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4.1 Introduction

This chapter describes the changes to the human environment that could occur as a result of implementing the alternatives outlined in Chapter 2. Changes to the human environment are described using the terms "effect" and "impact," which are synonymous under the National Environmental Policy Act (NEPA). Effects may be direct, indirect, or cumulative in nature.

- Direct effects occur at the same time and place as the action.
- Indirect effects are reasonable foreseeable effects that occur later in time or are removed in distance from the action.
- Cumulative effects are those impacts to the environment that result from the incremental impacts of an alternative when added to other past, present, and reasonably foreseeable future actions.

In this chapter, the direct and indirect effects of an action are discussed in combination for all the affected resources under the general term "Impacts." Cumulative effects are described in Chapter 5.

NEPA requires that effects be discussed in terms of context and intensity. In this Environmental Impact Statement (EIS), context refers to the location, type, or size of the area to be affected relative to each resource component. Intensity refers to the severity or level of magnitude of impact. In this EIS, the intensity of effects are defined as Major, Moderate, Minor, or Negligible. In addition, the duration of effects can be temporary, short term, or long term. These terms are described more specifically in Table 4.1-1. In each resource section, an example of how these terms apply to the specific resource is given.

Table 4.1-1 Summary of Terms used to Describe Effects

Attribute of Effect		Description
Quality	Beneficial	An improvement of current conditions.
	Adverse	A degradation of current conditions.
Magnitude (Intensity)	Negligible	No measurable change in current conditions.
	Minor	A small, but measurable change in current conditions.
	Moderate	A moderate, measurable change in current conditions.
	Major	A big, easily measurable change in current conditions.
Duration	Temporary	Short-lived (i.e., during construction).
	Short-term	10 years or less.
	Long-term	More than 10 years.

4.1.1 Connected Actions

The alternatives described in Chapter 2 do not authorize surface disturbance. Therefore, environmental impacts in this chapter are analyzed as connected actions. Connected actions are defined by the Council on Environmental Quality (CEQ 1508.25) as actions that: 1) automatically trigger other actions that may require environmental impact statements, 2) cannot or will not proceed unless other actions are taken previously or simultaneously, and 3) are interdependent parts of a larger action and depend on the larger action for their justification. Forest Service regulations (36 CFR 228.102(c)(4)) require the Forest Service to consider the subsequent actions that would be authorized by a lease as connected actions. Connected actions are the basis of the environmental analysis from which leasing decisions would be

made. In this chapter, connected actions are the predicted disturbance from oil and gas leasing activity, which is discussed in Chapter 2.

4.1.2 Consideration of Available Science

The techniques and methodologies used in this analysis consider the best available science. The analysis includes a summary of the credible scientific evidence that is relevant to evaluating reasonably foreseeable impacts. In addition, the analysis also identifies the methods used and references the scientific sources relied on. When appropriate, the conclusions are based on a scientific analysis that shows a thorough review of relevant scientific information, a consideration of responsible opposing views, and the acknowledgment of incomplete or unavailable information, scientific uncertainty, and risk.

4.1.3 Indicators

In this chapter, effects will be described using indicators developed for each resource. Using the environmental conditions described in Chapter 3 as a baseline, indicators are used to predict or measure change in a resource related to effects of the alternatives. Some indicators are quantitative and measure effects based on numerical thresholds, while other indicators involve a narrative to qualitatively describe any changes relevant to baseline conditions.

4.2 Visual Resources

4.2.1 Introduction

The terms used to describe the context and intensity of effects in this section are discussed in Section 4.1 and Table 4.1-1. Table 4.2-1 provides an example how these terms would apply to Visual Resources.

Table 4.2-1 Terms used to Describe Effects to Visual Resources

Attribute of Effect		Description relative to Visual Resources
Quality	Beneficial	An enhancement to the scenic value of the landscape.
	Adverse	A reduction in the scenic value of the landscape.
Magnitude (Intensity)	Negligible	A change in the scenic value of the landscape that is so slight it cannot be detected by the casual observer.
	Minor	A change in the scenic value of the landscape that can be detected by the casual observer, but the change appears relatively natural in the landscape.
	Moderate	Alterations in the scenic value of the landscape that are obvious to the casual observer, but borrow from natural attributes such as form, pattern, and edge effect. These alterations may begin to dominate the landscape view.
	Major	Heavy alterations in the scenic value that are dominant in the landscape view.
Duration	Temporary	A change in the scenic quality of an area (equipment onsite; traffic; etc.) during construction of a facility (i.e., road, well pad) that does not occur once construction is completed.
	Short-term	A change in the scenic quality of an area due to exploration activities (i.e., construction of exploratory well pads or access roads). The change is limited only to the time needed for exploration and reclamation, 10 years or less.
	Long-term	A change in the scenic quality of an area due to the construction of production facilities (i.e., a production field and associated roads). The life of the production field and the time needed for reclamation would exceed 10 years.

4.2.2 Measurement Indicators

- Measurement Indicator #1 PREDICTED LUMENS FOR VARIOUS PHASES
- Measurement Indicator #2 NARRATIVE OF POTENTIAL CHANGES TO THE LANDSCAPE ADDRESSING THE DURATION AND CHANGE FOR EACH VISUAL ATTRIBUTE
- Measurement Indicator #3 COMPLIANCE WITH THE SCENERY MANAGEMENT SYSTEM (SMS)/SCENIC INTEGRITY OBJECTIVES(SIO)
- Measurement Indicator #4 CONSISTENCY WITH THE 2000 DIXIE SCENERY MANAGEMENT SYSTEM LAND AND RESOURCE MANAGEMENT PLAN AMENDMENT

4.2.3 Impacts Common to All Action Alternatives

Under all alternatives other than No Action, it is assumed that the Reasonably Foreseeable Development Scenario (RFDS) would occur. The RFDS for oil and natural gas is based on the assumption that all potentially productive areas can be open under standard lease terms and conditions, except those areas designated as closed to leasing by law, regulation, or executive order. It assumes a time period of 15 years and includes all lands within the boundaries of the Dixie National Forest regardless of ownership, and adjacent non-Forest lands where oil and gas activity may impact Forest lands.

The RFDS activities may result in surface disturbance of up to 60 to 120 acres (depending on ranger district), associated with overland travel for seismic surveys; 80 to 330 acres (depending on ranger district) of land required for exploration roads and well pads, and 254 acres of land required for a production field. The locations of these activities cannot currently be predicted.

The primary concerns associated with energy development on the visual quality of the Dixie National Forest are the visibility of constructed features including roads, well pads, and pipelines; the presence of seismic or drilling equipment and transportation on Forest roads surrounding mobilization to seismic testing or drill sites; and the long-term presence of a production facility.

The direct effects of post-leasing activities in the Dixie National Forest on visual resources are generally related to surface disturbance, activity, and the presence of un-natural elements previously not part of a landscape or view. Any human activity or man-made feature could degrade the visual quality of an area. The degree of degradation is dependent upon the amount of contrast between the natural and constructed landscape, the viewing distance, and the concern of the viewer for visual quality. Viewing distances are typically described as foreground (within 0.5 mile), middleground (0.5 mile to 3-5 miles), and background (3-5 miles and beyond). Facilities sited in a relatively open, flat, desert shrub community near (in the foreground) a commonly-used Forest road would impact the landscape in a different way than facilities sited within pinyon-juniper forest, against a rock outcrop, or distant from an actively-used Forest road.

The visual impacts related to construction of roads and well pads are mainly caused by removal of vegetation and the resulting inconsistency in the natural landscape. The impacts of vegetation removal are described in Section 4.9. In addition, the traffic associated with well installation and the presence of the equipment on the well pad create direct visual impacts, which vary in intensity depending upon the distance a viewer might be from the activity and the

amount of disturbance. The visual impacts due to traffic activity for the purposes of seismic exploration or well installation would be temporary and could be major; the quality or degree of the impact would depend, again, on the sensitivity of the landscape (High SIO landscapes are more sensitive than Low), and the location of the activity in relation to roads and viewer access. The visual impacts of an exploratory drilling rig or an installed well depend upon the siting and location of the equipment or facility. Approximately 50 percent of Dixie National Forest lands are designated Moderate or Low SIOs (see Table 3.2-1 in Chapter 3). The diverse variety contained in the landscape on the Dixie National Forest will facilitate a high degree of alterations before middle ground or background Moderate SIOs or foreground to background Low SIOs are not achievable.

The potential impacts to visual resources associated with post-leasing activity (exploration, access, development) would include changes to scenic integrity based on the effects to scenic quality and scenic views. Although the diverse forest landscape has the ability to absorb some of the effects of exploration, there are some sensitive areas where it would be more difficult to meet scenic integrity objectives. The most sensitive areas are characterized as High SIO areas such as Red Canyon and the Scenic Byways. In these areas, depending upon the viewing distance, it most often would not be possible to meet the scenic integrity objectives under SLT. In addition, the Dixie National Forest lands are within view of neighboring National Parks and Monuments including Zion, Bryce Canyon, Capitol Reef, Cedar Breaks, and Grand Staircase-Escalante.

Exploratory drilling would result in strong visual contrasts resulting from vegetation removal, soil disturbance, the addition of linear road features in undeveloped areas, and the presence of equipment that does not easily blend into the landscape. The visual impacts of drilling would be greater in areas visible from scenic travel ways or viewpoints. These moderate to strong direct effects would, however, be temporary, lasting from approximately nine to twelve months per well site (USFS 1995b). Under the RFDS, this activity could be ongoing in several areas of the Dixie National Forest during any one year and ongoing for 15 years. Public access would be restricted from newly constructed drill roads, limiting views of some exploration areas, but others may be highly visible from existing roads and trails.

