsed time between the production and abandonment phases of a field may be 15 to 20 years. If geophysical exploration and/or exploratory drilling are unsuccessful in the discovery of a commercial deposit of oil and gas, operations are terminated and abandonment is initiated. The operation also may go directly from development to abandonment if one or more of the development wells is unsuccessful.

### **PRELIMINARY INVESTIGATIONS (PHASE 1)**

Indications of the presence of oil and gas can be obtained by exploration methods such as remote sensing and the mapping of rock outcrops and seeps. In many cases indirect methods, such as seismic, gravity, and magnetic surveys are used to delineate subsurface features that may contain oil and gas.

#### **Permitting Process**

Geophysical exploration (seismic reflection surveys) on National Forest System lands is authorized under a prospecting permit issued by the Forest Service. However, geophysical operations within the leasehold may be conducted by the lessee under the terms of the oil and gas lease without a Forest Service prospecting permit. Proposals for geophysical operations on and off an oil and gas lease are examined by the Forest Service prior to being approved or authorized. Most casual-use investigation methods, such as geological, gravity, geomagnetic, and geochemical surveys, do not require a permit since no surface disturbance occurs and only a "casual" presence on the land surface is required to conduct the operations.

In order to secure a permit for operations on National Forest System lands, the geophysical operator is required to file, in person or by mail, an application for a prospecting permit. The application must



describe the proposed activities in detail and include a map showing access routes and location of exploration activities. Upon receipt of the application, the Forest Service reviews the proposed activities to determine the stipulations necessary to protect surface uses and resources. After the Forest Service reviews the application, a permit is prepared. The operator is sent the prospecting permit indicating the stipulations, fee to be paid (if applicable), and amount of bond required. The operator must sign and return the permit with fee and bond required prior to receiving a permit. A permit is not required for casual-use investigations.

The operator must receive approval of a prospecting permit prior to initiating operations outside a lease. The operator must also notify the Forest Service of the scheduled entry onto the land, must comply with all stipulations, and receive prior approval of any changes in the original plans. A prework conference and a cultural resources survey may be required prior to undertaking surface disturbing activities. Compliance inspections are conducted by the Forest Service during exploration operations to ensure compliance with the permit and to prevent unnecessary damage to the surface resources.

The geophysical operator is required to notify the Forest Service when operations are completed. The Forest Service conducts a final inspection prior to approval of termination of the permit and release of the bond.

### **Geologic and Remote Investigations (Surveys)**

Geologic investigation begins with a review of geologic and technical data available for the area of interest. If the data indicates a potential for oil and gas, information for specific areas or trends are evaluated. If the area does not have a history of producing and no previous wildcat wells have been drilled, an extensive geophysical exploration program covering a large area may be undertaken to collect the subsurface data in order to evaluate the oil and gas producing potential.

Remote investigations may be conducted either from the air or on the ground. These are preliminary investigations that involve only casual use and no permits are required. However, the investigators must comply with the Forest Service rules and regulations. The oil and gas lease does not grant an exclusive right to conduct remote investigations and geophysical exploration. These activities may be conducted prior to, or after, leasing by either the lessee or someone other than the lessee. These investigations may result in an expression of interest to lease specific areas.

**Geological Surveys** Geological surveys normally are a casual use. Rock outcrops and topography are examined to determine the structural attitude and age of surface formation and surface maps are prepared. In some areas, sufficient information may be obtained to enable the geologist to recommend a drilling location without conducting additional exploration work.

**Geochemical and Soil-gas Surveys** Geochemical and soil-gas surveys involve casual use of the land. In geochemical surveys, the chemical contents of water, soil, or vegetative samples are analyzed for the minute presence of oil or gas.

**Gravity Surveys** Gravitational prospecting is a casual use to detect microvariations in gravity caused by the differences in the density of various rock types. The instrument used for gravity surveys is a small portable device called a gravimeter, which can be carried by an individual. There is little surface disturbance associated with gravity prospecting except that which may be caused by off-highway vehicle (OHV) use to transport equipment.



**Geomagnetic Surveys** Magnetic prospecting is used to a limited extent in oil and gas exploration. Magnetic surveyors use an instrument called a magnetometer to detect small magnetic anomalies in the earth's crust. Most magnetic surveys are conducted from the air by suspending a magnetometer under an airplane. This is a casual use. There is no surface disturbance from magnetic survey operations.

### **Seismic Reflection Surveys (Geophysical Exploration)**

Seismic prospecting is the most common indirect method used for locating subsurface structures that may contain oil and gas. Shock waves are induced into the earth using one of several methods. These waves travel downward and outward encountering various strata, each having a different seismic velocity. Sensing devices called geophones are placed on the surface to detect these reflections. The geophones are connected to a data recorder, which stores the data. The time required for the shock waves to travel from the seismic energy source down to a given reflector (a change in rock strata) and back to the geophone can be correlated to the depth of the reflector. At the present time, vibriosis and drilling/explosive are the two most commonly used geophysical exploration methods.

**Vibriosis Surveys** The thumper and vibrator methods pound or vibrate the earth to create the shock wave. Usually four large trucks, each equipped with vibrator pads (about four feet square), are used. The pads are lowered to the ground and vibrators on all trucks are turned on simultaneously. Information is recorded, the trucks are moved forward a short distance, and the process is repeated. Except where an access trail may be constructed or cross-country travel is necessary, surface disturbance is usually minimal since little surface area or disturbance is required to operate the equipment at each test site.

**Drilling/Explosives** The drilling method uses truck-mounted drills that drill small-diameter holes to depths of 100 to 200 feet. Four to twelve holes are drilled per mile of line. Usually, a 50-pound charge of explosives is placed in the hole, covered, and detonated. The explosion sends energy waves that are reflected back to the surface from subsurface rock layers. The holes are drilled along a line that can be miles in length. In rugged topography, inaccessible to wheeled vehicles, a portable drill may be transported by helicopter. A typical drilling seismic operation may use 10 to 15 men operating five to seven trucks. Under normal conditions, three to five miles of line can be surveyed each day using the explosive method. The vehicles used for a drilling program include several heavy truck-mounted drill rigs, water trucks, a computer recording truck, and several light pickups for the surveyors, shot-hole crew, geophone crew, permit man, and party chief. Public roads and existing private roads and trails are used. Off-road, cross-country travel also is necessary. Motor graders and/or dozers may be required to provide access to remote areas. Several trips a day are made along a seismograph line, which usually establishes a well defined two-track trail. Drilling water, when needed, is usually obtained locally.

In some cases, seismic exploration is conducted using small portable drills that are transported by helicopter from site to site to drill the "shot holes". The recording equipment and crews also are transported by helicopter from a staging area or landing zone. Generally, the shot holes are shallower than when drilled with truck mounted drills and the size of the explosive charge used is smaller.

**Surface Charges** Another portable technique eliminates the drill holes by placing the charges on wooden sticks, or lath, three feet above the ground. Charges used are either 2.5 or 5 pounds. Usually, ten charges in a line are detonated at once. In remote areas, a series of short seismic lines may be used to determine the regional dip and strike of subsurface formations. Seismic lines then may be aligned in relationship to the regional structures to facilitate more accurate seismic data and interpretations. The seismic sensors and energy source are located along lines on a one- to two-mile grid. Although alignment may be critical, spacing of the lines can often be changed 0.25 mile on a one-mile grid before the investigation is significantly affected.



**Primacord** Another seismic technique involves the use of explosive cord. The cord is buried in a 2.5-foot-deep furrow, plowed by a specially designed mechanical plow mounted on a tractor. Multiple sets of cord, often in a pattern, are buried at the same time. This method offers efficiency advantages over the shot-hole seismic method in that it is faster, less costly, and the quality of the data is often improved. However, surface disturbance may be considerably greater than with the shot hole seismic method.

### **Post-Lease Preliminary Investigations**

If the preliminary investigations indicate that an oil or gas trap may exist in an area, the company may secure leases either directly through the Federal leasing system or from existing leaseholders through assignment (lease is purchased and ownership is assigned). Additional preliminary investigations may be carried out after a lease is acquired. Post-leasing investigations may include airborne and surface operations similar to those of the preleasing phase. The lessee may intensify the seismic studies by extending lines on 0.5 mile grids and laying out a criss-cross pattern of lines tying to the previous seismic lines. Other preliminary investigations may also be initiated prior to drilling.

## **EXPLORATORY DRILLING (PHASE 2)**

### **Permitting Process**

Where preliminary investigations are favorable and information warrants further exploration, exploratory drilling is conducted. More precise data on the geologic structure may be obtained by stratigraphic tests using shallow holes. The presence of suspected oil and gas deposits may be confirmed by exploratory (wildcat) drilling of deep holes. Exploratory drilling on National Forest System lands is authorized only by a Federal oil and gas lease, but cannot be conducted unless a Surface Use Plan of Operations (SUPO), drilling program, and Application for Permit to Drill (APD) are approved.

Proposed construction and other operations that involve surface disturbance conducted under the terms of a lease must be approved by the Forest Service before such activities are conducted. Proposed drilling, development, and production operations must be approved by the BLM. Operations must be approved and conducted in accordance with (1) lease terms; (2) 43 CFR 3160; (3) 36 CFR 228, Subpart E; (4) Onshore Oil and Gas Order No. 1; (5) other onshore oil and gas orders; (6) applicable Notices to Lessees (NTLs); (7) conditions of approval; and (8) subsequent orders of the authorized officers of the BLM and Forest Service.

No drilling operations or related surface disturbance can be conducted without an approved APD. An APD includes a drilling plan which consists of (1) a surface use program and (2) a drilling program. The detailed information required to be submitted under each program is identified in Onshore Oil and Gas Order No. 1 and 36 CFR 228, Subpart E. An onsite inspection of the proposed wellsite, road location, and other areas of proposed surface use is conducted prior to approval. The inspection team includes BLM and Forest Service representatives, the lessee or operator, and operator's principal drilling and construction contractors and archaeologist. The purpose of the onsite inspection is to identify problems and potential environmental impacts associated with the proposal, and the methods for mitigating those impacts. These may include making adjustments to the proposed well site and road locations, identifying the construction methods to be employed, and identifying reclamation standards for the lands after drilling.

The Forest Service is responsible for conducting the environmental analysis, preparing the documentation, and providing mitigation measures to protect surface resource values on National Forest System lands for



APD approvals. The BLM is responsible for approval of the drilling program, protection of groundwater resources, and final approval of the APD.

Other proposals to occupy the surface that involve surface disturbance, but are not associated with drilling a well, must also receive advance approval under the procedures described above.

There are two options available to the oil and gas operator when applying for approval of an APD. These are (1) the Notice of Staking (NOS) option and (2) the APD option.

**NOS Option** The NOS consists of an outline of what the company intends to do including a location map and sketched site plan. The NOS document is reviewed to identify any conflicts with known resource values and also used for the onsite inspection and to provide the preliminary data to assess what items are needed to complete an acceptable surface use plan and drilling program.

**Application for Permit to Drill (APD) Option** The operator or lessee may submit a completed APD, in lieu of the NOS, to the BLM. A field inspection is held by the BLM with the operator and the Forest Service. The drilling plan may be revised or site-specific mitigation added as conditions of approval to the APD for protection of surface and/or subsurface resource values in the vicinity of the proposed activity.

Special-use permits are issued by the Forest Service for facilities, tank batteries, pipelines, truck depots, powerlines, and access roads that occupy National Forest System lands outside the lease or unit boundary whether constructed by the lessee/operator or a third party.

### **Oil and Gas Exploratory Units**

Surface use in an oil or gas prospect may be affected by unitization (consolidation) of the leaseholds. In areas of Federally-owned minerals, an exploratory unit may be formed before a wildcat exploratory well is drilled. The boundary of the unit is based on geologic data. The leaseholders of the unit can enter into an agreement to explore and/or develop and operate a unit, without regard to separate lease ownerships (43 CFR 3180). Costs and benefits of the exploration are allocated according to agreed-upon terms.

### **Stratigraphic Tests**

Stratigraphic test holes are typically drilled 100- to 500-feet deep to locate geologic indicators. The holes are usually drilled with truck-mounted equipment and disturb a relatively small area. Casing is needed for stratigraphic holes in areas of shallow high-pressure zones. The roads and trails constructed for access to the test sites are temporary and involve minimal construction. Only one to three days are required to drill each hole. The drillsite typically occupies an area approximately 30 feet by 30 feet and is sometimes placed in the center of a new or existing trail.

### **Wildcat Wells**

Wildcat wells are deeper tests, require larger drilling rigs with support facilities, and may disturb a larger surface area than stratigraphic tests. Construction of access roads, drill pads, reserve pits, and, in some cases, worker camps and helicopter pads, are typically required to conduct exploratory drilling operations.



The well site is selected on the basis of prior surface investigations, seismic surveys, data from other wells that have been drilled in the area, topography, accessibility, and requirements of lease stipulations and protection of surface resources.

### **Surface Requirements and Construction**

Upon approval of the APD, construction equipment may enter the leasehold. The types of construction equipment used include dozers (track-mounted and rubber-tired), scrapers, and motor- graders. Moving equipment to the construction site requires several semi-trucks.

Construction usually begins with the access road to the well site. Generally, the shortest feasible route consistent with the topography is selected to reduce the haul distance and construction costs. In some cases, potential environmental impacts or existing transportation plans dictate a longer route. In rough terrain, road construction uses the sidecasting method where the material taken from the cut portion of the road is used to construct the fill portion. Roads are usually constructed to an 14-foot-wide travel surface (in relatively level terrain). Road surfacing may be required in some cases because of adverse soil conditions, steepness of grade, and moisture conditions.

Well sites are selected and constructed with consideration to the amount of level surface required for safe assembly and operation of a drilling rig. The area required varies with the drilling depth and the type of rig used and may vary between two and four acres in size. An average well site is approximately 300 feet by 400 feet, or 2.75 acres. The substructure of the drilling derrick must be located on solid ground. Settling of uncompacted fill material under the drill rig may cause the substructure and mast to lean or even fall. In addition to the drilling platform, a reserve pit is constructed to accommodate spent drilling fluids and cuttings resulting from drilling. The pit is usually square or oblong, but may be constructed in another shape to accommodate topography.