Once access roads are constructed and a well site is cleared and leveled, it is estimated that total one-way traffic volume would be up to 1,924 trips per exploration well (see Section 4.10). Traffic volume is directly correlated to estimated size of drill pads and amount of road construction/reconstruction. This concentration of traffic to/from a drill site location may cause dust and related visual quality issues, and/or may cause recreationists or Forest visitors to leave an area in search of a more pleasing Forest setting.

Drill rigs vary in height from 100 feet (single) to 136 feet (triple) (Barry Olsen, Sale Manager, IDM Equipment, LTD., Houston, Texas, Personal Communication). Depending on the height of the substructures, the mast of a drill rig may rise to 160 feet above ground surface, and is the most visible and noticeable part of a drill rig (USFS 1995a, Appendix D). Drilling operations typically continue 24 hours a day and 7 days a week. Nighttime lighting on the rigs can be controlled to reduce the nighttime visibility of the derrick from a distance. This can be done by including shades on the lights and being careful that they shine inward to the working area of the rig and not outward (Dustin Doucett, Petroleum Engineer, Utah Division of Oil, Gas, and Mining, Personal Communication). Focus and illumination engineering can be utilized to make the entire rig non-visible from outside of the drilling location (Barry Olsen, Personal Communication) in many instances or locations. The potential for light pollution would be minor to moderate, depending upon the site, and temporary.

In the development and production phase of post-leasing activity, visual impacts would be minor to major adverse effects, depending upon the site, and they would be long term (at least 30 years of production). It is estimated that total one-way traffic volume would be up to 6,884 trips for development of a 20-well production field (Section 4.10). Average daily traffic is thus estimated to be 13 one-way trips during the production field development stage. The presence of an oil field, with all the associated activity, dust, and traffic, may cause some viewers or recreationists to abandon use of the area (USFS 1995a).

If the exploration does not result in discovery, the equipment would be removed, and the area reclaimed. The visual contrast from exploration disturbance and activity would likely be minor to negligible after several months, and over the long term would disappear entirely.

With regard to the lighting at the oil fields, many well sites are designed with adequate tank storage so there is not a need for nighttime pickups of oil and/or produced water by transporters; i.e. these operations only occur in the daytime. These types of well sites would typically not be lit at night. Those sites that are lit at night are not brightly lit to illuminate the whole location. Rather, the lighting is only placed where necessary for safety reasons and to operate specific equipment. When stray lighting is an environmental issue for such sites, the operator could install appropriate lamps and fixtures to reduce the stray light out from the location (Dustin Doucett, Petroleum Engineer, Utah Division of Oil, Gas, and Mining, Personal Communication).

The indirect effects of post-leasing activity are connected to recreation, use, access, viewpoints, and the more personal perspective and expectation of the viewer in the landscape. Therefore, indirect effects are variable, personal, and site-dependent but together influence the scenic experience of those who enjoy and use the Dixie National Forest. The direct and indirect effects of oil and gas leasing on the Forest may affect SIOs, depending upon the site and leasing option applied to these areas.

Table 4.2-2 lists the leasing options assigned to the various SIOs under each of the alternatives. The leasing options and associated impacts to visual resources are described in Section 4.2.4. Each assigned leasing option would either allow or restrict certain oil and gas activities (described in the RFDS) wherever the applicable resource component occurs on the Dixie National Forest.

Table 4.2-2 Leasing Options Assigned under each Alternative for Visual Resources

SIO	Alternative				
	A	B	C	D	E
Very High	NL	NSO	NSO	NSO	SLT
High	NL	NSO	NSO	CSU	SLT
Moderate	NL	CSU	CSU	SLT	SLT
Low	NL	SLT	SLT	SLT	SLT
SIO Unassigned	NL	LN	LN	LN	SLT

4.2.4 Impacts of Connected Actions by Leasing Option

Leasing options would dictate the conditions under which connected actions (described under the RFDS) may occur. Impacts from connected actions under each leasing option are discussed in this section. Impacts to visual resources considering leasing option overlaps (i.e., overlaps with more restrictive leasing options assigned to other resources) are discussed in Section 4.2.5 (Impacts by Alternative).

4.2.4.1 Not Legally Available (NA)

NA applies to lands that are not legally available for leasing and includes Brian Head Ski Permit Area, wilderness areas (which are designated as Very High SIO areas), and areas surrounding the Box-Death Hollow Wilderness Area that were withdrawn from leasing by the Utah Wilderness Act of 1984. No oil and gas leasing would occur in these areas and there would be no effects to scenic resources. This leasing option does not apply directly to visual resource components.

4.2.4.2 No Lease (NL)

NL applies to lands where no new leases would be authorized. These lands would not be administratively available for leasing. Under Alternative A, there would be no new leasing, so no connected actions to leasing and no visual effects would occur in addition to those within currently leased areas.

4.2.4.3 No Surface Occupancy (NSO)

Under the NSO option, there would be no surface disturbance due to construction or activities related to oil and gas exploration or development, other than seismic surveys. NSO prohibits use or occupancy of the land for fluid mineral exploration or development, in order to protect identified resource values. Under Alternatives B and C, NSO applies to lands designated with Very High or High SIO (see Table 3.2-1 in Chapter 3). Under Alternatives C, D, and E, with the Roadless Area Conservation Rule in effect, NSO would apply to Inventoried Roadless Areas (IRAs) in High, Medium, and Low SIO areas.

Measurement Indicators

- Measurement Indicator #1 PREDICTED LUMENS FOR VARIOUS PHASES

There would be no effects to visual resources as a result of lighting conditions under NSO because there would be no occupancy. Seismic exploration would have a negligible effect on lighting impacts to visual resources as these operations are performed only in daytime.

- Measurement Indicator #2 NARRATIVE OF POTENTIAL CHANGES TO THE LANDSCAPE ADDRESSING THE DURATION AND CHANGE FOR EACH VISUAL ATTRIBUTE

Under NSO, there would be minor and temporary effects to the landscape with seismic exploration activity. There would be no impacts to the SIOs under this option.

- Measurement Indicator #3 COMPLIANCE WITH THE SCENERY MANAGEMENT SYSTEM (SMS)/SCENIC INTEGRITY OBJECTIVES (SIO)

Under NSO, there would be negligible to minor and temporary effects to the landscape with seismic exploration activity. In Very High SIO areas, the landscape character would remain intact, with few, if any deviations – the definition of Very High SIO areas (USFS 1995g). Seismic exploration in Very High SIO areas may impact the SIO in the short term due to crushed vegetation trails, if exploration occurs in areas inaccessible by existing roads and trails. High, Moderate, and Low SIOs are not expected to be compromised in the short term or long term. There would be no long-term impacts to the SIOs under this option.

- Measurement Indicator #4 CONSISTENCY WITH THE 2000 DIXIE SCENERY MANAGEMENT SYSTEM LAND AND RESOURCE MANAGEMENT PLAN AMENDMENT

Under NSO, there would be no long-term effects to SIOs; NSO would be consistent with the 2000 Dixie Scenery Management System Land and Resource Management Plan amendment.

4.2.4.4 Timing Limitation (TL)

TL does not apply directly to visual resources.

4.2.4.5 Controlled Surface use (CSU)

CSU provides for controlled but generally allowed surface use on all or portions of a lease. Operations would be held to special operational constraints that may otherwise exceed the mitigation provided by SLT, and the regulations and operating orders.

CSU applies to some High SIO areas under Alternative D. Under Alternatives B and C, CSU is the lease option applied in Moderate SIO areas. CSU would require the use of the Bureau of Land Management's (BLM)-established Best Management Practices (BMPs) in the location and design of oil and gas exploration sites, and prior approval by the Dixie National Forest of proposed designs to reduce visual effects of exploration and production. Refer to Appendix D for descriptions of the CSU.

Measurement Indicators

- Measurement Indicator #1 PREDICTED LUMENS FOR VARIOUS PHASES

There could be minor temporary effects to visual resources as a result of lighting conditions under CSU. As under SLT, the drill rig lighting can be directed inward and shields provided to minimize the visibility of the site. Seismic exploration would have a negligible effect on lighting impacts to visual resources.

- Measurement Indicator #2 NARRATIVE OF POTENTIAL CHANGES TO THE LANDSCAPE ADDRESSING THE DURATION AND CHANGE FOR EACH VISUAL ATTRIBUTE

Under CSU, there would be minor to major temporary effects to the landscape with seismic exploration activity and exploratory drilling. Impacts to visual resources under a production scenario would be minor to major and long term dependant on location.

- Measurement Indicator #3 COMPLIANCE WITH THE SCENERY MANAGEMENT SYSTEM (SMS)/SCENIC INTEGRITY OBJECTIVES (SIO)

Under CSU, there would be minor to major (depending upon the availability of vegetative or topographic screening and distance from viewpoints) temporary effects to the landscape with exploration drilling activity. Drilling or production field activities would not comply with High SIOs, since the drilling rigs and production equipment would be difficult to screen. Once drilling is completed, and a drill site is reclaimed, it would again be in compliance with the SIO. In Moderate SIO areas, compliance is more likely to be maintained during drilling and production with BMPs such as siting to reduce visual impacts, painting of facilities to match the landscape, and interim road reclamation. However, drilling in foreground locations would not meet the Moderate SIO until after reclamation is complete. In Low SIO areas, compliance with SIOs would be maintained.