All soil material suitable for plant growth is first removed from areas to be disturbed and stockpiled in a designated area. Well sites located on flat terrain usually require little more than removing the topsoil material and vegetation. Well sites on ridge tops and hillsides are constructed by cutting and filling portions of the location to provide a level area (drill pad) to accommodate the drill rig, ancillary facilities, and drilling operations. The majority of the excess cut material is stockpiled in an area that will allow easy recovery for reclamation. Extra cut material may need to be stockpiled to avoid casting the excess material down hillsides and drainages where it cannot be recovered for rehabilitation.

Depending on the relation of the drillsite to natural drainages, it may be necessary to construct water bars or diversions. The size of the area disturbed for construction and the potential for successful revegetation often depends on the steepness of the slope.

The drilling rig, and its attendant facilities such as pumps, mud tanks, generators, pipe racks, tool house, etc., are located on the drill pad. Other facilities such as storage tanks for water and fuel may be located on or near the drill pad.

### **Drilling Operations**

Usually drilling activities begin within a week or two after the well site and access road have been constructed. The drilling rig and associated equipment are moved to the site and erected. Moving a drilling rig requires 30 to 40 truckloads of equipment over public highways and private roads.



The most commonly used drilling equipment is the rotary rig, which consists of (1) a power system, normally diesel-engine-powered electric generators; (2) a hoisting system, which consists of a derrick ("mast"), crown block, and traveling block used to lift and lower the drill; and (3) the rotary system, which consists of the drill bit attached to a length of tubular high tensile steel "drill-stem pipe" (collectively called the "drill string") which is turned by a rotary table; and (4) the mud circulating system (i.e., drilling fluid) consisting of mud tanks, mud pumps, and reserve pit.

Depending on the height of the substructures, the mast may rise to over 160 feet above the ground surface and is the most visible and noticeable feature of a drill rig. The start of drilling is commonly referred to as "spudding". The actual drilling is accomplished by passing the drill string through the rotary table, which turns the drill string and bit, which in turn performs the actual drilling. The weight of the drill string provides downward pressure on the drill bit, which chips and pulverizes the rock as it rotates in the bottom of the hole. By continually adding more drill-stem pipe to the drill string, the hole is steadily deepened.

The initial hole is drilled to a depth of 80 to 100 or more feet, depending on the surface geology of the area. The hole then is lined with conductor pipe (casing). The space between the conductor pipe and the drilled hole (borehole) is filled with cement. This prevents unconsolidated surface formations from sloughing into the hole. The pipe must be set in rock that is capable of withstanding the maximum anticipated pressure to which it may be exposed.

After the conductor pipe is in place, a series of blowout preventer (BOP) valves are attached to the well. The valves close down the well in the event the drill bit penetrates rock formations exhibiting extreme pressure zones that could cause unexpected changes in pressure and a well blowout. Special attention is given to the prevention of well blowouts and most of the equipment used to support the actual drilling operations is for controlling excess pressure that may be encountered.

Blowouts are extremely dangerous and may result in uncontrolled fire, escape of toxic gases, loss of lives, extensive environmental damage, and loss of resources and equipment. It is usually very difficult and expensive to bring a well back under control. Blowout prevention equipment is tested and inspected by both the rig personnel and the BLM. The drill rig crew must be trained in safety and blowout prevention.

Drilling is resumed after installation of casing and BOP equipment using a smaller bit. After the borehole has penetrated all of the surface formations, which may contain fresh water, the bit and drill string are hoisted out of the well and another length of pipe (surface casing) is lowered into the borehole and cemented in place. The depth of the conductor pipe is an important part of blowout prevention. The casing also protects the quality of water-bearing strata (aquifers) from being contaminated by the drilling mud.

Drilling mud (fluid) is circulated through the drill pipe and bit to the bottom of the hole, then up the bore of the well, through a screen that separates the cuttings, and into holding tanks from which it is pumped back into the well. The mud is maintained at a specific weight and thickness to cool the drill bit, lubricate the drill string, seal porous rock zones, prevent blowout or loss of drilling fluid, and transport the cuttings resulting from the drilling to the surface for disposal. Various additives are used to maintain the drill mud at the desired viscosities and weights. Some additives that may be used are caustic, toxic, or acidic. The spent drilling mud and rock chips are disposed of in the reserve pit.

Water for drilling is hauled by truck to the rig storage tanks or transported by surface pipeline. Water sources are usually rivers, wells, or reservoirs. Occasionally, water supply wells are drilled on or close to the drill site. The operator must obtain a permit from the State for the use of surface or subsurface water for drilling. When the Forest Service holds the water permits for surface water (stock ponds), it must also approve such use. Water is continually being transported to the well site during drilling operations. Although it will vary significantly from well to well, approximately 40,000 barrels or up to 1,700,000 gallons



of water may be required to drill an oil or gas well to the depth of 9,000 feet. If water is hauled by truck, a significant amount of traffic to and from the drill site will be generated by water hauling. More water is required if the underground rocks are fractured and drilling fluids are lost into the formation (lost circulation zone). Uncontrollable loss of drilling fluids may cause drilling to be terminated.

In some areas where drilling must penetrate clay or shale layers, oil-base drilling muds are often used instead of water-base muds after the surface casing has been installed and cemented. The oil-base muds prevent the clays or shales from swelling and caving into the borehole, which can result in the collapse of the borehole making it impossible to pull the bit out of the hole.

As the drilling proceeds, additional casings of concentrically smaller diameter are lowered into the well and cemented in place until the final depth (target zone) is reached. During the drilling process, the drill string must be pulled from the well periodically to change the drill bit, install casing, or remove core samples from the wellbore. Core samples are analyzed to determine the type of rocks penetrated and their porosity, permeability, chemical properties, and hydrocarbon content.

Drilling operations continue 24 hours a day and seven days a week. The crews usually work three eight-hour shifts or two 12-hour shifts a day. The greatest amount of human, vehicular, and equipment activity and accompanying noise, etc., occurs during construction and drilling activities. A significant amount of traffic is generated by trucks hauling equipment and water, service companies delivering supplies and equipment and performing specialized work on the drill, drilling crew shift changes, well treatment, and testing equipment, etc. There is a high level of human activity and use of heavy construction and drilling equipment during drilling operations, which is accompanied by considerable noise and highly visible activity.

Upon completion of drilling, the well is "logged" and tested to obtain information about the rock formation and production of fluids. After completion of the tests the drill rig and other equipment are removed. If oil or gas is not discovered in commercial quantities, the well is considered dry. The operator must comply with State and Federal procedures for plugging a dry hole.

### **Directional Drilling**

Directional drilling may be used where the drill site cannot be placed directly over the reservoir, as might be the case where a river or mountain is involved, where no surface occupancy is permitted on the leasehold, or where land use restrictions require centrally located drillsites.

There are limits both to (1) the degree that the wellbore can be deviated from the vertical and (2) the horizontal distance the well can be drilled from the well site to the target zone. It is not possible to drill directionally from outside an area where surface occupancy is denied and reach a target zone at a horizontal distance of more than one or two miles from the drill site. The limit of horizontal distance also is affected by depth of the target zone, characteristics of the rock formation to be penetrated, and the additional costs of directional drilling. These factors all are considered before applying this technology.

### **Oil and Gas Discovery**

At the completion of drilling, the well is evaluated to determine if hydrocarbons can be commercially produced. A "drill-stem test" is conducted to directly measure the fluid content (water, oil, or gas) of the formation and the amount of flow and shut-in pressure of the well. The well is logged by measuring the electric resistivity that provides information as to the porosity of the rock, the kind of fluids present, and fluid saturation level of the rocks. These physical characteristics of the rock formations and associated fluids



are measured and recorded. If it is determined, based on the tests, that the well can be economically developed for production, the well is readied for production, and connected to a gathering system (refer to Field Development Phase 3 and Production Phase 4).

### **FIELD DEVELOPMENT (PHASE 3)**

The completion of a wildcat well as a commercial producer marks the beginning of the development of an oil and gas field.

#### **Approval of Field Development Plans**

A Field Development Plan consists of a coordinated collection of site-specific drilling and surface use proposals for individual wells as required by Onshore Oil and Gas Order No. 1. The lessee/operator is required to submit the plan when sufficient information is available to project a reasonably foreseeable development of the field. Sufficient information may not be available until one or more confirmation wells have been drilled to delineate the characteristics of the reservoir. The limits of a field located on a structural trap can be determined more easily than a stratigraphic field based on the information obtained from drilled wells and geophysical data. The proposed field development is subject to environmental analysis prior to approval or rejection of the APD.

The surface plan includes information on existing roads, the proposed location of the access roads, the proposed and existing wells, and the tank battery, camps, and airstrips; the proposed location and type of water supply; the proposed waste disposal methods; plans for reclamation of the surface; and other information deemed necessary.

The subsurface information required to be submitted includes:

- a) Occurrence and anticipated depths of fresh water aquifers
- b) Expected depths of possible oil or gas productive zones above or below the zone already discovered
- c) Other mineral-bearing formations
- d) The potential for entering highly permeable formations in which the drilling mud might be lost
- e) The anticipated pressures in the formations to be drilled
- f) The potential for encountering other geologic conditions that could cause drilling problems.

This information is obtained to determine whether the proposed drilling program is adequate, and to ensure the drilling mud, pressure control, casing, cementing, testing, well logging, and completion programs adequately protect the surface and subsurface environments, protect other subsurface resources, and provide safe working conditions.

#### **Well-Spacing Pattern**

Before development of an oil and gas field begins, a well-spacing pattern is established to allot a spacing unit for each well that will be drilled in the discovery area. Oil well spacing patterns in the United States range from 2.5 acres per well to 640 acres per well. Spacing units established for oil production are usually closer than gas well spacings and are generally in multiples of 40 acres (i.e., 40, 80, 160, 320, 640 acres



per well). Gas well-spacing patterns in the United States range from 40 to 1440 acres per well. Most spacing patterns established at the present time for production of gas are 160, 320, or 640 acres per well.

The well-spacing pattern established for an oil and gas field is the primary factor that determines the amount and intensity of human presence and associated activity during the development and operation of an oil and gas field and the amount of surface disturbance and land area required to accommodate surface facilities. The wider the well-spacing pattern, the lower the intensity and concentration of human activity and the less overall surface disturbance occurs within the oil and gas field. Typically, wells on the North Slope have been spaced 640 acres per well.

### **Unitization**

Surface use in an oil and gas field is affected by unitization (consolidation of leases) of the leaseholds. In areas involving Federal lands an exploratory unit is formed pursuant to 43 CFR Subpart 3180 through Subpart 3186. The area enclosed within an exploratory unit is based on available geologic data.

A unit agreement provides for (a) development and operation of the field as a single, consolidated unit without regard to separate lease ownerships; and (b) the allocation of costs and benefits according to terms of the agreement. "Exploratory units" also are formed to share the cost of drilling exploratory wells to test geologic structures. Unit agreements involving Federal leases require BLM approval.

Leases that are committed to a producing unit are considered producing leases and will not terminate as long as production continues within the unit. As the limits of the productive area are defined by additional drilling, some leases may be dropped from the unit. If a lease is dropped from a unit, the term of the lease may be extended for a period of two years if less than two years remain in the primary term of the lease.

Field development under a unit agreement reduces the surface use requirements because all wells within the unit boundaries are operated as though they are located on a single lease. Development and operations of the field are planned and conducted by a single unit operator and, therefore, duplication of field processing equipment and facilities is minimized. Oil or gas field development under a unitization plan also may involve a wider well-spacing pattern and fewer wells than fields developed on a lease by lease basis.

### **Drilling Procedures**

The drilling of development wells is essentially the same as the drilling of a wildcat well. Roads and other facilities are planned and constructed for long-term use.

### **Surface Use Requirements**

Surface uses associated with oil and gas field development wells include access roads, well sites, flowlines, storage tank batteries, and facilities to separate oil, gas, and water. In remote locations, worker camps may be required. Access roads are planned, located, and constructed for long-term use as opposed to roads built for short-term use to drill wildcat wells.



## **Surface Use and Construction Standards**

The minimum standards for design, construction, and oil and gas operations are set forth in the *Surface Operating Standards for Oil and Gas Exploration and Development, Third Edition - U. S. Forest Service and Bureau of Land Management*. The publication prescribes the minimum operating standards for oil and gas operations on Federal lands. The objective of the standards is to minimize surface disturbance, effects on other resources, and retain the reclamation potential of the disturbed area. Additional site-specific construction and design standards may be required depending on the proposed activities and conditions encountered at the construction site.

The locations for well sites, tank batteries, reserve pits, pumping stations, roads, and pipelines are selected to minimize to the extent possible the long-term impacts to other resources and disruption of other land uses. Ideal locations for oil and gas activities are seldom available and avoidance of damage to surface resources is not always possible. Well sites are constrained by the geologic target to be drilled and pipelines, because of their linear nature, cannot always be located to avoid all areas exhibiting environmental sensitivity to impacts. In the selection of sites, special attention is given to avoiding construction on steep topography and unstable soils, near streams and other open water areas, on cultural resource sites, and in threatened, endangered, or sensitive species habitats. It is not possible or practical to avoid all situations, and special construction techniques may need to be employed to minimize the impacts.

Well sites are usually located on the most level location available that accommodates the intended use consistent with reaching the geologic target. The drill site layout also can be oriented to conform to or fit into the topographic conditions at the drillsite. However, safety considerations in a hydrogen sulfide (H<sub>2</sub>S) area may be an overruling factor when determining the topographic setting and providing adequate escape routes for the drill crew. In general, steeply sloping locations, which require deep, nearly vertical cuts and steep fill slopes, are avoided or appropriately mitigated. The well site also is reviewed to determine its effect in conjunction with the location of the access road. Advantages gained on a good well site or tank battery location may be negated by adverse effects from the location of the access road.

### **Well-site Construction Standards**

Construction of the well site must conform to the approved well site and layout plan in the Surface Use Plan of Operations (SUPO) and excavation of the cut-and-fill slopes of the well site are guided by information on the surveyed construction stakes. Generally, all surface soil materials (topsoil) are removed from the entire construction area and stockpiled. The depth of topsoil to be removed and stockpiled is determined at the predrilling inspection and stated either in the proposed SUPO or specified as a condition of approval. In order to avoid mixing topsoil with subsurface materials during construction and reclamation, topsoil stockpiles are located at specified locations, out of the way of construction activities.

Fill materials are to be compacted to minimize the chance of slope failure. Terracing may be used on both cut-and-fill slopes to reduce the land area occupied by the well site, to prevent excessive water accumulation, slope failure, and erosion. If excess material needs to be excavated, the excess material is to be disposed of or stockpiled at approved locations. Snow and frozen soil material cannot be used in the construction of fill areas or reserve pits.

The area of the well pad that actually supports the drilling rig substructure must be level and capable of supporting the weight of the rig. The drilling rig, tanks, heater-treater, etc., are not placed on uncompacted fill material. The area used for mud tanks, generators, mud storage, and fuel tanks, etc., is usually slightly



sloping to provide surface drainage from the work area. Runoff water from offsite areas is diverted away from the well site by ditches, waterbars, or terraces up-slope from the drilling and well site.

The reserve pit is to be located and constructed entirely in cut material. If this is not possible, at least 50 percent of the reserve pit must be constructed below original ground level to prevent failure of the pit dike. Pit dikes constructed of fill material are to be adequately compacted.

Pits improperly constructed on slopes may leak along the plane between the natural ground level and the fill. There is a significant potential for pit failure in these situations.

It may be required to line reserve pits to prevent contamination of ground water and soil. Bentonite, plastic, or other synthetic liners may be required. Fencing of reserve pits is usually required to prevent access to wildlife or livestock. In some environmentally sensitive areas or where topography limits the size of the well site, a "self-contained mud system" may be required. The drilling fluids, mud, and cuttings are stored in metal tanks and transported to approved offsite disposal areas.

A closed mud system and safety "surge tank" may be used in lieu of a reserve pit at locations such as areas with limited space in which to locate a typical drill pad, high-water-table area, or other situations where a reserve pit cannot be accommodated. The surge tank is used to contain the spent downhole fluids, muds, and cuttings from the wellbore. Since there is no reserve pit in which to dispose of the cuttings and spent drilling fluids they must be periodically trucked from the drill site during drilling and disposed of at an approved location. The removal and disposal of the wellbore cuttings and spent drilling fluids is very expensive and closed mud systems, although not infrequently used, are not employed as a standard drilling practice.

### Roads and Access Ways

It is Forest Service policy that existing roads be used for access when they are available, when they meet Forest Service standards for the intended use, and when there are no significant conflicts with other uses. When access involves use of existing roads, the oil and gas operator may be required to contribute to the road's maintenance. Usually this use is authorized by a joint use agreement in which each user's *pro rata* share of the road maintenance costs are assessed.

New road construction, or reconstruction, by the operator is consistent with the goals of the Forest's transportation plan and must meet Forest Service standards established for the intended road use.

Proper road location is critical for the engineering success and mitigation of the environmental effects of road construction. The surface and subsurface conditions of a proposed road location also determine the cost to survey, design, construct, and maintain a road. The following factors are considered when determining road locations:

- Intended use of the road, planned season of use, and type of vehicles to be used
- Forest's transportation plan, which may already identify feasible routes for the area
- Existing data including maps and aerial photos, of administrative, biological, physical, and cultural conditions of the area.

A field reconnaissance during the predrill inspection of the proposed and alternative routes is made to determine type of excavation, landslide areas, and subgrade conditions, indicating the need for surfacing, potential cut slope problems, surface or subsurface water problem areas, suitability of fill material, potential gravel pits or quarries for road aggregate, and potential borrow and waste sites.



When steep slope areas, erosion hazard areas, visually sensitive areas, stream crossings, and other areas of high environmental sensitivity cannot be avoided, special road design, and construction techniques may be required.

Both the BLM and the Forest Service require that all permanent roads constructed by nongovernment entities across public or National Forest System lands be designed by, or constructed under the direction of, a licensed professional engineer. The design and construction requirements depend on the site conditions, planned use of the road, seasons of use, amount and type of traffic, and whether use will be short or long term. These factors also are used to determine the class of road built to accommodate the intended use(s).

The specific design specifications and requirements depend on whether the road class is (1) short term, (2) local, (3) collector; or (4) arterial road. The design and construction standards for these road classes are described in *Oil and Gas Roding Guidelines; R-4* and in *Surface Operating Standards for Oil and Gas Exploration and Development; USDI and USDA, Third Edition*, as well as Forest Plan standards and guidelines for roads.

Other factors, unique and directly applicable to the oil and gas industry, considered include:

- the prevailing wind direction in relation to the potential for encountering sour gas (H<sub>2</sub>S) and the need for a clear escape route from the drill site
- the potential for year-round operation (drillsites and producing locations may require all-weather access and special maintenance considerations for snow removal)
- the potential for exploratory drilling to result in a producing operation (the initial road alignments will be such as to allow upgrading to a permanent road if a discovery is made)

When the road location information is submitted to the Forest Service in the Surface Use Plan, the proposed route, and if applicable, alternative routes, road design standards and construction methods, are evaluated. Final approval of the road location, road design standards, and construction standards are made during processing of the Surface Use Plan.

### **Pipelines Standards**

General pipeline construction standards were established to minimize surface disturbance, provide soil stability, and preserve reclamation potential. Pipeline construction usually involves clearing vegetation and leveling a strip of land wide enough to accommodate a pipeline trench, excavated material, and pipeline construction equipment and transport trucks. The width of the area cleared and leveled is kept to a minimum consistent with access and construction requirements. The width of the disturbed area varies depending on the number of lines within a corridor, size of the pipeline, equipment, and topographic setting.

Locating pipeline routes on steep hillsides or adjacent to live watercourses is avoided to the extent possible. However, because of the extended linear nature of a pipeline these situations cannot be entirely avoided. Extensive cuts and fills that destabilize steep slopes are major problems with sidehill locations. Pipelines located adjacent to watercourses increase the risk of petroleum spills and silt from construction sites entering streams.



Pipeline beds are constructed so they do not block, dam, or change the natural watercourse of any drainage. Pipelines suspended above watercourses must provide adequate clearance for water runoff and waterborne debris, and allow for the passage of wildlife and livestock. Pipelines located on gentle topography usually require less construction and surface disturbance, and are, therefore, inherently more stable and retain greater reclamation potential.

It is a standard practice to stockpile topsoil to the side of the pipeline right-of-way prior to construction and leveling the pipeline bed. The topsoil is segregated and not mixed or covered by excavated material during construction.

Upon completion of construction, the pipeline is graded to conform to the adjoining terrain, the surface soil material returned to the right-of-way, and the pipeline right-of-way waterbarred and revegetated to avoid erosion and minimize the visual intrusion.

### **Oil Field Production Development**

Production operations in an oil field begin soon after the discovery well is completed. Portable and temporary facilities located on the drill pad are used to initiate the production of oil from the reservoir. As further drilling proceeds and reservoir limits are established, permanent production facilities are designed and installed at centralized locations. The type, size, and number of the facilities are determined by the number of producing wells, expected production rates, volumes of gas and water expected to be produced with the oil, the number of separate leases involved, and whether or not the field is being developed on a unitized or individual lease basis. Development of production on a lease basis requires handling and processing facilities be installed on or near each lease. Unitization reduces the number of facilities needed to produce, process, and store the oil prior to marketing.

### **Gas Field Production Development**

Production operations in a gas field begin when a pipeline to a market outlet is constructed. Market pipelines are not economical unless sufficient gas reserves have been proven to exist by drilling operations. Gas wells are often shut-in after completion for periods of several months or years until a pipeline connection becomes available.

### **Rate of Development**

The rate at which development wells are drilled in a newly discovered field depends upon;

- Whether the field is developed on a lease basis or unitized basis
- The probability of profitable production
- The availability of drilling equipment
- Protective drilling requirements
- The degree to which limits of the field are known.

The development of a field that is based on a stratigraphic reservoir may proceed more slowly and yield more dry holes than development of a field located on a structural trap reservoir.

The most important factor when determining how fast field development occurs is indicated production potential. If large productive capacity and substantial reserves are indicated, development drilling proceeds



at a rapid pace. If there is a question as to whether indicated reserves are sufficient to warrant additional wells, the development drilling occurs at a slower pace. An evaluation period to observe production performance may follow between the drilling of each well.

Development on an individual lease basis proceeds more rapidly than development in a unitized area. When development drilling is undertaken on a lease basis, each lessee drills his own well(s) to obtain production from the field. This creates a competitive situation where the first wells drilled produce the greatest share of oil from the reservoir and quickest and greatest return on investment. When unitized, all owners within the "participating area" share in a well's production regardless of whose lease on which the well is located. The development of a reservoir then can proceed in an orderly manner and pace.

### **Protective Drilling**

The drilling of a well to prevent drainage of petroleum to a producing well on an adjoining lease may be required in fields that contain a mixture of Federal lands and patented or fee lands. The terms of Federal leases require the drilling of a protective well on the leased tract if an "offset" well is located on adjacent non-Federal lands or on Federal lands leased at a lower royalty rate. An "offset" well is a well drilled at the next location in accordance with the established spacing rule to prevent the drainage of oil and gas to an adjoining tract where a well is being drilled or is already producing.

### **Pool Discoveries**

Discovery of a "new pay zone" within an existing field is a "pool" discovery, as distinguished from a new field discovery. A pool discovery results in the drilling of additional wells -- often on the same well pads as existing wells, or often sharing the same boreholes or separated only by a few feet. Existing wells also may be drilled deeper to the new pay zone. Each new pay zone developed requires additional flowlines, storage, and treatment facilities if the fluids from the various pools are to be kept separate. Some fields contain as many as seven or more pay zones all sharing a geologic structure that created the conditions for the accumulation of oil and gas.

## **PRODUCTION (PHASE 4)**

Production is a combination of operations that includes:

- Bringing the fluids (oil, gas, and water) to the surface
- Maintaining and/or enhancing the productive capacity of the wells
- Treating and separating the fluids
- Purifying, testing, measuring, and otherwise preparing the fluids for market
- Disposing of produced water
- Transporting oil and gas to market.

The production of oil and gas from a single well is usually initiated as soon as drilling is completed and the well is developed for production. In the meantime, other wells may be in production, being drilled, or exist only in the field development plans. Also, there is usually little time between the activities associated with exploratory drilling, oil and gas field development, and actual production of oil or gas. It may take a few months to several years before a field is fully developed. Therefore, field development activities and those activities normally associated with oil and gas production occur simultaneously during the early life of a



field. Drilling of new wells is undertaken periodically throughout the life of a producing field to increase or maintain production from the reservoir.

### Well Completion Report

A "Well Completion or Recompletion Report and Log" must be filed with the BLM within 30 days after completion of a well for production. The completion report reflects the mechanical and physical condition of the well. Geologic data and, when applicable, information on the completed interval and production is required. Operators must notify the BLM no later than the fifth business day after a well begins production. The information in these reports may be withheld from the public as proprietary information.

### Well Completions

After a well has been drilled and evaluated for its economic worth and profit, work to set the casing and prepare the well for completion and production begins. The decision to complete an individual well for production is based on the type of oil or gas accumulations involved, the expected future development that may be undertaken during the life of the well, and the economic circumstances at the time.

Well completion involves installation of steel casing between the surface casing and the oil and gas producing zone. The casing is cemented between the wellbore and casing wall to provide stability and to protect specific zones (i.e., fresh water aquifers). The casing is perforated opposite the "pay zone" and the "pay zone" may then be "stimulated" or "treated" to increase productivity.

The drilling rig and most of the support equipment are moved from the wellsite after the casing is cemented and the pay zone is stimulated. Small diameter "production" tubing is then placed inside the casing down to the producing zone. The tubing is connected to the surface equipment and transports the oil and gas from the bottom of the well to the surface. If the pressure is sufficient to raise a column of oil to the surface the well is completed as a flowing well. When pressure is not sufficient, a pumping system is installed. After the well is completed, the well is tested for a period of days or months before another well is drilled.

Temporary storage tanks are normally used to hold the produced oil during testing. A "separator" is required to separate the gas from the oil. The gas separated from the oil may be burned off as waste until a pipeline connection is available. This flaring requires prior approval from the BLM in accordance with NTL-4A, Beneficial Use. If water is produced with the oil, a "treater" is needed to separate emulsified oil and water.

### Well Stimulation

"Well stimulation" is employed to enlarge channels or to create new ones in the producing formation rock to enhance oil and gas production. Since oil is usually contained in the pores or cracks of sand or limestone formations, enlarging or creating new channels allows the oil or gas to accumulate and move more freely to a wellbore. A well may be restimulated several times during its lifetime to maintain or increase production. There is a short-term increase in activity at the well site during this process. Generally, no new surface disturbance is required to perform these operations. Two basic well stimulation methods have been developed: acid treatment and hydraulic fracturing.

Acid treatment dissolves rock with weak hydrochloric acid, thereby enlarging existing channels and opening new ones for oil to flow to the wellbore. Reservoir rocks most commonly acidized are limestone (calcium



carbonate) and dolomite that exhibit low permeability. Well servicing rigs are used to prepare both new and old wells for acid treatment.

Hydraulic fracturing is used to create or enlarge cracks in sandstone reservoirs in the same manner as acid treatment is used in limestone or dolomite reservoirs. Hydraulic pressure is applied against the formation by pumping fluid, under high pressure into the well. This pressure splits and cracks the rocks to improve the productivity of the well, or increase the rate fluids can be injected into disposal wells. Most well pads are of sufficient size to accommodate the trucks and other equipment needed to complete a "frac" job, however, a second pad and additional surface disturbance may be required for safety considerations and to accommodate the large amount of equipment needed to perform special "massive fracture" jobs.