- Measurement Indicator #4 CONSISTENCY WITH THE 2000 DIXIE SCENERY MANAGEMENT SYSTEM LAND AND RESOURCE MANAGEMENT PLAN AMENDMENT

Under CSU, the impacts to SIOs are described above. CSU in High SIO areas or Moderate SIO areas may not be consistent with the 2000 Dixie Scenery Management System Land and Resource Management Plan amendment.

4.2.4.6 Lease Notice (LN)

The LN does not impose new restrictions on oil and gas activities; it provides more detailed information concerning existing limitations, regulations, or orders, or addresses special considerations. A LN based upon visual resources would apply if proposed leasing occurs in unassigned SIO Areas. In this case, the lessee would be notified that a visual analysis would need to be conducted to determine a scenic attractiveness Class to the landscape, and an associated SIO prior to any project implementation. The impacts under LN would be the same as those described for SLT, below.

4.2.4.7 Standard Lease Terms (SLT)

Impacts in this section are discussed assuming no restrictions or leasing options other than those listed on BLM Lease Form 3100-11 (SLT) and the environmental protection measures that would be implemented by other laws and regulations as described in Section 1.8.5.2. As a minimum, all leases are governed by SLT and the impacts described in this section represent the maximum amount of disturbance that could occur as a result of oil and gas activities.

BLM and USFS (2007) provides operators with a combination of guidance and standards for encouraging compliance with agency policies and operating requirements. For example, site selection and design are required to “minimize long-term disruption of the surface resources and existing uses, and to promote successful reclamation.” Further, the operator must work towards compliance with the visual resource management objectives, or SIOs established in the land use plan for “all activities that alter landforms, disturb vegetation, or require structures. Site-specific mitigation practices may be required by the surface management agency to minimize visual impacts, while remaining consistent with the lessee’s right to conduct operations under the lease.” The BLM has outlined BMPs for Fluid Minerals (BLM 2006b) in consideration of visual resources. In visually sensitive areas, BMPs may include painting of facilities to blend with the surrounding landscape, locating structures to utilize topographic or vegetation screens, locating structures away from ridgelines or other prominent natural features, use of low-profile equipment, and completing interim reclamation of disturbed areas. Under SLT, BMPs are those reasonable measures taken by the operator to minimize undesirable impacts to the environment.

Alternatives B and C apply the SLT leasing option only to the Low SIO areas. Alternative D applies the SLT leasing option to Moderate and Low SIO areas, while Alternative E would apply the SLT leasing option to all visual SIO areas including Very High and High. Impacts to these visual resources under SLT are described below

Under SLT, leases within Very High and High SIO areas would be issued under the conditions of the standard federal oil and gas lease and subject to existing regulations. There would be no laws or regulations that would protect the visual resource from the effects of oil and gas post-leasing activity. This leasing option would not comply with Very High or High SIOs. Impacts to visual resources under SLT could be minor to major and short to long term.

Under SLT, leases within Moderate SIO areas would be issued under the conditions of the standard federal oil and gas lease and subject to existing regulations. There would be no laws or regulations that would protect the visual resource from the effects of oil and gas post-leasing activity. In areas of activity close to roads, the strong visual contrasts of exploration may not comply with this SIO until reclamation is complete. When activity occurs in background areas more easily screened from public views, uses under SLT incorporating BMPs (BLM 2006b) for visual resources management would comply with the visual resources objectives in Moderate SIO areas. Full production field development in foreground or middleground views would not comply with Moderate SIOs.

Under SLT, leases within Low SIO areas would be issued under the condition of the standard federal oil and gas lease and subject to existing regulations. There would be no laws or regulations that would protect the visual resource from the effects of oil and gas post-leasing activity. In these areas, the activity may be obvious in the landscape, but must borrow from existing natural shapes and colors in the background. Painting the facilities with non-reflective paint in a color to blend with the environment would be required, as well as other BMPs (BLM 2006b). Oil and gas activity under SLT would comply with Low SIO.

Under SLT, leases within Unassigned SIO areas would be accompanied by a Lease Notice providing a reminder that a visual analysis would be conducted prior to any surface disturbance under the lease. The scenic analysis would be part of the Surface Use Plan approval process; however, the application of a scenic integrity objective would not preclude leasing activity. Oil and gas activity in Unassigned SIO areas is expected to comply with the determined SIO for the landscape in Low and Moderate SIO areas, and may not comply with the SIOs of areas determined under the scenic analysis to be High or Very High. The likelihood of Unassigned SIO areas being assigned a High or Very High SIO is, however, slight, as most Unassigned SIO areas of the Forest are of less distinctive scenic attractiveness (and therefore likely to be assigned Low or Moderate SIOs).

Measurement Indicators

- Measurement Indicator #1 PREDICTED LUMENS FOR VARIOUS PHASES

According to Barry Olsen, drill equipment manufacturing representative, the lumen ratings for derrick lights all vary. Based upon this, the total lumens for each phase would be completely variable depending upon equipment utilized. This measurement indicator would not be effective in determining the effects of various phases of oil and gas exploration and production, and will not be analyzed further. Impacts to visual resources from light emission would occur but the range of magnitudes is not known. As noted above, the drill rig lighting itself can be directed inward and shields provided to minimize the visibility of the site.

- Measurement Indicator #2 NARRATIVE OF POTENTIAL CHANGES TO THE LANDSCAPE ADDRESSING THE DURATION AND CHANGE FOR EACH VISUAL ATTRIBUTE

As noted above, exploratory drilling would result in major, short-term impacts, particularly in areas that have not been previously developed. Visual contrasts would be strongest initially, during surface disturbance and construction, and would lessen over time as activity decreases and reclamation is completed.

Development of a production field in the foreground of a viewpoint would create major, long-term impacts. A production field in the distance from a viewpoint would create moderate long-term impacts.

- Measurement Indicator #3 COMPLIANCE WITH THE SCENERY MANAGEMENT SYSTEM (SMS)/SCENIC INTEGRITY OBJECTIVES (SIO)

There would not be compliance with SIOs under SLT in Very High or High SIO areas. In Moderate SIO areas, compliance is likely for middleground to background activities. In Low SIO areas, exploration and production activities would be in compliance with the objectives.

- Measurement Indicator #4 CONSISTENCY WITH THE 2000 DIXIE SCENERY MANAGEMENT SYSTEM LAND AND RESOURCE MANAGEMENT PLAN AMENDMENT

In High SIO corridors, SLT without site-specific mitigation measures to maintain the SIO would not be consistent with the designation of Scenic Byways and Backways as Concern Level 1 travelways in the 2000 Dixie Scenery Management System Land and Resource Management Plan amendment (USFS 2000a).

4.2.5 Impacts by Alternative

The degree to which the impacts of connected actions (Section 4.2.4) would differ by alternative is discussed in this section. Alternatives involve leasing options, which would restrict the locations and the nature of oil and gas impacts. Because different resource components overlap, leasing options assigned to each resource component would also overlap and the most restrictive leasing option would take precedence (refer to Section 2.3.1).

Table 4.2-3 shows the acres of each resource component under each leasing option by alternative. Table 4.2-3 incorporates the amount of overlap with more restrictive leasing options (assigned to other resources) in addition to the leasing options assigned directly to each resource component. Alternatives D1, D2, E1, and E2 represent the dual analysis of Alternative D and E. D1 and E1 represent the acres available with NSO in all IRAs. D2 and E2 represent the acres with leasing allowed in IRAs under a less restrictive leasing option. The following SIO designations fall within IRAs: 1,119 acres Very High SIO (1 percent of Very High SIO acres); 128,437 acres High SIO (32 percent of High SIO acres); 144,451 acres Moderate SIO (27 percent of Moderate SIO acres); and 159,383 acres Low SIO (54 percent of Low SIO acres). Table 4.2-3 does not include acres for Unassigned SIOs, as these lands would most likely be assigned an SIO of Low or Moderate (see above, Section 4.2.4.7). Low and Moderate SIO areas are mostly covered by equal or more restrictive leasing options, as a result of overlapping leasing options assigned to other resources, than assigned specifically to SIO Low or Moderate for all alternatives.

In this section, impacts are generally discussed at the Forest-wide level and not by ranger district. This is done to avoid repetition and facilitate the comparison of impacts across alternatives. However, any pronounced differences in the impacts to a resource component between ranger districts will be highlighted and discussed. Impacts in regards to *Measurement Indicator #2* would be the same for Alternatives B through E, as described above in Section 4.2.4.

4.2.5.1 Alternative A

There would be no effects to the landscape under the No Action Alternative, other than those already occurring in existing lease areas. There would be no effects to SIOs under No Action (*Measurement Indicator #3*). There is no concern for lack of consistency with the 2000 Scenery Management System Amendment to the Land and Resource Management Plan (*Measurement Indicator #4*).