### **Oil Wells - Wellhead Facilities**

The "wellhead" is the equipment installed to maintain control of the well at the surface and to prevent well fluids from "blowing" or "leaking" at the surface. The pressures encountered in the well determine the type of wellhead equipment needed. This varies from a simple assembly to support the weight of the production tubing in the well to a high-pressure wellhead to control reservoir pressures. Pressures in these reservoirs are usually great enough to result in a "flowing" well. However, after reservoir pressures are depleted, some type of artificial lift is usually required to bring the oil to the surface.

### **Flowing Wells**

The surface equipment at the head of a flowing well is limited to a series of valves, or "Christmas tree," and a fenced service area ranging from 15 feet by 15 feet to 50 feet by 50 feet around the wellhead. A service area also may contain a small (1 foot by 2 feet by 3 feet) gas powered chemical pump and "guy line" anchors for servicing units brought in for well repairs. Chemical pumps used to inject emulsion breakers, corrosion inhibitors, or paraffin solvents into the well or flowline may be present.

### **Artificial Lifts (Pumping)**

When a well is completed, the natural reservoir pressure drives the fluid to the surface. At some time during the life of an oil well, the pressure is depleted and some form of artificial lift is used to raise the fluid to the surface. The most common methods of artificial lift are sucker rod pumps, centrifugal pumps, hydraulic pumps, and gas lift. All of the pump systems require some type of surface equipment and a power system. All power systems generate noise; however, this ranges from almost none for electric motors to high noise levels for single-cylinder gas engines.

**Sucker Rod Pumps** - The pumping unit is the most visible and recognizable piece of equipment within oil fields. Pumping units vary in size from 4 feet to over 25 feet in height depending on depth of well. The principle of the sucker rod pump is the same as that of the common hand pump used to lift water. A series of rods and a valve move up and down through a "stuffing box" in the well to bring the oil to the surface. The stuffing box is regularly maintained to prevent oil leaks from the wellhead. Failed packing in stuffing boxes is a common cause of oil spills. The rod is connected to a reciprocating pumping unit or "pump jack". Surface pumping units are usually powered by electric motors; however, internal combustion engines are used when electric power is not available. Single-cylinder engines operate at high noise levels, whereas multi-cylinder engines operate at lower noise levels and electric motors at a low noise level.



**Centrifugal Pumps** - Centrifugal submersible oil well pumps consist of a stack of 25 to 300 electric-powered small pumps located inside the well casing. Centrifugal pumps require little equipment above the ground and generate minimal noise at the surface. Surface equipment requirements include a switch or control cabinet, the wellhead, a spool for the cable used to transmit electricity to the pumps, and an electric powerline.

**Hydraulic Pumps** - The pumping unit of a hydraulic system is located inside the well and is powered by oil under high pressure. The equipment required on the surface includes a storage tank for the power oil, a pump to pressurize the oil, an electric motor or internal combustion engine to power the oil pump, power oil regulating valves and pressure gauges, hydraulic pump, and the oil wells. The total surface area used for this type of facility may be greater than for other pumping systems if a centralized power system and additional oil pressure lines are used to carry the power oil from the pump to the wellheads. The noise level created at the wellhead depends on whether an electric motor or internal combustion engine is used to power the oil pump.

**Gas Lift** - Gas lift is commonly used where low-cost, high-pressure natural gas is available and where pressure in the petroleum reservoir is sufficient to force the petroleum part of the way up the well. In this system natural gas is injected into well casing under pressure. The gas forces the fluids up the production tubing to the surface. The gas pressure maintained inside the casing creates a flowing well. The surface equipment used for gas lift includes gas compressor, oil storage tank, and separator. The system is quiet if the compressor is powered by electric motor and little physical space is required at the wellhead.

### Gas Wells

Most gas wells produce by natural flow and, in most cases, do not require pumping. Surface use at a flowing gas well usually is limited to a 20-foot by 20-foot fenced area. Water may enter a gas well and choke off the gas flow. A pump then is installed to pump off the column of water. Some gas wells may require from periodic to almost continual water pumping. The typical gas wellhead facilities are similar to those of a flowing oil well, consisting of a relatively unobtrusive wellhead "Christmas tree".

### Oil Field Gathering Systems

Crude oil is transferred in small diameter pipelines called "flowlines" from the wells to treatment facilities and central tank storage battery before it is transported from the lease. The flowlines may be constructed with 3- or 4-inch-diameter steel pipes, but plastic pipe is more commonly used.

Flowlines are usually buried; however, under certain circumstances, may be elevated above the ground. The installation of flowlines is similar to small scale pipeline construction. Generally, a level bed is constructed to provide for vehicle access, trenching, and burial of the flowline. Flowlines are often installed in, or adjacent to, a roadbed to reduce surface disturbance and facilitate its installation.

After the oil is gathered from the field and is treated, measured, and tested, it will be transported from the lease by pipeline or trucked to market.

### Gas Field Gathering Systems

Natural gas is often sold at the wellhead and transported directly off the lease. If processing and conditioning are required to remove liquid hydrocarbons, "associated gases", and water, the gas may be



transferred to a central collection point and treating facility through flowlines prior to sale. All gas gathering systems include equipment for (1) conditioning and upgrading the gas; (2) compressing the gas so that it flows through the pipelines; and (3) controlling, measuring, and recording its flow.

### **Oil and Gas Separating, Treating, and Storage Facilities**

Fluids produced from a well normally contain oil, gas, and water. The oil, gas, and water are separated or treated before the oil is stored in the tank battery. The treating facilities may be located at the wellhead, but in a fully developed field, they are usually located at the tank battery site. If enough "natural gas" is produced with the oil to warrant separation, it will be separated from the fluids, compressed, and pipelined direct to market.

Enough "casinghead gasoline" or "drip gas" may be produced in the field to make it economical to process it for marketing. A "gasoline" plant may then be built in the area to remove natural gasoline, butane, and propane. Some of the residue gas may be used to fuel gas compressors, pump engines, and heat the separating and treating vessels. The remainder of the gas is marketed.

The oil and water produced from a well are usually in the form of an emulsion. Water is separated and removed after the gas is removed. The type of treatment facilities used depends on the amount of emulsification. If emulsification is high, chemical and/or heat treatment is used to separate the oil and water. Heat is applied in a facility called a "heater-treater", which breaks the oil in water emulsification. The heat is supplemented in most cases by chemical emulsion breakers. The oil and water, when not highly emulsified, may be separated by gravity in a tall settling tank called a "gun barrel". Conditioning equipment such as separators, heaters, dehydrators, and compressors may be located at the wellhead where the oil and gas first reach the surface or at the tank batteries and/or gas compressor stations in the field.

After the oil and water are separated, the oil is piped to storage tanks (tank batteries). The tank batteries are usually located on, or in the vicinity of, the lease. Tank batteries usually contain at least two tanks. The number and size of tanks vary with the rate of petroleum production from the field. Small leases may contain only one tank battery; large leases or units may contain several, each with its own separating, treating, and storage facilities. Tank battery sites may occupy from one to five acres depending on associated facilities and number and size of tanks.

Although natural gas is produced in varying quantities with the crude oil, in many fields the primary or sole production is the natural gas itself. The field processing to upgrade the gas for transportation and marketing consists of two primary treatments. The first is to separate the natural gas from crude oil and/or other liquid condensates including free water. In this process the gas is run through "separators" and "heater" to separate the liquids from the gas. The gas then is run through a "dehydration unit" to remove the remaining water vapor. The removal of the water vapor is important since its presence in natural gas or other hydrocarbons will form "hydrates" that precipitate out and cause blockage of pipelines. The treatment of the gas is done either at the wellhead or at a centralized field facility located at the tank battery site or at a compressor plant. No gas is stored at these facilities, but is entered directly into a marketing pipeline after treatment.

Hydrogen sulfide (H<sub>2</sub>S) and carbon dioxide (CO<sub>2</sub>) are "associated gases" commonly produced with the natural gas. H<sub>2</sub>S is extremely toxic, heavier than air, highly corrosive to unprotected metal, and will cause eventual failure of the metal. Unless these gases are present in very small quantities they must be removed from the natural gas. There are several processes used to remove "acid gases". The most common is the alkanolamine process in which the gas is absorbed in an alkanolamine solution. Large



compressors are used to compress the gas up to, or in excess of, a hundred times the normal atmospheric pressure. Large reciprocating compressors driven by gas engines are typically used, but centrifugal units driven by gas turbines or electric motors are also used. Large compressor stations along the pipeline often use natural gas from the pipeline for fuel. Compressor stations operate at a high noise level and are normally housed in large metal buildings. Storage and maintenance facilities for the gas field's operations are usually located at the compressor station. Compressor stations are the largest and most visible features in a gas field and are the center of most of the human activity.

### Disposal of Produced Water

After water is separated from oil at the tank battery, it is disposed of under BLM approval and supervision. Although most produced waters are brackish to highly saline, some produced waters are fresh enough for beneficial surface use.

Produced water from oil and gas operations is disposed of by subsurface injection, lined pits, unlined pits, or other methods acceptable to the BLM, in accordance with the requirements of Onshore Order No. 7. Disposal of produced water by disposal/injection wells requires permit(s) from the primacy Utah Division of Water Quality (UDAQ). Approval of surface use by the Forest Service also is required.

The advantages and disadvantages of the alternative water disposal systems vary. Surface systems (lined evaporation pits) may require an area larger than the tank batteries. Because saltwater seldom issues from heater-treaters completely free from oil, oil skimmer pits are installed between the separating facilities and the evaporation pits. If a skimmer or evaporation pit is accidentally breached, oil and/or saltwater spills may occur. Evaporation pits do not work efficiently at high elevations and cool temperatures. Evaporation and skimmer pits are hazardous to waterfowl and other wildlife because of the residual oil.

When saltwater is disposed of underground, it is introduced into a subsurface horizon containing water of equal or poorer quality. Also, it may be injected into the producing zone from which it originated to stimulate oil production. Dry holes or depleted wells may be converted for saltwater disposal. Occasionally new wells will be drilled for this purpose. An injection pump is used to force the saltwater into the disposal zone. Saltwater is prevented from migrating up or down from the injection zone and into other formations in disposal wells.

Although not a secondary recovery process, saltwater disposal is a common form of fluid injection. Its primary purpose is simply to dispose of the saltwater produced with crude oil. A typical system is composed of collection centers in which saltwater from several wells is gathered, a central treating plant in which corrosion-forming substances are removed, and a disposal well. The saltwater is injected into the originating zone and used to pressurize and drive the oil towards the borehole of a producing well.

### Secondary and Enhanced Recovery of Oil

Oil, gas, and water are typically trapped within fine rock pores under high pressure in the oil reservoir. Expansion of pressurized water and gas in solution forces oil out of the rock pores into the well and up to the surface. This is known as the "primary drive" or "primary recovery". Oil flowing out of the rock drains energy from the formation; pressure in the reservoir begins to slowly decline; primary drive diminishes and the production rate falls. The oil cannot be produced unless pressures within the reservoir are maintained or restored to cause displacement of the oil being held in the rock and to drive it to the wellbore. Usually, only 15 to 20 percent of the oil is recovered from a reservoir during primary production. As reservoir pressures continue to drop, gas in the oil escapes, forming bubbles in the rock pores. Installation and



implementation of a secondary and enhanced recovery system significantly increase a field's productivity and longevity. Many reservoirs are developed for secondary and enhanced recovery early in the life of a field.

## **Secondary Recovery Methods**

Fluid injection is a secondary recovery operation in which a depleted reservoir is restored to production by the injection of liquids or gases (from extraneous sources) into the wellbore. In essence, this injection restores reservoir pressures and moves the formerly unrecoverable oil through the reservoir to the well. Fluids are injected into selected wells at, or near, original pressure levels to achieve maximum recovery efficiency. Two of the more common fluid injection methods are waterflood and saltwater disposal.

The installation of a secondary recovery system involves drilling of injection wells and new recovery wells or conversion of production wells to injection wells. Fluid injection lines are installed and additional water separation and storage facilities constructed to implement the secondary recovery system. Secondary recovery results in a significant increase in the amount of water produced. Additional land area is needed to accommodate water supply facilities, water storage and treating facilities, water injection pumps, and waterlines to wells. Drilling and construction and other human activities intensify in the oil field during installation of a fluid injection system.

### Waterflood

The most commonly employed form of secondary recovery is waterflooding. Water is injected into the reservoir under pressure to drive additional oil to the producing wells. On the average, a successful waterflood doubles the amount of oil recovered from a reservoir. In some fields, water for waterfloods is injected into depleted existing wells. In other cases, additional wells may need to be drilled for water injection. Most waterfloods are difficult to operate on a lease basis, so entire fields, if not already being operated under a unitization agreement, are usually unitized before flooding. If unitization precedes a waterflood, there is little or no duplication of secondary recovery facilities. However, additional surface area is used for the water supply facilities, water storage and treating facilities, water injection pumps, and waterlines to injection wells. If the injection well is a converted producing well, the waterline replaces the producing flowline. If the injection well is a converted dry hole or a new well drilled for the waterflood, the water injection line is the only addition to the pipeline system and requires the same amount of land as a flowline for a producing well.

### Gas Injection

Gas injection is a secondary recovery technique that is generally used only in oil and gas reservoirs that have an existing gas cap. Natural gas is injected under pressure to restore and maintain reservoir pressures to displace and move oil to the producing wells.

## **Enhanced Recovery Methods (Tertiary recovery)**

Enhanced recovery methods increase the amount of oil produced and recovered from an oil reservoir beyond that obtained from primary and secondary methods. Enhanced oil recovery techniques employ chemicals, water, gases, and heat singly, either singly or in combination, to reduce the factors that inhibit oil recovery. Considerable technical and financial risk is involved because of the large investment in



equipment and the unknown factors or characteristics of the oil reservoir that may affect the success of an enhanced recovery method. There are three broad categories of enhanced recovery methods currently used; namely

- Thermal enhancement, which primarily involves injecting high-pressure steam into the oil reservoir to reduce oil viscosity and increase its ability to flow,
- Miscible flood, in which propane, butane, natural gas, CO<sub>2</sub>, or other gases are injected into the reservoir to dissolve and displace the oil,
- Chemical enhancement, which includes injecting polymers to thicken injected waters to increase uniformity of oil displacement in the reservoir or injecting detergents ("surfactants") that essentially "wash" the oil from the reservoir rocks.

As with secondary recovery systems, additional land surface is required to accommodate the injection and oil recovery systems. This includes additional wells, injection lines and flowlines, roads, storage, and treatment facilities, pumps, and injection equipment. There also is an increase in construction and drilling activities during the installation of all enhanced recovery systems.

### Transportation Pipelines

A transportation pipeline is needed in order to transport natural gas and oil to market or refineries. In most cases, oil is transported to the refinery via a pipeline, although trucks may be used to transport oil from isolated fields or new fields to pipeline terminals or the refinery.

Oil is moved through the pipeline by pumps. Pump stations are located either at gathering stations or trunkline stations, or a combination of both. A gathering station is located in or near an oil field and receives oil through a pipeline gathering system from the operators' tanks. From the gathering station, oil is relayed to a trunkline station, which is located on the main pipeline, or trunkline. The trunkline station relays the oil to refineries or shipping terminals. To maintain pressure, booster pumps are spaced along the trunkline. Tank batteries located along the line receive and temporarily store the oil before it continues.

Months and sometimes years of engineering studies and surveys of potential gas reservoirs and markets precede the final decision to build a pipeline.

Construction of a large transportation pipeline may involve as many as 250 to 300 men in a normal operation and up to 500 men in a very large operation. The amount of construction equipment needed depends on the variety and difficulty of terrain. Stream crossings, marshes, bogs, heavily timbered forests, steep slopes, or rocky ground can require different types of equipment and construction practices. 250 to 300 men can move at a rate of three miles a day with a distance of sometimes 10 or 15 miles separating the beginning of the work crew from the end.

In practice, a strip of land from 50 to 75 feet wide is cleared depending on the size of the pipe and the type of terrain. The clearing crews open fences and build gates, cattle guards, and bridges. A roadway capable of supporting vehicle access is graded and completed adjacent to the pipeline. The cleared area needs to be wide enough for the pipeline trench, the largest side-boom tractor, and transportation of pipe and equipment. In rocky terrain, a machine equipped with a ripper that extends several feet into the ground is often used to loosen rocks for removal before the ditching operation begins.

A ditch is made by loose-dirt ditching machines or by wagon drills suspended from side-boom tractors. Dynamite blasting is used for hard rock surfaces. Pipe is transported to the ditching sites where the pipe is coated, double jointed, welded, and lowered into the ditch. The pipe must be buried deep enough to



ensure that it does not interfere with normal surface uses. The Department of Transportation requires a minimum of 36 inches of cover. The trench is backfilled, compacted, and the cleared area waterbarred, and revegetated.

### **Well Servicing and Oil and Gas Field Maintenance**

Producing wells in active oil and gas fields periodically require repair and workover operations. Operations involving no new surface disturbance to redrill, deepen, and plug-back require prior approval of the authorized officer of the BLM. In some cases, these operations require the approval of the Forest Service. No prior approval or subsequent report is required for well clean-out work, routine well maintenance, bottom hole pressure survey, or for repair, replacement, or modification of surface production equipment provided no additional surface disturbance is involved.

When prior approval is required, the operator must submit a Sundry Notice, or APD, as applicable. A detailed written statement of the plan of work must be provided to the authorized officer with the appropriate form. When additional surface disturbance will occur, a description of any subsequent new construction, reconstruction, or alteration of existing facilities, including roads, damsites, flowlines and pipelines, tank batteries, or other production facilities on any lease, must be submitted to the authorized officer for environmental reviews and approvals. On National Forest System lands, the BLM coordinates with the Forest Service to obtain their approval on the surface disturbing activities. Emergency repairs may be conducted without prior approval provided the authorized officer is promptly notified.

The servicing of individual wells to improve or maintain oil and gas production is an activity that extends throughout the life of the field. This work is usually performed with the use of a well servicing unit or self-propelled workover rig, which is similar to a scaled down oil rig. Both the workover rig or well-servicing unit carry hoisting machinery that is used to pull sucker rods and tubing from the wellbore. The most common well-servicing operations conducted are: cleaning out the well, changing pumps, repairing rod string and tubing, changing the producing and reestablishing oil producing intervals, installing artificial lift, and repairing casing and other downhole equipment. There is an intense, but short-term, increase in human and motorized activity at the well site during servicing.

Construction, reconstruction, and normal maintenance work continue throughout the field's life. Flowlines, pipelines, pumping units and other oil and gas field equipment, no longer functional because of corrosion, metal fatigue, wear, or because it has become outdated and inefficient, is replaced, upgraded, or abandoned and removed. Major and minor maintenance activities are a normal part of the operations during the life of the oil and gas field.

### **Pollution Control**

All spills or leakages of oil, gas, produced water, toxic liquids or waste materials, blowouts, fires, personal injuries, and fatalities must be reported by the operator to the BLM and the surface management agency (i.e., Forest Service). The BLM requires immediate reporting of all major undesirable events (more than 100 barrels of fluid/500 MCF of gas released or fatalities involved). A spill prevention, control, and countermeasure plan (SPCC) is required by the EPA under 40 CFR Part 112 and any discharge of oil (oil spill) must be reported immediately to the National Response Center, EPA (refer to 40 CFR 110).

Firewalls/containment dikes must be constructed and maintained around all storage facilities/batteries. The containment structure must have sufficient volume to contain, at a minimum, the entire content of the



largest tank within the facility/battery, unless more stringent site-specific protective requirements are deemed necessary by the authorized officer.

### Inspection and Enforcement

The BLM and Forest Service have developed procedures to ensure that leaseholds, which are producing or expected to produce significant quantities of oil or gas in any year, or have a history of noncompliance, are inspected at least once a year. Other factors such as health, safety, and environmental concerns, and potential conflict with other resources also determine inspection priority. Inspections of leasehold operations ensure compliance with applicable laws, regulations, lease terms, Onshore Oil and Gas Orders, NTLs, other written orders of the authorized officer, and the approved plans of operation. The administration of oil and gas operations on National Forest System lands is conducted in accordance with 36 CFR 228.111 - 228.114.

### **ABANDONMENT (PHASE 5)**

All abandonments, whether they involve one wildcat well, a well no longer productive, or an entire leasehold, require the approval and acceptance of the abandonment of the individual well(s) by the BLM and the Forest Service. An acceptable abandonment includes (1) the plugging of the wellbore and (2) reclamation of the land surface to a stable and productive use.

### Approval of Abandonment

Well abandonment operations may not be started without prior approval of a "Sundry Notices and Reports on Wells" by the authorized officer of the BLM. The Sundry Notice serves as the operator's Notice of Intent to Abandon (NIA). In the case of newly drilled dry holes, failures, and in emergency situations, oral approval may be obtained from the authorized officer followed by written confirmation. In such cases, the surface reclamation requirements will have been discussed with the operator and stipulated in the approved APD. Additional surface reclamation measures may be required by the Forest Service. For older existing wells, not having an approved SUPO, a reclamation plan must be submitted with the NIA. Reclamation requirements are part of the approval of the NIA. The operator must contact the BLM prior to plugging a well to allow for approval and witnessing of the plugging operations.

### Plugging of Wells

The purpose of plugging a well is to prevent fluid migration between zones within the wellbore to protect aquifers of useable quality water, to protect other minerals from damage, and to assist in the reclamation of the surface area. Well plugging requirements vary with the characteristics of the rock, geologic strata, well design, and reclamation requirements. For wells no longer capable of production, all perforations must be isolated so as not to allow fluid to migrate up hole to the surface. The perforations may be isolated by:

- 1) Placing a cement plug across the perforations and extends 50 feet above and below the perforations
- 2) Setting a cement retainer (cement tool that acts like a plug except that cement can be pumped below the tool but no fluid can pass above the tool) +/- 100 feet above the perforations and pumping a sufficient volume of cement into the perforations



- 3) Setting a bridge plug (a tool similar to a cement retainer except that no fluid can pass in either direction) +/- 100 feet above the perforations and placing 50 feet of cement on top of the bridge plug.

The production casing may be removed. If the casing is cut and removed, the casing stub (the top of the casing remaining in the hole) must be plugged with a 100 foot cement plug to extend 50 feet inside the casing stub and 50 feet outside the casing stub (open hole). If casing is not removed the surface casing shoe must be isolated by perforating the production casing near the surface casing shoe. A cement retainer must be set about 100 feet above the perforations and a sufficient volume of cement is pumped below the retainer, through the perforations, and between the outside of the production casing and the inside of the surface casing for a distance of 100 feet. All cement plugs must have sufficient volume to fill 100 feet of hole plus an additional volume of 10 percent per 1000 feet of depth (e.g., a 100 foot plug at 5000 feet would be required to have an additional 50 feet of cement). At the surface, all annular spaces must be plugged with at least 50 feet of cement.

The operator's plan for plugging and abandonment is submitted with the Notice of Intent to Abandon and is reviewed for completeness and adequacy. Although the plugging of each well must be designed individually, the minimum requirements are described below.

In open hole situations, cement plugs must extend at least 50 feet above and below zones with fluid that has the potential to migrate, zones of lost circulation (this type of zone may require an alternate method to isolate), and zones of potentially valuable minerals. Thick zones may be isolated using 100-foot plugs across the top and bottom of the zone. In the absence of productive zones and minerals, long sections of open hole may be plugged by placing plugs every 3,000 feet. In cased holes, cement plugs must be placed opposite perforations and extending 50 feet above and below except where limited by plug back depth. (See Onshore Oil and Gas Order No. 2)

A permanent abandonment marker is required on all wells unless waived by the Forest Service. This marker pipe is usually four feet above the ground and embedded in cement at the borehole site. The pipe is capped and the well's identity and location permanently inscribed.

Dry wildcat and development wells are normally plugged before the drill rig is removed from the wellsite. This allows the drill rig to plug the hole and avoid the necessity of bringing in other plugging equipment.

Before a lessee/operator abandons a well no longer capable of production, it must be shown that it is no longer suitable for profitable operation. Wells are normally plugged when they are no longer capable of production. However, if a well has potential for use in a secondary recovery program, it may be allowed to stand idle. Truck-mounted equipment is used to plug former producing wells.

### **Surface Reclamation**

A reclamation plan is a part of the Surface Use Plan of Operations (SUPO). Reclamation may be required of any surface previously disturbed that is not necessary for continued well or other operations. When abandoning a well and other facilities that do not have a previously approved reclamation plan, a plan must be submitted with a NIA. Additional reclamation measures may be required based on the conditions existing at the time of abandonment. Any additional reclamation requirements are made part of the conditions of approval of the NIA. The general standards and guidelines for reclamation and abandonment of oil and gas operations are set forth in the third edition of the *Surface Operating Standards for Oil and Gas Exploration and Development*. Additional standards and requirements may be applied to accommodate the site-specific and geographic conditions of the reclamation site.



Prior to the start of reclamation, all equipment and debris to be reclaimed. When an entire lease is abandoned, the separators, heater treaters, tanks, and other processing and handling equipment are removed and the surface restored. Flowlines and injection lines installed on the surface are removed, but buried lines usually are left in place.

**Well Site Reclamation** - Well site reclamation must be planned on both producing and abandoned well sites. The entire site, or portion not required for the continued operation of the well, is reclaimed.

When they are dry, all excavations and mud pits must be closed by backfilling and graded to conform to the surrounding terrain. Waterbreaks and terracing may be installed to prevent erosion of fill material.

Cut and fill slopes must be reduced and graded to blend the site to the adjacent terrain. The well site may be recontoured by bringing the construction material back onto the well pad and reestablishing the natural contours where desirable. Areas surfaced with gravel are buried deep in the recontoured area to prevent possible surface exposure.

The topsoil is replaced on the reclamation area and prepared to provide a seedbed for reestablishment of desirable vegetation. Standard reclamation practices may include contouring, terracing, gouging, scarifying, mulching, fertilizing, seeding, and/or planting.

**Reserve Pit Reclamation** - All pits must be reclaimed to a natural condition similar to the rest of the reclaimed well site area. In addition, the reclaimed pit must be restored to a safe and stable condition. In most cases, if a pit contains a synthetic liner, the pit is not to be trenched (cut) or filled while still containing fluids. Pits must be allowed to dry, be pumped dry, or solidified by adding cement *in situ* prior to backfilling. The pit area is usually mounded to allow for settling. The mounding allows for positive surface drainage off the reclaimed pit, which reduces the possibility of leaching or lateral movement of undesirable substances from the buried pit into surface streams or shallow aquifers.

The concentration of hazardous substances in the reserve pit at the time of pit backfilling must not exceed the standards set forth in the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA). All oil and gas drilling-related CERCLA hazardous substances removed from a location and not reused at another drilling location are disposed of in accordance with applicable state and federal regulations.

**Road Reclamation** - Roads no longer needed for oil and gas operations and not within the Forest Service Transportation System must be abandoned, closed, and obliterated. Reclamation of abandoned roads will involve one or more of the following techniques:

- 1) Recontouring to the original contour
- 2) Recontouring to blend with natural contours
- 3) Recontouring only selected sections of the roadway
- 4) Obliteration of the roadway surface with no other modification of the road profile.

Reclamation treatments also may include ripping, scarifying, waterbarring, and barricading. Stockpiled soil, debris, and fill materials are replaced on the roadbed and the road reseeded in accordance with the approved site-specific reclamation plan.

**Pipeline and Flowline Reclamation** - Abandonment and reclamation of pipelines and flowlines, similar to the reclamation of abandoned roads involve replacing fill material in the original cuts, reducing and grading cut and fill slopes to conform to the adjacent terrain, replacement of surface soil material, waterbarring, and revegetating in accordance with the reclamation plan.



Pipeline trenches are compacted during backfilling and must be maintained to correct backfill settling and prevent erosion. Waterbars and other erosion control devices are repaired or replaced as necessary.