Table 4.2-3 Acreage of Visual Resource Components under each Leasing Option by Alternative

Resource Component	Leasing Option[3]	Alternative[1,2]						
		A	B	C	D1	D2	E1	E2
Very High (Wilderness and RNA's)	NA	85,592	85,592	85,592	85,592	85,592	85,592	85,592
	NL	4,336	4,291	4,247				
	NSO		45	89	4,336	4,336	3,217	
	CSU							
	SLT						1,119	4,336
High	NA	1,535	1,535	1,535	1,535	1,535	1,535	1,535
	NL	396,519	283,390	8,562				
	NSO		112,942	387,956	171,686	68,101	128,436	
	CSU				224,834	328,420		
	SLT						268,084	396,519
Moderate	NA	220	220	220	220	220	220	220
	NL	538,881	368,304	379				
	NSO		115,889	372,077	180,369	39,375	144,542	
	CSU		54,688	166,427	328,872	469,866		
	SLT				29,643	29,643	394,342	538,881
Low	NA	130	130	130	130	130	130	130
	NL	292,950	237,527	6,161	73	73		
	NSO		44,209	231,668	173,603	23,731	159,385	
	CSU		11,268	55,169	115,345	265,217		
	SLT			7	4,059	4,059	133,565	292,950
Unassigned	NA							
	NL	310,845	223,858	63				
	NSO		72,004	264,251	137,685	5,971	132,822	
	CSU		14,956	46,312	170,238	301,951		
	SLT		32	219	2,922	2,922	178,023	310,845

[1] Small discrepancies in the acreage presented for each alternative are due to the fact that the GIS database has limitations when applied over an extremely large area that result in an inability to calculate acreages that match exactly between alternatives. A more detailed table that separates the acreage by resource component and ranger district will be available in Appendix B.
[2] Alternatives D1, D2, E1, and E2 represent the dual analysis of Alternative D and E. D1 and E1 represent the acres available with NSO in all IRAs. D2 and E2 represent the acres with leasing allowed in IRAs under a less restrictive leasing option.
[3] Areas not legally available (NA) for leasing (see Section 1.5.2) are included in the Table to provide context to the analysis.

4.2.5.2 Alternative B

Under this alternative there would be No Leasing on 4,291 acres of Very High SIO land, and leasing under NSO on 45 acres. The remaining 85,592 acres, or 95 percent of Very High SIO lands are Not Available for leasing.

In the designated High SIO areas of the Dixie National Forest, there would be No Leasing on 283,390 acres (71 percent), and the lease option would be NSO for an additional 112,942 acres, or approximately 28 percent of the High SIO areas of the Forest. The remaining High SIO lands (1 percent) are Not Available for leasing.

Of the Moderate SIO lands on the Forest, there would be No Leasing on 368,304 acres, or 68 percent of the designated Moderate SIO lands. On 115,889 acres, or 21 percent of the Moderate SIO lands on the Forest, NSO would be applied. The lease option would be CSU on 54,688 acres, or 10 percent of the Moderate SIO lands on the Forest. The remaining Moderate SIO lands (1 percent) are Not Available for leasing.

There would be No Leasing on 237,527 acres, or 81 percent of the Low SIO lands on the Forest. The NSO option would be applied to 44,209 acres, or 15 percent of the Low SIO lands on the Forest. On 4 percent, or 11,268 acres of Low SIO lands, leasing would be allowed under CSU. The remaining 147 acres (Brian Head and small areas associated with limitations of the GIS data) of Low SIO lands are Not Available for leasing.

With the exception of Alternative A, this alternative provides the most protection for the scenic resources of the Forest, and would be in compliance with the SIOs, with considerations made for facility location and site design in Moderate SIO areas adjacent to viewing corridors (*Measurement Indicator #3*). This alternative would be consistent with the 2000 Dixie Scenery Management System Land and Resource Management Plan amendment (*Measurement Indicator #4*).

4.2.5.3 Alternative C

Alternative C has less restrictive leasing options than Alternative B and more restrictive options than Alternative D. The Very High SIO lands carry essentially the same options as under Alternative B, other than the NSO option, which increases slightly to 89 acres.

Under this alternative, there are few High SIO areas (less than 1 percent) that are Not Available for leasing. There would be No Leasing on 8,562 acres of High SIO lands. The leasing option would be NSO for 387,956 acres, or about 97 percent of the High SIO areas of the Forest.

Of the Moderate SIO lands, NSO would be applied to 372,077 acres, or 69 percent of the Moderate SIO lands on the Forest. The lease option would be CSU on 166,427 acres, or 31 percent of the Moderate SIO lands on the Forest. The remaining Moderate SIO lands are Not Available for leasing or would have NL applied.

The NSO option would be applied to 231,668 acres, or 79 percent of the Low SIO lands on the Forest. On 20 percent, or 55,169 acres of Low SIO lands, leasing would be allowed under CSU. The remaining Low SIO lands are Not Available for leasing or would have NL applied.

This alternative places the majority of the Forest acreage into the NSO option. This provides protection for the scenic resources of the Forest, and would be in compliance with the SIOs, with considerations made for facility location and site design in Moderate SIO areas adjacent to viewing corridors (*Measurement Indicator #3*). This alternative would be consistent with the 2000 Dixie Scenery Management System Land and Resource Management Plan amendment (*Measurement Indicator #4*).

4.2.5.4 Alternative D1 (NSO in IRAs)

Alternative D has less restrictive leasing options than Alternative C and more restrictive options than Alternative E. The majority of Very High SIO lands are Not Available for leasing. There are 4,336 acres that could be leased under NSO. Of the High SIO lands, 171,686 acres, about 43 percent of the High SIO areas of the Forest, would be NSO. The CSU option applies to 224,834 acres, or 56 percent of High SIO lands. The remaining High SIO lands (less than 1 percent) are Not Available for leasing.

Under this alternative, many SIO Moderate and Low areas would be available for leasing under SLT. Of the Moderate SIO lands, NSO would be applied to 180,369 acres, or about 33 percent of the Moderate SIO lands on the Forest. The lease option would be CSU on 328,872 acres, or 61 percent of the Moderate SIO lands on the Forest. SLT would be the option on 29,643 acres, less than 5 percent of Moderate SIO lands. The remaining Moderate SIO lands (less than 1 percent) are Not Available for leasing.

The NSO option would be applied to 173,603 acres, or 59 percent of the Low SIO lands on the Forest. On 37 percent, or 115,345 acres of Low SIO lands, leasing would be allowed under CSU. SLT would be the option on 4,059 acres, approximately 1 percent of Low SIO lands. The remaining 130 acres of Low SIO lands are Not Available for leasing.

This alternative provides for NSO in IRAs. CSU in High SIO areas would not likely be in compliance with the SIO, depending upon the site and distance from viewing areas (*Measurement Indicator #3*). CSU, with considerations made for facility location and site design in Moderate SIO areas adjacent to viewing corridors, is likely to comply with the SIO. This alternative would likely not be consistent with the 2000 Dixie Scenery Management System Land and Resource Management Plan amendment for those High SIO corridor areas subject to CSU (*Measurement Indicator #4*).

4.2.5.5 Alternative D2 (CSU in IRAs)

The majority of Very High SIO lands are Not Available for leasing. There are 4,336 acres that could be leased under NSO. Of the High SIO lands, the leasing option would be NSO for 68,101 acres, about 17 percent of the High SIO areas of the Forest. The CSU option applies to 328,420 acres, or 82 percent of High SIO lands. The remaining High SIO lands (less than 1 percent) are Not Available for leasing.

Of the Moderate SIO lands, NSO would be applied to 39,375 acres, or about 7 percent of the Moderate SIO lands on the Forest. The lease option would be CSU on 469,866 acres, or 87 percent of the Moderate SIO lands on the Forest. SLT would be the option on 29,643 acres, less than 5 percent of Moderate SIO lands. The remaining Moderate SIO lands (less than 1 percent) are Not Available for leasing.

The NSO option would be applied to 23,731 acres, or 5 percent of the Low SIO lands on the Forest. On 90 percent, or 265,217 acres of Low SIO lands, leasing would be allowed under CSU. SLT would be the option on 4,059 acres, approximately 1 percent of Low SIO lands. The remaining Low SIO lands (less than 1 percent) are Not Available for leasing.

This alternative provides for CSU in IRAs. CSU in High SIO areas would not likely be in compliance with the SIO, depending upon the site and distance from viewing areas (*Measurement Indicator #3*). CSU, with considerations made for facility location and site design in Moderate SIO areas adjacent to viewing corridors, is likely to comply with the SIO. This

alternative would likely not be consistent with the 2000 Dixie Scenery Management System Land and Resource Management Plan amendment for those High SIO corridor areas subject to a TL or CSU (*Measurement Indicator #4*).

4.2.5.6 Alternative E1 (NSO in IRAs)

Alternative E would open the majority of the Dixie National Forest to leasing under the standard lease terms and conditions contained on BLM Lease Form 3100-11, with the exception of areas identified as Visual Retention/SIO Very High and IRAs under the dual analysis scenario. Visual Retention/SIO Very High areas would be NSO or not available for leasing. The majority of Very High SIO lands are Not Available for leasing. There are 3,217 acres that could be leased under NSO and 1,119 acres under SLT. In High SIO areas, 128,436 acres would be NSO, 67 percent of High SIO areas. SLT would apply to 268,084 acres of High SIO lands, 32 percent.

In Moderate SIO areas, NSO would apply to 144,542 acres or 27 percent, and SLT would be the option on 394,342 acres or 73 percent of Moderate SIO lands. In Low SIO areas, NSO would apply to 159,385 acres, or 54 percent, and 133,565 or 46 percent would be available under SLT

This alternative would likely not be consistent with the 2000 Dixie Scenery Management System Land and Resource Management Plan amendment for High SIO areas, and Moderate foreground and middleground SIO areas subject to SLT (*Measurement Indicator #4*).