**Revegetation** - Disturbed areas are revegetated after the site has been contoured, graded, and the soil surface satisfactorily prepared. In order to minimize the soil erosion potentials and provide a stable seed bed, site preparation may include ripping, contour furrowing, terracing, reduction of steep cut and fill slopes, waterbarring, etc. Revegetation involves seeding, planting of containerized plants, or a combination of the two. Native perennial species, or other plant materials specified by the Forest Service are used. The oil and gas operator is advised as to species, methods of revegetation, and seasons to plant. Seeding is normally done by drilling on the contour or by other approved methods. Seeding and/or planting is repeated until satisfactory revegetation is accomplished, as determined by the Forest Service. Mulching, fertilizing, fencing, or other practices also may be required depending on site-specific conditions.

**Visual Resources** - For all activities that alter landforms, disturb vegetation, or require temporary or permanent structures, the operator is required to comply with visual resource management objectives for the area. Site-specific mitigation practices may be required by the Forest Service to avoid or minimize changes in the character of the landscape or minimize the impacts of unnatural intrusions in the landscape.

**Additional Requirements** - Additional reclamation methods and techniques that reflect local site conditions are required. Technical advances in reclamation practices that may be successfully applied to oil and gas construction are continually being developed.

### **Inspection and Final Abandonment Approval**

Final abandonment is not approved until the surface reclamation work required by the APD or NIA is completed and the required reclamation is acceptable to the Forest Service. The operator must file a Subsequent Report of Abandonment (SRA) following the plugging of a well. A Final Abandonment Notice (FAN), which indicates that the site is ready for inspections, must be filed upon completion of reclamation.

### **Release of Bonds**

If the well is covered by an individual lease bond, the period of liability on that bond is terminated once the final abandonment or phased bonding release has been approved. The principal can request termination of the period of liability from the BLM State Office holding the bond. If the well is covered by a state-wide or nation-wide bond, termination of the period of liability of these bonds is not approved until final abandonment of all activities conducted under the bond have been approved by both the BLM and Forest Service.







**APPENDIX E**

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***REASONABLE FORESEEABLE DEVELOPMENT  
SCENARIO***







## APPENDIX E - REASONABLE FORESEEABLE DEVELOPMENT SCENARIO

### INTRODUCTION

This report forecasts the rate and extent of oil and gas exploration and development activity for the years 1994 through 2009 on lands administered by the Dixie National Forest. This forecast is based on historic drilling rates and success correlated with economic trends and the geologic environment. Based on the activity rate predictions, acres of surface disturbance are then projected. These forecasts provide the level of oil and gas activity upon which the Oil and Gas Leasing Environmental Impact Statement will be based.

In this report, the forest is subdivided into potential areas. These are broad geographic areas of consistent geologic character and oil and gas resource potential. These potential areas are based on the areas evaluated for oil and gas potential in Kilbourne (1990). The certainty of occurrence, on a scale of 1 to 4, is also given for each area. The ratings are for occurrence potential and do not reflect potential for development, which is the purpose of this report. The potential for the occurrence of oil and gas within each potential area is shown in Table E-1 below:

**Table E-1  
Areas With Potential For Oil and Gas (Hydrocarbons and Carbon Dioxide)**

Ranger District	Oil and Gas Potential Area	Certainty of Occurrence
<b>Areas With Low Potential for Hydrocarbons and Carbon Dioxide</b>		
Pine Valley	Southern Bull Valley Mountains Northern Pine Valley Mountain/ Harmony Mountains	1
Teasdale	East End of Boulder Mountain	2
<b>Areas With Moderate Potential for Hydrocarbons and Carbon Dioxide</b>		
Pine Valley	Western and Northern Bull Valley Mountains	1
Pine Valley	Southern and Central Pine Valley Mountains	2
Cedar City	Markagunt Plateau	3
Powell	Sevier and Paunsaugunt Plateaus	3
Escalante, Southwest	Southern Escalante Mountains Table Cliffs Plateau Kaiparowits Plateau/ Escalante Benches	3
Teasdale and Escalante	Between the East End of Boulder Mountain and the Main Part of the Aquarius Plateau Within Teasdale Ranger District and the Eastern Part of the Escalante Ranger District along the Escalante Benches.	3
<b>Areas with Moderate Potential for Hydrocarbons and High Potential for Carbon Dioxide</b>		
Teasdale and Escalante	Aquarius Plateau Norther Escalante Mountains	4
Escalante, South	Escalante Anticline	4



Definitions of the potential ratings and certainty of occurrence of oil and gas are provided in Table E-8. Oil and Gas Potential areas are depicted in Figure 2-1 in Chapter 2.

## SUMMARY

This report predicts eight (8) wildcat exploration wells could be drilled between 1991 and 2006. The historic success ratio of one field discovery for every thirteen wildcat wells drilled suggests that at most one field would be discovered. A discovery would most likely be for carbon dioxide (CO<sub>2</sub>). CO<sub>2</sub> field development is not likely to occur unless a regional pipeline is constructed. Should a pipeline be constructed the existing resources in the Escalante Anticline, and perhaps the smaller discovery on the Aquarius Plateau, would likely be developed. This could involve approximately 25 development wells and associated field facilities. Should another CO<sub>2</sub> field be discovered, development could involve an additional 27 wells and associated facilities. Although no areas of high hydrocarbon potential occur on the Forest, there is a high level of interest in the Precambrian Chuar Formation. A discovery in the Chuar or any other area of the Forest could result in a field development, which it is assumed for this scenario, would be similar to the Upper Valley oil field involving approximately 38 wells and associated facilities.

A summary of the total surface disturbances associated with the full scenario are as follows:

- Exploration - 215 acres gross, 55 acres net
- CO<sub>2</sub> development (2 fields) - 552 acres gross, 373 acres net
- Oil field similar to Upper Valley - 264 acres gross, 201 acres net

**Total - 1031 acres gross, 629 acres net.**

## METHODOLOGY

This report first evaluates the most significant factors needed to forecast oil and gas activity: historic drilling activity, economic trends, industry interest, and geology. Preliminary forecasts of drilling activity are made using historic drilling rates alone and then using a correlation of oil and gas prices and historic drilling rates.

Finally, all the factors are brought together to build the Development Scenario To Be Used In The EIS. Based on this scenario, surface disturbances for each potential area are given at the end of the report. In this report, exploration wells include wildcat wells used to find new fields and non-producing field development wells (step-out wells) used to find the limits of an existing field.

## HISTORIC DRILLING ACTIVITY

A total of approximately 60 wells have been drilled on the Dixie National Forest since 1947. Of these, 20 were producers and 40 were exploration wells, including both wildcat and field step-out wells, some of which were converted to injection wells in the Upper Valley oil field. Table E-2 presents a summary of the drilling history on the Dixie National Forest.



**Table E-2  
Drilling History of the Dixie National Forest by Ranger District and Activity**

<b>Year</b>	<b>Number of Wells</b>	<b>Year</b>	<b>Number of Wells</b>
1947	1	1969	3
1948		1970	1
1949	1	1971	9
1950	0	1972	2
1951	2	1973	1
1952	1	1974	2
1953	0	1975	2
1954	0	1976	1
1955	0	1977	1
1956	0	1978	1
1957	1	1979	0
1958	0	1980	2
1959	0	1981	1
1960	2	1982	1
1961	2	1983	1
1962	1	1984	4
1963	3	1985	0
1964	3	1986	0
1965	2	1987	0
1966	0	1988	0
1967	5	1989	0
1968	8	1990	0
<b>Total</b>			<b>64</b>



Table E-3 shows the number of wells drilled in each of the oil and gas potential areas.

**Table E-3**  
**Number of Wells Drilled in**  
**Areas With Potential For Oil and Gas (Hydrocarbons and Carbon Dioxide)**

Ranger District	Oil and Gas Potential Area	Number of Wells
<b>Areas With Low Potential for Hydrocarbons and Carbon Dioxide</b>		
Pine Valley	Southern Bull Valley Mountains Northern Pine Valley Mountain/ Harmony Mountains	0
Teasdale	East End of Boulder Mountain	0
<b>Areas With Moderate Potential for Hydrocarbons and Carbon Dioxide</b>		
Pine Valley	Western and Northern Bull Valley Mountains	0
Pine Valley	Southern and Central Pine Valley Mountains	2
Cedar City	Markagunt Plateau	3
Powell	Sevier and Paunsaugunt Plateaus	3
Escalante, Southwest	Southern Escalante Mountains Table Cliffs Plateau Kaiparowits Plateau/ Escalante Benches	38 - Approx. 30 wells on Forest System Lands on or near the Upper Valley anticline, approx. 7 wells on the Johns Valley anticline and one well west of the Escalante anticline
Teasdale and Escalante	East End of Boulder Mountain and the main part of the Aquarius Plateau.	0
<b>Areas with Moderate Potential for Hydrocarbons and High Potential for Carbon Dioxide</b>		
Teasdale and Escalante	Aquarius Plateau Northern Escalante Mountains	7 - one of which was a minor CO <sub>2</sub> discovery
Escalante, South	Escalante Anticline	7

### Analysis of Drilling Activity

Drilling activity was sporadic between 1949 and 1959. A slight peak occurred in 1951 and 1952 (3 wells in 2 years). This was also a period of accelerated activity on other forests in Utah.

A peak in drilling activity occurred between 1960 and 1965 (31 wells in 6 years). Activities were primarily related to exploration on the southern part of the Escalante Ranger District in the Johns Valley, Upper Valley, and Escalante Anticlines. Significant shows of oil and gas and the discovery of CO<sub>2</sub> on the Upper Valley anticline in 1961 may have accounted for the drilling activity during this period.

Highest peak activity on the Forest occurred between 1966 to 1971 (26 wells in 5 years; 9 wells in 1971). This activity was a result of discovery and development of the Upper Valley oil field. Drilling activity was



steady between 1972 and 1978 (11 wells, or nearly 2 per year). A slight peak occurred between 1980 and 1984 (10 wells, or 2.5 per year).

Lulls in activity have also occurred. No wells were started between 1953 and 1956, 1958 and 1960, 1966, 1979, 1982, 1984, and 1986 to the present. The last lull could be correlated to a down turn in oil prices and lack of any new discoveries. The slight peak that occurred between 1980 and 1984 may have been related as much to renewed interest in earlier carbon dioxide discoveries in the Escalante anticline as to the high oil prices in those years.

With the exception of the major peak related to discovery of the Upper Valley field, drilling activity has generally occurred at a relatively steady rate of about one well every one and one half years.

Of the 64 wells drilled, approximately 40 were wildcats. Successes are field discoveries with development potential. Oil was discovered at Upper Valley, CO<sub>2</sub> in the Escalante Anticline, and CO<sub>2</sub> on the Aquarius Plateau. There were three successes in approximately 40 attempts for a success ratio of 1:13.

### **PROJECTION OF DRILLING ACTIVITY BY AREA BASED ON HISTORIC DRILLING RATES**

Historic oil and gas drilling rates can be used to predict future rates of drilling. Nearly all drilling on the Dixie National Forest has occurred within the last 40 years. Drilling rates over this period reflect the ups and downs of the oil and gas industry, but have limited applicability to the more recent oil and gas scene. Drilling rates over the last 15 years are more appropriate to present economic conditions. The average rate of drilling for this time period suggests a minimum level of activity that can be expected over the next 15 years, whereas drilling rates within high activity periods suggest the reasonable upper limits of what can be expected.

Over the last 15 years 11 wells have been drilled for a rate similar to the overall average, approximately one well every 1.5 years.

The upper limit for prediction of drilling activity is set by the average drilling rate for the highest activity peak. This is 26 wells over 5 years (1967-1971), or approximately 5 wells per year. This would result in 78 wells in 15 years. The highest individual year peak that can be projected by historic data is 9 wells.

### **Economic Trends in the Oil and Gas Industry**

The price per barrel in 1976 was \$8.19, the lowest within the period being considered. Since 1976, the highest oil and gas prices occurred from 1980 through 1984, with a peak of \$31.77 per barrel in 1981 (Energy Review, 1989). Periods such as these represent times of increased exploratory and production drilling activity. The prices dropped to \$12.57 per barrel in 1986 and remained relatively steady until climbing to about \$18.00 in 1990. Prices have been forecast to rise steadily to \$28.00 per barrel by the year 2000 (Energy Review, 1989). This is just below the high of \$31.77 experienced in 1981. These prices represent national trends.

### **Correlation of Oil and Gas Activity to Economic Trends**

It is not clear that oil and gas activity on the Forest correlates with the ups and downs felt by the oil and gas industry. Table E-4 shows drilling activity on the Forest since 1976 compared to national oil prices (Energy Review, 1989) and Utah oil prices (Petroleum Independent and Utah State Tax Commission). The



greatest rate of activity does correlate with the peak price years of 1980 to 1985. However, nearly as much activity occurred from 1975 to 1978 when prices were lowest.

**Table E-4  
Correlation of Drilling Activity on the Forest with Economic Trends**

Year	(from Energy Review, 1990)		(from Petroleum Independent, 1989)		(from Utah State Tax Commission, 1990)	
	Forest Wide Wells	Dollars per Barrel of Oil	Dollars per Barrel of Oil	Dollars per Thousand Cubic Feet of Gas	Dollars per Barrel of Oil	Dollars per Thousand Cubic Feet of Gas
1975	2	7.62		n/a		
1976	1	8.19	8.19	n/a		
1977	1	8.57	8.73	n/a		
1978	1	9.00	9.49	n/a		
1979	0	12.64	11.41	.72	13.01	n/a
1980	2	21.64	19.79	1.12	22.97	n/a
1981	1	31.77	34.14	1.10	33.65	n/a
1982	1	28.52	30.50	3.06	30.80	2.91
1983	1	26.19	28.12	3.40	28.70	3.18
1984	4	25.88	27.21	4.08	25.80	3.16
1985	0	24.09	23.98	3.52	23.01	3.23
1986	0	12.57	13.33	2.90	13.01	2.43
1987	0	15.40	17.25	1.88	16.60	1.80
1988	0	12.57	14.25	1.72	14.20	1.72
1989	0	15.85	17.72	n/a		
1990	0	20.03				

Price projections are shown in Table E-5. The projected price increase over the next 15 years could cause an increase in drilling activity based on this type of industry response in other areas, such as the Manti-La Sal National Forest. However, historic trends do not support such a projection on the Dixie National Forest.