4.2.5.7 Alternative E2 (SLT in IRAs)

Leasing would be allowed anywhere on the Dixie National Forest that is legally available. This alternative would be similar to Alternative E1 above, except NSO areas would decrease, and SLT would increase. The majority of Very High SIO lands are Not Available for leasing; there are 4,336 acres that could be leased under NSO. Other than Very High SIO lands noted, the remainder of the Forest, for the most part (99 percent), would be available under SLT. In High SIO areas, 396,519 acres would be SLT. In Moderate SIO areas 533,881 acres would be SLT. In Low SIO areas, 292,950 acres would be available under SLT. Under this alternative, impacts would be as described in Section 4.2.4.7

4.3 Inventoried Roadless Areas and Eligible Wild and Scenic Rivers

4.3.1 Introduction

The terms used to describe the context and intensity of effects in this section are discussed in Section 4.1 and Table 4.1-1. Tables 4.3-1 and 4.3-2 provide examples of how these terms would apply to IRAs and eligible Wild and Scenic Rivers, respectively.

Table 4.3-1 Terms used to Describe Effects to IRAs

Attribute of Effect		Description relative to IRAs
Quality	Beneficial	An improvement in the roadless characteristics or wilderness attributes of an IRA.
	Adverse	A degradation of the roadless characteristics or wilderness attributes of an IRA, such as wildlife habitat fragmentation or a loss of acres eligible to be managed as an IRA.
Magnitude (Intensity)	Negligible	A change in roadless characteristics that is too small to be effectively measured or be perceptible to a human visitor. *Example: Oil and gas activity adjacent to an IRA that is not easily seen or heard from within the IRA.*
	Minor	A measurable or perceptible change that is small enough that it does not result in a change to ecological conditions, a loss of acres eligible to be managed as an IRA, or a marked decrease in a users experience within the IRA. *Example: Seismic exploration that avoids off-road travel in sensitive areas.*
	Moderate	A measurable or perceptible change that is large enough that it may result in changes to ecological conditions, a loss of roadless acres, or a decrease in a user's experience. Loss of roadless acres does not affect the ability of the IRA to be managed as such. *Example: An exploratory well that requires a small amount of road construction, but that would not bisect the IRA in any way.*
	Major	A change that is easily measurable and visibly apparent. Changes would result in changes to ecological conditions, a loss of roadless acres, or a decrease in a user's experience. Loss of roadless acres may reduce the size of the IRA such that it may not be able to be managed as an IRA. *Example: A road that bisects an IRA into several smaller areas.*
Duration	Temporary	An increase in noise during construction or seismic exploration that does not occur once construction or exploration is completed.
	Short Term	A degradation of roadless characteristics that occurs during exploration activities (i.e., construction of exploratory well pads or access roads). Any disturbance (including roads) is limited only to the time needed for exploration and reclamation, 10 years or less.
	Long Term	A degradation of roadless characteristics due to the construction of production facilities (i.e., a production field and associated roads). The life of the production field and the time needed for reclamation would exceed 10 years.

Table 4.3-2 Terms used to Describe Effects to Eligible Wild and Scenic Rivers

Attribute of Effect		Description relative to Eligible Wild and Scenic Rivers
Quality	Beneficial	An improvement in the outstandingly remarkable values or protection of the free flow of an eligible stream.
	Adverse	A degradation of the outstandingly remarkable values or the free flow of an eligible stream.
Magnitude (Intensity)	Negligible	A change in the outstandingly remarkable values that is too small to be effectively measured or be perceptible to a human visitor. *Example: Oil and gas activity adjacent to an eligible stream that is not easily seen or heard from within the ¼-mile river corridor..*
	Minor	A measurable or perceptible change that is small enough that it does not alter the outstandingly remarkable values, alter the free flow, result in a loss of acres eligible to be designated as a Wild and Scenic River, or result in a marked decrease in a users experience within the eligible area. *Example: Seismic exploration that avoids off-road travel in sensitive areas.*
	Moderate	A measurable or perceptible change that is large enough that it may result in changes to the outstandingly remarkable values, a loss of acres eligible to be designated as a Wild and Scenic River, or a decrease in a user's experience. Loss of acres does not affect the overall eligibility of the stream to be designated as a Wild and Scenic River. *Example: An exploratory well that requires a small amount of road construction, but that would not cross or bisect the eligible segment.*
	Major	A change that is easily measurable and visibly apparent. Changes would result in degradation to the outstandingly remarkable values, a loss of acres eligible to be designated as a Wild and Scenic River, alteration of free flow, or a decrease in a user's experience. Loss of acres or free flow may be such that the stream may not be able to be designated as a Wild and Scenic River. *Example: A road that crosses or bisects and eligible segment.*
Duration	Temporary	A degradation of outstandingly remarkable values that occurs during construction or seismic exploration, but that does not occur once construction or exploration is completed.
	Short Term	A degradation of outstandingly remarkable values that occurs during exploration activities (i.e., construction of exploratory well pads or access roads). Any disturbance (including roads) is limited only to the time needed for exploration and reclamation, 10 years or less.
	Long Term	A degradation of outstandingly remarkable values due to the construction of production facilities (i.e., a production field and associated roads). The life of the production field and the time needed for reclamation would exceed 10 years.

4.3.2 Measurement Indicators

4.3.2.1 Inventoried Roadless Areas

- *Measurement Indicator #1* NARRATIVE DISCUSSION TO IMPACTS TO ROADLESS CHARACTERISTICS AND WILDERNESS ATTRIBUTES
- *Measurement Indicator #2* MILES OF ROADS (RECONSTRUCTION AND NEW CONSTRUCTION) AND ACRES OF DISTURBANCE IN IRAS

4.3.2.2 Eligible Wild and Scenic Rivers

- *Measurement Indicator #1* NARRATIVE DISCUSSION TO ELIGIBILITY AND "OUTSTANDINGLY REMARKABLE" VALUES
- *Measurement Indicator #2* MILES OF ROADS (RECONSTRUCTION AND NEW CONSTRUCTION) AND ACRES OF DISTURBANCE WITHIN ¼-MILE DISTANCE FROM EITHER BANK OF ELIGIBLE STREAM SEGMENTS

4.3.3 Impacts Common to All Action Alternatives

Under Alternatives B, C, D, and E it is assumed that activities described under the RFDS would occur on some portion of the Dixie National Forest. However, depending on the alternative, activities described under the RFDS would be restricted in some locations. These activities include 60 to 120 acres (depending upon ranger district) of surface disturbance associated with seismic surveys, 83 to 332 acres (depending upon ranger district) of land clearing surface disturbance associated with road and pad building for exploration wells, and 254 acres of land clearing surface disturbance for a production field (per ranger district). The locations of activities are not yet known. Given that the roadless and wilderness characteristics of IRAs and the outstandingly remarkable values of eligible Wild and Scenic Rivers relate to a broad array of resources, nearly every aspect of oil and gas activity has the potential to impact these resources. In general, the impacts of seismic exploration would be negligible to minor and temporary to short term due to the small amount of disturbance expected.

Exploratory wells and access roads would have a much larger impact on both of these resources, ranging from minor to major depending upon the location of the disturbance relative to the IRA and/or eligible Wild and Scenic River. For both of these resources, roads present the greatest potential for impacts due to the extent of ground covered and the fact that IRAs and streams eligible to be classified as "wild" are valued for their lack of roads. However, temporary roads used to access exploratory wells (as well as the well pads themselves) would still have a short-term impact, as these areas would be reclaimed following exploration. Well pads, production facilities, power lines, pipelines, and access roads associated with a production field would have long-term impacts due to the direct loss of roadless acres for the life of the development and the impacts to the tentative classification of river segments eligible for inclusion in the National Wild and Scenic River System. These impacts could range from minor to major depending upon the location of the facilities relative to the resource.

Table 4.3-3 lists the leasing options assigned to IRAs and eligible Wild and Scenic Rivers under each alternative. Descriptions of leasing options (and associated impacts on these resources) are described in Section 4.3.4. Each assigned leasing option would either allow or restrict certain oil and gas activities (described under the RFDS) whenever the applicable resource component occurs on the Dixie National Forest.

Table 4.3-3 Leasing Options assigned under each Alternative

Resource Component	Alternative[1]						
	A	B	C	D1	D2	E1	E2
Inventoried Roadless Areas	NL	NL	NSO[2]	NSO[2]	CSU	NSO[2]	SLT
Eligible Wild and Scenic Rivers	NL	NL	CSU	CSU	CSU	SLT	SLT

[1] Alternatives D1, D2, E1, and E2 represent the dual analysis of Alternative D and E. D1 and E1 represent the acres available with NSO in all IRAs. D2 and E2 represent the acres with leasing allowed in IRAs under a less restrictive leasing option.
[2] Actual leasing option is CSU, but the CSU would effectively prohibit most surface use or occupancy and is analyzed as NSO. This CSU is more restrictive than the CSU applied under Alternatives D2 and E2.

Leasing options and the 2001 Roadless Area Conservation Rule are discussed in Section 2.3.2. The rule does not explicitly prevent issuing new oil and gas leases (NL) nor does it strictly require a NSO leasing option be connected with mineral leases in IRAs. It does prohibit the road construction and timber removal that would be practically necessary for efficient oil and gas exploration through drilling, as well as the road building and timber removal necessary for building oil and gas production facilities. It is possible that certain resource mapping and exploration activities could occur on new oil and gas leases in IRAs as long as these activities are not prohibited by the 2001 Roadless Area Conservation Rule. In actuality, a agency-wide CSU leasing option would be applied to new leases within an IRA, but the fact that the CSU leasing option and compliance with the 2001 Roadless Area Conservation Rule (no roads or timber cutting) would effectively prevent use of the lease surface for efficient exploration and development of oil and gas has been reflected in this impact analysis by assuming new leases in IRAs would essentially include a NSO leasing option. As a result, the agency-wide CSU applied to Alternatives C, D1, and E1 is referred to throughout the EIS as NSO. The CSU leasing option applied to IRAs under Alternatives D2 and E2 is a less restrictive CSU than the one described above.