**Table E-5  
Projected Price of Oil (Energy Review, 1990)**

Year	Dollars Per Barrel
1991	30.00
1992	15.90
1993	17.10
1994	18.90
1995	20.60
2000	28.00



Political instability and military conflicts in the Middle East (such as between Iraq and Iran and Iraq and Kuwait) in the recent past year have caused rapid fluctuations in the price of oil. At one point the price per barrel went over \$30 but is now relatively stable at below \$20 barrel. These conflicts in the Middle East point to the volatility and unpredictability of oil prices in the world economy.

## **INDUSTRY INTEREST**

Industry typically expresses oil and gas interest through drilling, leasing, and geophysical exploration. Expressions of interest to lease give some indication of where industry feels oil and gas might occur. As of October 1, 1989, oil and gas leasing interest has been expressed by 4 companies or individuals for 2 general areas. The first includes portions of Township 32 South to 35 South and Ranges 1 East to 3 East. This area runs from the north end of the Upper Valley anticline to the Escalante anticline, all within the Escalante Ranger District. The second area occurs in Township 36 South and Ranges 3 to 4 1/2 West. This area lies at the north end of the Paunsaugunt Plateau in the Powell Ranger District.

As of May, 1994, there is a high level of interest in the Precambrian Chuar Formation. Two wildcat wells are planned for 1994, one in the Circle Cliffs (T 33 S, R 7 E) and the other in Judd Hollow (T 43 S, R 2 E). Another well has been proposed for the central portion of the Circle Cliffs but has not yet been permitted because of its location within the Glenn Canyon National Recreation Area.

## **GEOLOGIC CONSIDERATIONS**

### **General**

Historically oil and gas exploration in southwestern Utah has centered around obvious anticlinal structures. Although most of these have been explored, few have been definitively tested. The only structures known to contain commercial quantities of oil and gas are: 1) the Upper Valley anticline which produces oil from the Timpoweap Member of the lower Triassic Moenkopi, Permian Kaibab, Mississippian Redwall formations and 2) the Escalante anticline which contains carbon dioxide in the Permian and Triassic sections. Both fields are located in the Escalante Ranger District. Consideration of the entrapment of hydrocarbons by ground water movement, such as occurs at the Upper Valley field, and the search for deeper hydrocarbons, related to Precambrian source rocks, could lead to re-testing of some structures. Considering hydrodynamic drive, the untested southwest flank of the Escalante anticline is also a potential target.

Oil and gas drilling in or near the Pine Valley, Cedar City, Powell, and Teasdale Ranger districts has been minimal. Exploration has generally been limited to perimeters leaving the plateau interiors virtually untested. Thick volcanic sections which inhibit seismic exploration, rugged and remote terrain, and failure to find another 'Upper Valley' in the obvious anticlinal structures have discouraged exploration activities.

A search for more elusive stratigraphic traps and structures hidden beneath Tertiary volcanic and sedimentary cover might follow improved geophysical exploration technology and higher oil and gas prices. Bold exploration efforts have demonstrated that the presence of igneous rock does not preclude preservation of oil and gas. For example, ARCO drilled through 2,500 feet of igneous rock in the Three Peaks laccolith and found hydrocarbon shows in the sediments below.

Heat from volcanic activity possibly generating carbon dioxide from buried carbonates has resulted in some significant deposits. Within the Dixie National Forest, CO<sub>2</sub> has been discovered in the Escalante anticline (Escalante Ranger District) and on the Aquarius Plateau within the Teasdale Ranger District. The relatively large discovery in the Escalante anticline contains an estimated 3 trillion cubic feet of CO<sub>2</sub>. The discovery



on the Aquarius Plateau yielded an initial production of 750,000 cubic feet per day (PI). No total reserve estimates are available for this discovery. CO<sub>2</sub> has not been developed commercially, to date at either location. Almost the entire forest has favorable volcanic history and heat flow for the occurrence of CO<sub>2</sub> (Brandt, 1989). Recent discoveries of carbon dioxide will probably lead to additional exploration, especially in the eastern part of the Forest. Beard Oil made a CO<sub>2</sub> discovery in the Tanner 1-27 well in August, 1990, 5 miles north of the Teasdale Ranger District.

Shows of oil have been found in nearly every unit from the Cambrian to the lower Triassic. The Mississippian Redwall Limestone, lower Permian sandstones, the Permian Toroweap and Kaibab formations, and the Timpoweap-Sinbad Member of the Triassic Moenkopi Formation are considered to have the most potential.

Recent interest in Precambrian source rocks may also lead to exploration within Dixie National Forest. A Precambrian test would be deep and costly in some areas, so favorable areas with minimal drilling depths are the most likely to be explored, such as where strata have been removed by surface erosion or below major unconformities. A wildcat well is scheduled to be started on or about May 15, 1994, in the Circle Cliffs area (T33S, R7E), and another one during the summer of 1994 in Judd Hollow (T43S, R2E, Sec. 19), to test the Precambrian Chuar Formation. A discovery, or even a significant hydrocarbon show, could significantly alter the development scenario for the Dixie National Forest.

The Dixie National Forest has low potential for entrapment of hydrocarbons in buried hills sealed by fine-grained Tertiary valley fill, such as that found in Railroad Valley, Nevada.

Coal in the Dakota Sandstone and Straight Cliffs Sandstone may have potential for coal-bed methane exploration. Although exploration for coal-bed methane is being conducted in other areas of the west, such as the Book Cliffs coal field of eastern Utah, no similar exploration is being conducted in southwestern Utah. No specific exploration activity related to coal-bed methane is forecast at this time.

New drilling technologies, such as horizontal drilling of shale units, could lead to some additional exploration. No formation has been identified as a target for such technology within the Forest.

### **Potential Areas**

The Dixie National Forest is herein subdivided into Potential Areas. These are broad geographic areas of consistent geologic character and oil and gas resource potential. Unless specified otherwise, potential for oil and gas includes hydrocarbons and carbon dioxide. The following discussion of oil and gas potential will address potential area. Note a few potential areas were combined in this discussion.

#### **Pine Valley Ranger District - Western and Northern Bull Valley Mountains and Southern and Central Pine Valley Mountains**

A thick volcanic cover over much of the area obscures the geologic picture of, but does not significantly diminish the potential for, the occurrence of hydrocarbons. However, igneous intrusion may have locally destroyed hydrocarbons. Exploration is most likely to occur along the flanks of the Pine Valley Mountains due to the thick volcanic cover on top.

The following characteristics of the area are favorable for hydrocarbon accumulations: shows of hydrocarbons, close proximity to the Virgin and Anderson Junction oil fields, fair to good reservoir characteristics in the mid to upper Paleozoic section, a thick sedimentary section, potential source beds



such as the Chainman Shale down dip to the west, anticlinal structures, the potential for anticlinal structures hidden beneath Tertiary cover, rapid facies changes that may provide stratigraphic traps, and thrusts that could place reservoir rocks atop source rocks. Locally this potential is diminished where the geologic section has been disrupted by closely spaced tensional faults that could have breached potential traps. Favorable conditions for carbon dioxide occurrence are the presence of: volcanics, nearby geothermal resources, and carbon dioxide in the #1 Polly Ann development well in the southern part of the Virgin oil field (Brandt, 1989).

Overall, this area has moderate potential for oil and gas accumulations. Geologic information is based primarily on surface mapping and inference from surrounding areas because minimal direct subsurface information is available. Therefore, the confidence in the potential rating is low.

### **Pine Valley Ranger District - Southern Bull Valley Mountains and Northern Pine Valley Mountains/Harmony Mountains**

This is a band of intensely faulted terrain running eastward from the Nevada border and north of the main body of the Pine Valley Mountains. Hydrocarbons are likely to have escaped to the surface through the tensional fault structures. Any hydrocarbon traps that may still exist are likely to be very small, limited by the size of un-fractured blocks. There is some possibility that this faulted terrain does not extend below the upper plate of thrusts which are expected to underlie the area. The favorable hingeline location, may provide some potential for deep thrust related traps. The presence of volcanics and nearby geothermal resources indicates favorable conditions for generation of carbon dioxide gas.

Overall, the potential for the accumulation of oil and gas is low. Geologic information is based primarily on surface mapping and inference from surrounding areas because no direct subsurface information is available. Therefore the confidence in the potential rating is low.

### **Cedar City Ranger District (Markagunt Plateau)**

This area lies on the east side of the hingeline and may have received hydrocarbons that migrated up-dip from the Cordilleran geosyncline to the west. Rapid facies changes may provide stratigraphic traps. The close proximity to the Anderson Junction and Virgin oil fields demonstrate the presence of source rocks. The few wells drilled have also demonstrated the presence of a favorable Paleozoic to lower Mesozoic reservoir rocks such as the Timpoweap and Kaibab. The area, however, lies east of the Sevier thrust belt and lacks potential for thrust related traps.

Volcanics cover a substantial portion of the District. Although they obscure the geologic picture they are likely only to diminish potential for hydrocarbons in the immediate vicinity of volcanic vents which are numerous in some parts of the District. Faulting may have locally allowed hydrocarbons to escape, but these faults are generally widely spaced and may even provide mechanisms for entrapment. Precambrian source rocks may underlie the east side of the District. Favorable conditions for carbon dioxide occurrence are the presence of: volcanics, nearby geothermal resources, and carbon dioxide in the #1 Polly Ann development well in the southern part of the Virgin oil field (Brandt, 1989).

This area has moderate potential for oil and gas accumulations. Geologic information is based primarily on surface mapping and inference from surrounding areas because minimal direct subsurface information is available.



### **Powell Ranger District (Sevier and Paunsaugunt Plateaus)**

Laramide structures similar to the Upper Valley anticline may be hidden beneath the thick Tertiary cover of the plateau interiors. The northern part of the District on the Sevier Plateau is characterized by a thick volcanic cover and contains a few igneous intrusions. The volcanic activity may have generated carbon dioxide similar to that accumulated in the Escalante and Teasdale Ranger Districts to the east. Although the thick volcanic cover obscures the subsurface geology, it is not likely to have significantly diminished the potential for occurrence of hydrocarbons except near the intrusions. Wells drilled around the perimeter of the area have generally resulted in hydrocarbon shows. The District also has potential to be underlain by source rocks of the Precambrian Chuar Group and by reservoir rocks and seals within the Cambrian section.

This area has moderate potential for oil and gas accumulations. Geologic information is based primarily on surface mapping, direct subsurface information from only a few wells, and inference from surrounding areas. Therefore the confidence in the potential rating is low.

### **Escalante Ranger District south - Southern Escalante Mountains, Table Cliffs Plateau, Kaiparowits Plateau/Escalante Benches**

This area generally has moderate potential for carbon dioxide gas accumulations. However the Escalante anticline, which contains known carbon dioxide reserves, has high potential for additional carbon dioxide resources. Even though the area contains the productive Upper Valley oil field, it has only moderate potential for additional oil and gas accumulations. After extensive testing of the Permian and lower Triassic section in the obvious structures of the area, only one discovery was made, the Upper Valley oil field. The potential for additional discoveries in that geologic section is, therefore, low. However, the mid to lower Paleozoic section, especially the porous Mississippian Redwall Limestone, has not been adequately tested. Units overlying the Precambrian source rocks of the Chuar Group are essentially untested. No stratigraphic targets have been pursued.

This rating is based on both geologic surface mapping and subsurface information derived from over 35 wells drilled within the area. Therefore confidence in the potential rating is moderate to high.

Extensive testing of obvious anticlinal structures with no new oil discoveries suggests much lower drilling activity. Re-testing of some of these structures may occur with consideration to the effects of hydrodynamic drive. As with the Powell District, new potential exists for carbon dioxide and Precambrian related exploration. Should the Escalante Anticline go into production, additional development wells would be drilled. Lack of production on this structure may be related to the lack of local demand and lack of a regional pipeline. Additionally, exploration and development of CO<sub>2</sub> in the Escalante anticline will be constrained by the Box-Death Hollow Wilderness Area and conditions established by the 1984 Wilderness Act for management of the area.

### **Aquarius Plateau and Boulder Mountain - Escalante and Teasdale Ranger Districts**

Most of this area has high potential for carbon dioxide gas accumulations and moderate potential for hydrocarbon accumulations. High carbon dioxide potential is indicated by one discovery made within the Teasdale Ranger District on the Aquarius Plateau; discoveries a few miles to the south in the Escalante anticline and to the north in the Thousand Lakes Mountain area; and presence of volcanics which could generate carbon dioxide from carbonates below. The moderate hydrocarbon potential is based on significant shows, close proximity, and similar geology at depth to the producing Upper Valley oil field.



The east end of Boulder Mountain has low potential due to the likelihood of oil and gas migration up-dip, away from the Forest. A small area of moderate potential for both oil and gas lies between the unfavorable east end of Boulder Mountain and the more favorable area toward the mountain's interior.

This rating is based on both geologic surface mapping and subsurface information derived from a few wells drilled within the area and inferred from well information in adjacent areas. Therefore confidence in the potential rating is low to moderate. This area shares with adjacent areas the potential for carbon dioxide, as demonstrated by one discovery, and for Precambrian exploration.

Exploration activity and areas of interest will probably change as new geologic information is gathered. This information will help focus future exploration activities.

## **DEVELOPMENT SCENARIO TO BE USED IN THE EIS**

For the purposes of establishing a reasonably foreseeable oil and gas activity level in the Oil and Gas Leasing EIS, we will combine historic drilling rates, projected economic trends, industry interest, and geologic factors.