4.3.4 Impacts of Connected Actions by Leasing Option

This section summarizes the leasing options described in Chapter 1 of the EIS and describes how they would apply to IRAs and eligible Wild and Scenic Rivers under the various alternatives. Leasing options would dictate the conditions under which impacts from connected actions (as described in the RFDS) may occur. Impacts from connected actions under each leasing option are discussed in this section. Impacts to IRAs and eligible Wild and Scenic Rivers considering leasing option overlaps (i.e., overlaps with more restrictive leasing options assigned to other resources) are discussed in Section 4.3.5 (Impacts by Alternative). Under all leasing options and alternatives, oil and gas activity would be subject to the Best Management Practices (BMPs) listed in the *Dixie National Forest Oil and Gas Construction and Operating Standards and Well Site Design Requirements* contained in Appendix C and the *Surface Operating Standards and Guidelines for Oil and Gas Exploration and Development – The Gold Book* (BLM and USFS 2007).

4.3.4.1 Not Legally Available (NA)

NA applies to lands that are not legally available for leasing and includes the Brian Head Ski Permit Area, wilderness areas, and areas surrounding the Box-Death Hollow Wilderness Area that were withdrawn from leasing by the Utah Wilderness Act of 1984. No oil and gas leasing would occur in these areas. Death Hollow Creek, Mamie Creek, and Pine Creek are eligible Wild and Scenic Rivers located within these areas and a small portion of IRAs occur within the areas withdrawn by the Utah Wilderness Act of 1984. These would not be legally available for leasing.

4.3.4.2 No Lease (NL)

NL applies to lands where no new leases would be authorized. These lands would not be administratively available for leasing. No direct disturbance to IRAs or eligible Wild and Scenic Rivers would occur under NL. Under Alternative A, NL would apply to all areas on the Dixie National Forest and there would be no direct or indirect effects to IRAs or eligible Wild and Scenic Rivers. Under Alternative B, NL would also apply specifically to IRAs and eligible Wild and Scenic Rivers and no direct impacts would occur in these areas. Adverse indirect effects to these resources could occur as a result of oil and gas activity on lands available for leasing adjacent to these areas. Indirect effects are not likely to affect the ability of these areas to be managed as IRAs or Wild and Scenic Rivers; however, they could degrade various roadless or wilderness characteristics and outstandingly remarkable values. The types of indirect effects under NL would be the same as those described in Section 4.3.4.6. For seismic exploration and exploratory wells, adverse indirect effects would generally range from negligible to minor and be temporary or short term. A production field would have moderate to major, adverse, long-term indirect effects.

4.3.4.3 No Surface Occupancy (NSO)

NSO would prohibit occupancy or use of the land for oil and gas related activities (i.e., construction of well pads, central tank batteries, access roads, pipelines, power lines, and other linear structures). Seismic exploration could occur under NSO. NSO does not apply to eligible Wild and Scenic Rivers under any alternative. Under Alternative C and the dual analysis scenario for Alternatives D, and E, the 2001 Roadless Area Conservation Rule applies a CSU leasing option to IRAs. However, due to the level of restrictions predicated by the CSU leasing option, it is analyzed as NSO (explained in further detail above in Section 4.3.3 and under CSU).

Under NSO, the only direct impacts to IRAs would occur as a result of seismic exploration and would range from negligible to moderate, and adverse as summarized below in the measurement indicators.

Indirect impacts to IRAs would be the same as described in Section 4.3.4.6 and in most cases would be adverse, ranging from negligible to minor and temporary or short term.

Measurement Indicators

- *Measurement Indicator #1* NARRATIVE DISCUSSION OF IMPACTS TO ROADLESS CHARACTERISTICS AND WILDERNESS ATTRIBUTES

The impacts of seismic exploration in IRAs would generally be the same as described in Section 4.3.4.6 and the other sections of Chapter 4 referenced in Section 4.3.4.6. The impacts will be summarized in this section and the reader is referred to Section 4.3.4.6 and the other sections of Chapter 4 for more detailed information.

<u>Roadless Characteristics</u>

High quality or undisturbed soil, water, and air: The transportation of seismic equipment using buggies would produce surface ruts, particularly in areas of soft soil. The creation of ruts could promote small-scale soil erosion. Other direct impacts include possible chemical/fuel spills, vehicle emissions, and the creation of fugitive dust. Adherence to BMPs and prompt reclamation of disturbed areas would limit the magnitude and duration of these impacts. These impacts would be adverse, negligible to minor and short term.

Sources of public drinking water: Seismic exploration would have only short-term negligible to minor adverse effects as discussed for water in the previous roadless characteristic.

Diversity of plant and animal communities: Adverse effects of seismic exploration would be short term and minor resulting from the temporary disturbance of mobile wildlife due to noise and human presence, mortality to less mobile animals, and the potential to introduce noxious weeds.

Habitat for threatened, endangered, proposed, candidate, and sensitive species dependent on large undisturbed areas of land: Impacts to threatened, endangered, proposed, and candidate species would be avoided/mitigated through compliance with the Endangered Species Act. Impacts to sensitive species would be adverse, short term, and minor as described in the previous roadless characteristic.

Primitive, Semi-Primitive Non-Motorized, and Semi-Primitive Motorized: Seismic activity would lead to minor short-term increases in noise levels that would detract from the recreation experience.

Reference landscapes: Seismic exploration would have negligible to minor, short-term adverse impacts to an IRA's potential to serve as a reference landscape, due primarily to the possibility of noxious weed introductions.

Natural appearing landscapes with high scenic quality: Seismic exploration would not result in substantial alteration of the scenic quality of the landscape and impacts would be negligible and short term.

Traditional cultural properties and sacred sites: Cultural surveys would be required prior to any seismic exploration and areas identified would be protected by Section 106 of the National Historic Preservation Act and impacts would be negligible.

Other locally identified unique characteristics: Specific, comprehensive information on unique characteristics is not available for each IRA. Any unique characteristics present would likely be adversely impacted by seismic exploration with short-term effects ranging from negligible to moderate.

Wilderness Attributes

Natural Integrity: Seismic exploration would have negligible, adverse, short-term effects on long-term ecological processes, primarily due to the potential for noxious weed introductions.

Apparent Naturalness: Short-term impacts from seismic exploration would include the appearance of ruts and drill holes. These impacts would be adverse and minor.

Solitude and Primitive Recreation: Seismic activity would disturb the solitude of IRAs and opportunities for primitive recreation during the exploration, due primarily to helicopter and/or buggy traffic/noise and explosions. These adverse impacts would be minor and limited to the length of the exploration.

Challenging Experience: Seismic exploration would have no effect on the ability of IRAs to provide a challenging experience.

Special Features/Special Places/Special Values: Adverse, negligible to moderate short-term impacts could occur similar to what is described for locally identified unique characteristics.

Wilderness Manageability and Boundaries: Seismic activity would have no effect on the ability of an IRA to be managed as wilderness.

- *Measurement Indicator #2* MILES OF ROADS (RECONSTRUCTION AND NEW CONSTRUCTION) AND ACRES OF DISTURBANCE IN IRAS

The only disturbance that could occur within IRAs under NSO would be associated with seismic exploration. If the full amount of seismic exploration predicted by the RFDS were to occur within IRAs, disturbance could affect up to 60 acres on the Pine Valley Ranger District and 120 acres on each of the Cedar City, Powell, and Escalante Ranger Districts. No new or reconstructed roads would occur in IRAs

4.3.4.4 Timing Limitation (TL)

The TL leasing options does not directly apply to IRAs or eligible Wild and Scenic Rivers under any alternative.

4.3.4.5 Controlled Surface Use (CSU)

INVENTORIED ROADLESS AREAS

CSU provides for controlled but generally allowed surface use on all or portions of a lease. Operations would be held to special constraints that may exceed the standard lease terms, Forest Service regulations, and operating standards. An agency-wide CSU leasing option for new leases is applied to IRAs under the 2001 Roadless Area Conservation Rule that prohibits new temporary roads, permanent roads, road construction or reconstruction. Timber cutting associated with oil and gas exploration and development activities for new leases would also be prohibited by the CSU leasing option. As exploratory wells, production fields, and other facilities (i.e., pipelines, flowlines) would all require roads and timber cutting, it is unlikely that these activities would occur within IRAs under the CSU leasing option. As a result, it was determined that for the purpose of analyzing impacts the CSU leasing option would be analyzed as being practically equivalent to NSO and is referred to as an NSO in this chapter of the EIS.

A second CSU leasing option was also developed for IRAs for Alternative D2 with leasing allowed in IRAs. This CSU was designed to allow for exploration within IRAs while still preserving the ability of these areas to be managed for the undeveloped, unroaded charateristics of the area. The CSU would not allow mechanical road construction or reconstruction; as a result no new temporary or permanent roads would be constructed. Travel may occur along any existing roads located within IRAs (as described in Section 3.3.2, roads without evidence of mechanical construction, such as two-track roads, may exist in IRAs). In addition, this CSU would allow timber harvest. As a result, exploration, including seismic and exploratory wells, could occur within IRAs. It is unlikely that a production field would occur within an IRA under this CSU, as a production field would require permanent roads to service the wells and transport the oil to market. Seismic exploration and the construction and operation of well pads and associated facilities would have adverse effects to the roadless characteristics and wilderness attributes of IRAs. The general type of impacts would be the same as described for SLT in Section 4.3.4.6. However, the amount of disturbance and the duration of impacts would be reduced relative to SLT due to the lack of road construction and

the fact that a production field would not be developed. As a result, impacts would be short term. Impacts associated with seismic activity would be adverse, negligible to minor. Impacts associated with exploratory wells would be minor to moderate.

Measurement Indicators

- *Measurement Indicator #1* NARRATIVE DISCUSSION OF IMPACTS TO ROADLESS CHARACTERISTICS AND WILDERNESS ATTRIBUTES

The impacts of seismic exploration within IRAs would generally be the same as described in Section 4.3.4.6 and summarized in Section 4.3.4.3. The impacts of exploratory wells would also generally be the same as described in Section 4.3.4.6 and the other sections of Chapter 4 referenced in Section 4.3.4.6. While access roads would not be constructed under CSU, the types of impacts associated with roads in Section 4.3.4.6 would still occur under CSU due to the fact that travel would still be allowed on existing roads. However, under CSU there would be less disturbance of habitat as roads would not be mechanically constructed or widened to their full width.

- *Measurement Indicator #2* MILES OF ROADS (RECONSTRUCTION AND NEW CONSTRUCTION) AND ACRES OF DISTURBANCE IN IRAS

There would be no construction or reconstruction of roads. Disturbance would consist of seismic exploration, the construction of well pads, and the clearing on vegetation within or along existing roads. If the full amount of seismic exploration predicted by the RFDS were to occur within IRAs, which is unlikely, disturbance could affect up to 60 acres on the Pine Valley Ranger District and 120 acres on each of the Cedar City, Powell, and Escalante Ranger Districts. Without the disturbance associated with access roads, exploratory wells would disturb up to 5.9 acres per well, for a total of up to 29.5 acres on the Pine Valley Ranger District, 88.5 acres on the Cedar City Ranger District, and 118 acres each on the Powell and Escalante Ranger Districts. The amount of vegetation that would need to be cleared in order to use existing roads is unclear, but it is assumed that it would be much less than the full disturbance estimated for access road construction (6.6 acres per well) for a total of 33 acres on the Pine Valley Ranger District, 99 acres on the Cedar City Ranger District, and 132 acres on each of the Powell and Escalante Ranger Districts.

ELIGIBLE WILD AND SCENIC RIVERS

A CSU leasing option is applied to Wild and Scenic Rivers under Alternatives C and D. This CSU leasing option would not allow the construction of new roads within ¼-mile of either bank of an eligible stream to preserve its ability to be classified as wild. Further, in accordance with Section 9 of the Wild and Scenic Rivers Act and USFS (2006a), pipelines and power lines would not be allowed within ¼-mile of either bank of an eligible stream. Portions of other facilities, such as well pads and central tank batteries, could be located within ¼-mile of an eligible stream if the location of these facilities would not degrade the outstandingly remarkable values or make the stream ineligible for future inclusion in the National Wild and Scenic River System. Seismic exploration would be permitted under the CSU leasing option. Impacts to eligible Wild and Scenic Rivers under CSU are described in the measurement indicators below.

Measurement Indicators

- *Measurement Indicator #1* NARRATIVE DISCUSSION OF IMPACTS TO ELIGIBILITY AND “OUTSTANDINGLY REMARKABLE” VALUES

Seismic exploration using buggies could produce surface ruts, particularly in areas of soft soil near streams, which could promote small-scale soil erosion. Some of the eroded material has the potential to enter streams, which could negatively impact native fish habitat and ecological conditions in Moody Wash and the East Fork of Boulder Creek. Chemical or fuel spills in or adjacent to streams could also negatively impact fish habitat and aquatic ecology; however, these impacts should be mostly negligible due to the BMPs in BLM and USFS (2007), Appendix C, and the ability to move operations by up to 200 meters (656 feet) under SLT. Seismic surveys also have the potential to disturb recreation due to noise from drilling, blasting, and vehicular and/or helicopter traffic. The presence of buggies, helicopters, and mobile drill rigs would temporarily degrade the scenic qualities of these areas, with scenic integrity returning to baseline levels once these activities are completed. Well pads and associated facilities (excluding pipelines and power lines) could also be located within ¼-mile of either streambank if they do not jeopardize the eligibility of the stream for inclusion in the National Wild and Scenic River System. Constructing these facilities in a way that would not jeopardize eligibility likely involves locating them at a sufficient distance that they do not impact ecological conditions, scenic integrity, or recreational values. In all practicality, the inability to construct roads, pipelines, or power lines within ¼-mile of an eligible segment would preclude locating more than a portion of a well pad or other similar facility within the buffer. Considering this, impacts should be negligible to minor, and would not be expected to jeopardize a stream's eligibility for inclusion in the National Wild and Scenic River System. Impacts may be long or short term.

- *Measurement Indicator #2* MILES OF ROADS (RECONSTRUCTION AND NEW CONSTRUCTION) AND ACRES OF DISTURBANCE WITHIN ¼-MILE OF ELIGIBLE STREAM SEGMENTS

Under CSU, no road construction or reconstruction would occur. Up to 60 acres could be disturbed by seismic exploration on Moody Wash (Pine Valley Ranger District) and 120 acres on the North Fork of the Virgin River and the East Fork Boulder Creek (Cedar City and Escalante Ranger Districts, respectively). This disturbance estimate represents the maximum amount that may occur if all the seismic exploration predicted to occur by the RFDS were to occur within the ¼-mile buffer around eligible streams. Similarly, if it is assumed that an entire pad for an exploratory well could be constructed within the ¼-mile buffer around an eligible stream, then 5.0 acres could be disturbed per well, with a total possible disturbance of 29.5 acres on Moody Wash (5 wells), 88.5 on the North Fork of the Virgin River (15 wells), and 118 acres on the East Fork of Boulder Creek (20 wells). However, it is extremely unlikely that more than 1 well pad would be located with ¼-mile of an eligible stream due the ability of one exploration well to adequately explore the small area surrounding these streams, the CSU leasing option that would prevent any disturbance affecting stream eligibility, and the ability under SLT to move facilities by up to 200 meters (656 feet). As a result, the expected disturbance would be much less, likely no more than 1 well (5.9 acres). For a production field, the inability to construct any roads would also preclude constructing an entire production field within the buffer around an eligible Wild and Scenic River. Further, it is highly unlikely that a production field would be located in direct proximity to an eligible stream. However, for purpose of this analysis, the disturbance associated with the elements of a production field that could be located within ¼-mile of an eligible stream under CSU would be 137.6 acres (20 wells, topsoil storage areas, 1 water injection well, and production facilities).

4.3.4.6 Standard Lease Terms (SLT)

Impacts in this section are discussed assuming no restrictions or leasing option other than those listed on BLM Lease Form 3100-11 (SLT), the environmental protection measures that would be implemented by other laws and regulations as described in Section 1.8.5.2, and the BMPs listed

in Section 4.3.4. As a minimum, all leases are governed by SLT and the impacts described in this section represent the maximum amount of disturbance that could occur as a result of oil and gas activities.

INVENTORIED ROADLESS AREAS

Assuming IRAs are open to oil and gas leasing activity under SLT (2001 Roadless Area Conservation Rule is not in effect), disturbance could consist of seismic exploration, construction and reconstruction of roads, exploratory well pads and associated facilities, and production wells with their associated facilities. Table 4.3-4 shows the projected road construction that could occur within IRAs in each ranger district, assuming the 2001 Roadless Area Conservation Rule was not in effect. These activities/facilities would have adverse effects to the roadless characteristics and wilderness attributes of IRAs. In general, seismic exploration has the least potential for impacts, followed by well pads, production facilities, power lines, pipelines, and access roads. Roads would tend to have the greatest impacts due to the extent of ground covered and the fact that IRAs are valued for their lack of roads. Disturbance associated with seismic activity would be adverse, negligible to minor and short term as discussed in the measurement indicators. Impacts from exploratory wells would also be primarily short term, and minor to moderate. For both these activities, once activities and reclamation were completed, the conditions should return to baseline conditions. However, given the arid nature of many areas on the Dixie National Forest, reclamation could involve longer periods of time and some evidence of these activities may be present long term (greater than 10 years). If oil or gas is discovered, and a production field developed, there would be a direct loss of roadless acres for the life of the development, which is expected to be longer than 10 years. The direct loss of roadless acres would be an adverse effect and could range from minor to major, depending upon the size of the IRA and the roadless characteristic or wilderness attribute being impacted, as discussed in the measurement indicators.

Table 4.3-4 Projected Road Construction and Total Disturbance that could occur within IRAs, by Ranger District

Ranger District	Activity	[1]Roads (miles)		[1]Total Disturbance (Acres)
		New Roads	Reconstructed Roads	
Pine Valley	Seismic Exploration (100 miles)			60.0
	Exploratory Wells (5 wells)	3.3	19.6	83.0
	Production Wells (19 wells)	10.0		253.9
Cedar City	Seismic Exploration (200 miles)			120.0
	Exploratory Wells (15 wells)	9.9	58.8	249.0
	Production Wells (19 wells)	10.0		253.9
Powell	Seismic Exploration (200 miles)			120.0
	Exploratory Wells (20 wells)	13.2	78.4	332.0
	Production Wells (19 wells)	10.0		253.9
Escalante	Seismic Exploration (200 miles)			120.0
	Exploratory Wells (20 wells)	13.2	78.4	332.0
	Production Wells (19 wells)	10.0		253.9
[2]Forest Total	Seismic Exploration			420.0
	Exploratory Wells	39.6	235.2	996.0
	Production Wells	10.0		253.9

[1] Miles and acres of roads are a part of the estimated total disturbance, which also includes well pads, production facilities, power lines, pipelines, and truck loading areas (BLM 2007a).
[2] A single production field is predicted for the entire Forest; however, it could be located on any of the ranger districts. As a result, the total disturbance for production wells is the same for each ranger district and the Forest total.