Exploration activity is likely to be slightly less than historic annual drilling rates would indicate. The failure to discover any new oil and gas resources since the discovery of the Upper Valley Field in 1964 has put a damper on oil and gas exploration. The southwestern part of the Escalante Ranger District is not likely to experience the high rates of activity that occurred there after the discovery of the Upper Valley oil field. CO<sub>2</sub> activity is likely to be halted unless a regional pipeline is constructed that could carry reserves to market from the Escalante Anticline and the Aquarius Plateau. This is based on the existing situation, and may change suddenly if there is a discovery in the Chuar Formation. The reasonably foreseeable activity rates are as follows:

Forest wide, 9 exploration wells are forecast over the next 15 years.

Considering the historic success ratio of approximately 1 discovery for 13 tries, no more than one field discovery could reasonably be forecast. Discovery is most likely to occur in the areas of high potential for CO<sub>2</sub> in the Escalante and Teasdale Ranger Districts, but may occur in the areas of moderate potential for CO<sub>2</sub> and oil and gas resources elsewhere in the Forest. Even if CO<sub>2</sub> resources are discovered, activity is unlikely to increase significantly until a regional CO<sub>2</sub> pipeline is constructed. However, the discovery of substantial, additional CO<sub>2</sub> resource would provide greater justification for constructing such a pipeline.

If additional oil and gas resources are discovered, both exploration and development activity are likely to increase. The activity rate could be similar to the peak historic activity rate of 5 wells per year experienced between 1966 and 1971.

The Escalante Anticline is an undeveloped field discovery for CO<sub>2</sub> which could be developed. The CO<sub>2</sub> discovery on the Aquarius Plateau (Shell Federal-Harvey) is too small to be developed as an independent field.

Although hydrocarbon potential on the Dixie National Forest is considered only moderate, an oil field, modeled after Upper Valley oil field, is included on this scenario to provide information for completing an environmental analysis. The specific number of wells related to field development are included in discussions below on field developments.



**Table E-6**  
**Projected Number of Wells to be Drilled in**  
**the Dixie National Forest**

Ranger District	Oil and Gas Potential Area	Number of Wells
Pine Valley	Southern Bull Valley Mountains Northern Pine Valley Mountain/ Harmony Mountains	0
Teasdale	East End of Boulder Mountain	0
Pine Valley	Western and Northern Bull Valley Mountains	0
Pine Valley	Southern and Central Pine Valley Mountains	1
Cedar City	Markagunt Plateau	1
Powell	Sevier and Paunsaugunt Plateaus	1
Escalante, Southwest	Southern Escalante Mountains Table Cliffs Plateau Kaiparowits Plateau/ Escalante Benches	1
Teasdale and Escalante	Boulder Mountain and Escalante Benches - area between the unfavorable east end of Boulder mountain and the more favorable of Boulder mountain and the Escalante Anticline to the West	0
Teasdale and Escalante	Aquarius Plateau Norther Escalante Mountains Boulder Mountain	3
Escalante	Escalante Anticline	2

**Surface Disturbance of Development Scenario**

All figures given in this section represent averages from past Dixie National Forest activities or projections based on similar activities elsewhere. Actual figures could vary +/- 20% based on specific conditions at any given site.

**Exploration**

Each well would require 4.1 miles of access road and a well pad. The road distance is composed of 1.8 miles (@1.7 acres/mile) of light reconstruction of existing roads and 2.3 miles (@4.25 acres/mile) of new construction. Road type would be single lane with turnouts.

Each mile of access road impacts 3.13 gross acres and 2.67 net acres after rehabilitation of cuts and fills. Each well pad initially impacts 2.25 gross acres and no net acres after rehabilitation if it is unsuccessful or not put into production.







**Table E-7**  
**Land Surface Disturbance Associated with Exploration**

Ranger District	Oil and Gas Potential Area	Total Potential Disturbance
<b>Areas with Low Potential for Hydrocarbons and Carbon Dioxide</b>		
Pine Valley	Southern Bull Valley Mountains Northern Pine Valley Mountain/ Harmony Mountains	0
Teasdale	East End of Boulder Mountain	0
<b>Areas with Moderate Potential for Hydrocarbons and Carbon Dioxide</b>		
Pine Valley	Western and Northern Bull Valley Mountains	0
Pine Valley	Southern and Central Pine Valley Mountains	1 well 15.09 acres gross 10.95 acres net
Cedar City	Markagunt Plateau	1 well 15.09 acres gross 10.95 acres net
Powell	Sevier and Paunsaugunt Plateaus	1 well 15.09 acres gross 10.95 acres net
Escalante, Southwest	Southern Escalante Mountains Table Cliffs Plateau Kaiparowits Plateau/ Escalante Benches	1 well 15.09 acres gross 10.95 acres net
Teasdale	Boulder Mountain - area between the unfavorable east end of Boulder mountain and the more favorable area toward the mountains interior	0
<b>Areas with Moderate Potential for Hydrocarbons and High Potential for Carbon Dioxide</b>		
Teasdale and Escalante	Aquarius Plateau Northern Escalante Mountains Boulder Mountain	3 wells 45.27 acres gross 32.85 acres net
Escalante	Escalante Anticline	2 wells 30.18 acres gross 21.90 acres net

approximately **27 CO<sub>2</sub> wells**. This estimate will be used as the basis for the field development scenario for the Escalante anticline. Well depths would be relatively shallow, approximately 1,300 to 4,200 feet. Field life would be about 20 years or longer.

Field development is contingent upon construction of a regional gas pipeline, discovery of sufficient reserves, and demand for CO<sub>2</sub>. At present no regional pipeline has been constructed and demand for the resource has not been demonstrated. This scenario assumes that conditions favorable for development occur in the next 15 years.



## Surface Disturbance

Field development would require access roads, well pads, pipelines, power lines, phone lines, pump stations, a gas processing plant (dehydrator/compressor), and check dams.

Each well would require .7 mile of road. The scenario estimates 27 wells to be drilled. Presently, there are 2 wells capable of production. This leaves 25 wells to be drilled. Each well would be connected by pipeline to a central gas processing plant. When possible, pipelines are installed within road rights-of-way. Otherwise, they are constructed within their own right-of-way. Pipeline rights-of-way would be completely rehabilitated after the pipeline is installed. The average field contains 3.2 miles of pipeline outside of road rights-of-way. Pump stations are installed between wells and the central plant to maintain pressure and flow. These areas are accounted for in the pipeline rights-of-way. Electric and phone lines are generally constructed within road and pipeline rights-of-way. Ten check dams would be constructed in drainage bottoms to contain sediment.

Each mile of access road impacts 3.13 gross acres and 2.67 net acres after rehabilitation of cuts and fills. Each well pad disturbs 2.25 gross acres. After drilling is completed, the pad would be rehabilitated except for a 50 foot by 50 foot area (0.06 acre). Turn around areas on each pad are included in the road calculations. Each mile of pipeline outside the road rights-of-way impacts 3.03 gross acres and 0.0 net acres after rehabilitation. An average gas processing plant occupies 5 acres. Each check dam disturbs 0.25 acre.

Surface disturbance for a CO<sub>2</sub> field would be as follows:

### Roads:

25 wells X 0.7 miles/well X 3.13 acres/mile = 54.78 gross acres

25 wells X 0.7 miles/well X 2.67 acres/mile = 46.73 net acres

### Well pads:

25 wells X 2.25 acres/well = 56.25 gross acres

25 wells X 0.06 = 1.5 net acres

### Pipeline:

3.2 miles/field X 3.03 acres/mile = 9.70 gross acres

3.2 miles/field X 0 acres/mile = 0.0 net acres

### Gas processing plant:

5 gross acres

5 net acres

### Check dams:

10 dams X 0.25 acre/dam = 2.5 gross acres

10 dams X 0.25 acre/dam = 2.5 net acres

Development of a CO<sub>2</sub> field would disturb a total of 128.23 gross acres and 55.73 net acres.

## Additional CO<sub>2</sub> Field Development

The above scenario could be used to model an additional field development that could occur in the high CO<sub>2</sub> potential areas of the forest. If the Escalante anticline plus one additional field is developed, total



disturbance would be 265.34 gross acres, 114.38 net acres (disturbance of 2 additional wells, 27 total, is added to the model for the second field).

## Field Development - Oil Field Similar to Upper Valley

### Background

The Upper Valley field, which occurs primarily on the Escalante Ranger District and in part on BLM lands, could be used as a model for the typical oil field that could be discovered on Dixie National Forest. Any new oil fields are likely to be smaller than the Upper Valley field, thus the disturbances shown below probably represent the high end of reasonable. Such a field would produce oil hydrodynamically trapped in a Laramide anticlinal structure and could consist of the following:

Field size is approximately 40 million barrels ultimate recovery. Well spacing is 80 acres. Field life could range from 20 to 50 years. The decline in productivity is gradual.

### Surface Disturbance

The Upper Valley field contains 40 miles of access roads; 40 wells (13 injection wells, 23 producing wells, 2 outpost wells, and 2 wildcat wells drilled prior to discovery); 40 miles of pipeline which are mostly separate from the roads; power lines; phone lines; 4 tank batteries (2 contain heater treaters, 1 contains a loading dock, and the last contains a facility to remove water (free-water knock out)); a maintenance facility; and 10 check dams.

Each mile of access road impacts 3.13 gross acres and 2.67 net acres after rehabilitation of cuts and fills. Each well initially impacts 2.25 gross acres and .06 net acres during its production life. In this instance, gross disturbance for the 2 outposts would be 4.5 acres and no net acres because both have been rehabilitated. The 2 wildcats are included in the exploration section previously discussed and will not be included in these calculations. Turn around areas on each pad are included in the road calculations. Each mile of pipeline outside the road rights-of-way impacts 3.03 gross acres and 0.0 net acres after rehabilitation. Two of the tank batteries disturb 1 acre each, two others disturb 2 acres each for a total of 6 gross and net acres. The maintenance facility and each check dam disturbs .25 gross and net acres.

Surface disturbance for an oil field similar to Upper Valley would be as follows:

#### Roads:

40 miles X 3.13 acres/mile = 125.20 gross acres

40 miles X 2.67 acres/mile = 106.80 net acres

#### Well pads:

38 wells X 2.25 acres/well = 85.5 gross acres

36 wells X 0.06 = 2.16 net acres

#### Pipeline:

40 miles/field X 3.03 acres/mile = 121.20 gross acres

40 miles/field X 0.0 acres/mile = 0.0 net acres



Tank batteries:

6 gross acres

6 net acres

Maintenance facility:

.25 gross acre

.25 net acre

Check dams:

10 dams X .25 acre/dam = 2.5 gross acres

10 dams X .25 acre/dam = 2.5 net acres

The field development would result in a total of site disturbance of 340.65 gross acres and 117.71 net acres.

### Surface Disturbance Summary

A summary of disturbances from both exploration and field development is as follows:

Exploration - 135.81 gross acres, 98.55 net acres

CO<sub>2</sub> development (2 fields) - 265.34 gross acres, 115.31 net acres

Oil well similar to Upper Valley - 340.65 gross acres, 117.71 net acres

Total - 741.80 gross acres, 331.57 net acres

### REFERENCES

- Chidsey, Thomas C. and others, August 1990, Potential for Precambrian Source Rock in Utah: American Association of Petroleum Geologists, (Abstract) Bulletin, Vol. 74.
- Hintze, Lehi F., 1988, Geologic History of Utah: Brigham Young University, Special Publication 7.
- Kilbourne, Peter M. and all, 1989, Oil and Gas Resources of the Manti-LaSal National Forest: Manti-LaSal National Forest, unpublished report.
- MacDonald, Douglas Aird, April 3, 1989, letter to Bill Miller, Forest Service, showing Utah State Tax Commission data from Oil Occupation and Conservation Tax Reports.
- Palacas, James G and Reynolds, Mitchell W., 1989, Preliminary Petroleum Source Rock Assessment of Upper Proterozoic Chuar Group, Grand Canyon, Arizona (abs.): AAPG Bulletin, v. 73:3, p. 397.
- Smith, Archey D., Summer 1990, Methane and Coal Mining: Utah Geological and Mineral Survey, 1985: Survey Notes, pages 3-6.
- Taylor, Joe, editor, September 1989, The Oil and Natural Gas Producing Industry in Your State 1989-1990: Independent Petroleum Association of America, Petroleum Independent, Vol. 59 No. 9.
- U.S. Department of Agriculture, 1988, Environmental Impact Statement for Oil & Gas Leasing in the Escalante Known Geological Structure (KGS): Dixie National Forest.
- U.S. Department of Energy, April 1989, DOE/EIA - 0035 Monthly Energy Review January 1989: Energy Information Administration, Office of Energy Markets and End Use.



## OIL AND GAS OCCURRENCE POTENTIAL RATING SYSTEM

The Bureau of Land Management has developed a rating system for the occurrence potential of oil and gas resources. The system is identified in Bureau of Land Management Manual 3031. Accurately rating the potential for the discovery of oil and gas on the public mineral estate is difficult, as is predicting locations for future drilling and production. Thus, as new information is obtained, rating changes should be made.

Possible rating for oil and gas occurrence are: high, moderate, low, or no potential. A certainty factor is also applied, reflecting the degree to which information is available, and the subsequent confidence factor in assigning a rating for potential occurrence. The rating system is as shown in Table E-8, below.

**Table E-8  
Oil and Gas Occurrence Potential  
Rating System**

<b>Potential for Occurrence</b>	
High Potential:	Geologic structures and formations highly favorable for the accumulation of oil and gas are known to exist.
Moderate Potential:	The geologic environment, the inferred geologic processes, and the reported mineral occurrences indicate moderate potential for occurrence of oil and gas accumulations.
Low Potential:	The geologic environment and the inferred geologic processes indicate low potential for oil and gas accumulations.
No Potential:	Geologic structures and formations may or may not be present, but the potential for oil and gas accumulations does not exist.
<b>Certainty of Occurrence</b>	
4	The available data provide abundant direct and indirect evidence to support or refute the existence of oil and gas resources.
3	The available data provide direct evidence but are quantitatively minimal to support or refute the possible existence of oil and gas resources.
2	The available data provide indirect evidence to support or refute the possible existence of oil and gas resources.
1	The available data are insufficient and/or cannot be considered as direct or indirect evidence to support or refute the possible existence of oil and gas resources.



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