Indirectly, drill rigs, power lines, roads, seismic exploration, vehicular traffic, and other facilities and noise associated with oil and gas activity may be visible and audible from various locations within IRAs (USFS 1995a). These impacts would be both long and short term depending upon the nature of the development. Similar to direct impacts discussed above, indirect effects would be adverse and range from negligible to moderate depending upon the roadless characteristic or wilderness attribute. These effects are discussed in the measurement indicators.

Measurement Indicators

- *Measurement Indicator #1* NARRATIVE DISCUSSION OF IMPACTS TO ROADLESS CHARACTERISTICS AND WILDERNESS ATTRIBUTES

Many of the roadless characteristics are also resource issues that are described in other sections of Chapter 4. The impacts described in those reports are summarized for each roadless characteristic and the reader is referred to the appropriate sections for further information.

Roadless Characteristics

High quality or undisturbed soil, water, and air: Impacts to soil, water, and air are described in Sections 4.7 (water and watershed resources), 4.8 (soils and geologic hazards), and 4.12 (air resources). Seismic exploration in IRAs would be conducted primarily using the explosion method due to the lack of roads. Seismic drill rigs would be transported using off-road buggies or helicopter. The use of buggies would produce surface ruts, particularly in areas of soft soil, which could promote small-scale soil erosion. Other direct impacts include possible coolant/oil/fuel spills from equipment, vehicle emissions, and the creation of fugitive dust. Prompt reclamation of disturbed areas would limit the duration of these impacts. The construction of exploration and production drilling well pads and access roads would present a greater risk of soil erosion due to runoff events, wind, and traffic. Sediment could be transported to wetlands, streams, lakes, and other waterbodies, which would degrade aquatic ecosystem function. Further, impacts to soils and water could result from the spill of hydrocarbons, drilling mud, or other chemicals. Impacts to air quality would occur primarily from vehicle emissions and fugitive dust from road traffic. The ability to move operations up to 200 meters (656 feet) to avoid sensitive resources, compliance with the BMPs listed in BLM and USFS (2007) and Appendix C, and prompt reclamation of disturbances following short-term exploration activities would reduce impacts. Disturbances related to development and production activities would be minimally reclaimed following construction and full reclamation of these disturbances would be delayed for the duration of the production. Direct impacts from exploration to production would be expected to be adverse, negligible to moderate, and both short term to long term. There would be no indirect impacts to soil, water, or air within IRAs

Sources of public drinking water: The potential effects to sources of public drinking water are described in Section 4.7. Impacts to municipal watersheds would largely be avoided under SLT by moving facilities up to 200 meters (656 feet) where required to protect sensitive areas and by complying with the BMPs listed in BLM and USFS (2007) and Appendix C. If contamination did occur, adverse effects would range from negligible to major depending upon the location and amount of contamination. Effects would be primarily short term, as conditions would return to normal following the spill and proper cleanup and reclamation. Indirect impacts to portions of municipal watersheds located outside of IRAs would be the same as described in Section 4.7

Diversity of plant and animal communities: Impacts to plant and animal communities are described in Sections 4.9 and 4.5, respectively. Impacts of seismic exploration include

temporary disturbance of mobile wildlife due to noise and human presence and potential mortality to less mobile animals. Seismic exploration also has the potential to introduce noxious weeds, which could impact both plant and animal communities. Exploratory wells and access roads would remove vegetation/habitat for the life of the well and the time necessary for effective reclamation. Production wells and associated facilities would have similar impacts, but they would be more long term due to the delay in full reclamation until production ceases. Oil and gas activity could also disturb biological crusts, which would physically destabilize the soil, reduce soil fertility, decrease the ability of the soil to retain water, and increase the potential for noxious weed invasion (NSTC 2001). Recovery of biological crusts may take decades to hundreds of years. Further, oil and gas activity within the Side Hollow Ponderosa Pine Provenance Study Area could remove trees or disturb soil and vegetation communities, which would disrupt the long-term study underway. However, given the small size of the study area (4.5 acres), impacts would be avoidable under SLT by the ability to move operations by up to 200 meters (656 feet). Impacts to other unique habitats not identified in this section would vary depending upon the habitat and the location of disturbance. Overall, exploration activities would have the least amount of impacts on the diversity of plant and animal communities due to the relatively small amount of disturbance and direct adverse impacts would most likely range from negligible to moderate and would be short term. Due to the greater amount of disturbance expected from a production field, impacts could range from minor to major and would be long term. Oil and gas activity on land adjacent to IRAs would have no impacts on the diversity of plant communities within IRAs. Activity on adjacent land could intersect wildlife migration corridors and further isolate wildlife communities. However, given the large size of IRAs and the high quality habitat present in these areas, adverse indirect effects would be negligible and short term to long term.

Habitat for threatened, endangered, proposed, candidate, and sensitive species dependent on large undisturbed areas of land: Threatened, endangered, proposed, candidate, and sensitive species are discussed in Section 4.6. SLT requires lessees to comply with all applicable laws, including the Endangered Species Act. Compliance with the Endangered Species Act would avoid and/or mitigate most impacts to habitat for threatened, endangered, proposed, and candidate species. Habitat for sensitive species, and species dependent on large areas of land, would not be protected by the Endangered Species Act and could be impacted by oil and gas activity. The type of impacts would generally be the same as described above for the diversity of plant and animal communities. The intensity of impacts would vary depending upon the amount of habitat affected and could range from negligible to moderate and short term for exploration activities. Adverse impacts of a production field would be long term and would likely range from minor to major. Indirect impacts would be the same as described for the diversity of plant and animal communities.

Primitive, Semi-Primitive Non-Motorized, and Semi-Primitive Motorized: Impacts to recreation are discussed in Section 4.4. Exploration and development activities would lead to temporary increases in noise levels that would detract from the nearby recreation experience. In addition, the visual presence of facilities would detract from the recreation experience. These impacts would be adverse and negligible to minor in larger IRAs and moderate to major in the smaller IRAs such as Dixie, Gum Hill, Red Canyon South, Shakespeare Point, and South Rim. Impacts would primarily be short term, limited to the length of exploration and time needed for full reclamation. Production wells and facilities would have similar, but long-term effects until production ceased and the disturbances were fully reclaimed. Indirectly, the ability to see and hear oil and gas facilities and/or activities on adjacent land would degrade the recreation experience. These effects would be adverse, long term, and negligible to minor depending upon the topography and placement of the facilities relative to the IRAs.

Reference landscapes: Seismic exploration, exploratory wells, access roads, and production wells, would introduce human disturbance into IRAs and would potentially eliminate the ability to use parts of these areas as reference landscapes. The intensity of these adverse effects would be minor for seismic exploration to major for a production field, depending also upon the size of the IRA and the placement of facilities. Effects would be long term, since once a landscape is disturbed it loses its value as a reference landscape. There would be no indirect impacts to the ability of an IRA to be used as a reference landscape.

Natural appearing landscapes with high scenic quality: Scenic integrity is discussed in detail in Section 4.2. Seismic exploration would not result in substantial alteration of the scenic quality of the landscape. Well pads, access roads, and other facilities would alter its natural appearance and degrade the scenic qualities of landscapes. These impacts would be adverse and negligible to moderate depending upon the placement of facilities and would be short term, limited to the length of exploration for exploratory wells and associated access roads. They would be long term for production facilities until production ceased and disturbances were fully reclaimed. Indirectly, oil and gas facilities on adjacent land would also reduce the natural appearance of areas visible from IRAs, but not of IRAs themselves.

Traditional cultural properties and sacred sites: Cultural properties have not been identified in the majority of IRAs. However, cultural surveys would be required prior to any lease activity and areas identified would be protected by Section 106 of the National Historic Preservation Act. There would also be no indirect effects to cultural properties within IRAs.

Other locally identified unique characteristics: All the unique characteristics that may be present within IRAs on the Dixie National Forest were not identified in Chapter 3. Any unique characteristics that may be present within IRAs on the Dixie National Forest are likely considered under the specific resource for which it is unique and therefore considered elsewhere in the document. Impacts may be direct or indirect and intensity would vary depending upon the specific characteristics and both the level and location of oil and gas activity. In general, seismic exploration would have the least amount of impacts, followed by exploratory wells and production wells. Impacts could, therefore, range from negligible to major and may be short term or long term.

Wilderness Attributes

Natural Integrity: Seismic exploration would have little effect on long-term ecological processes. Well pads and access roads can disrupt ecological processes by increasing soil erosion and sediment delivery to aquatic ecosystems, removing vegetation, and removing or altering wildlife habitat. These impacts are discussed in further detail in Sections 4.5 (fish and wildlife), 4.6 (special status species), 4.7 (water and watershed resources), 4.8 (soils and geologic hazards), and 4.9 (vegetation). Without knowing the location of any future disturbance relevant to specific resources, it is difficult to predict the magnitude of the impacts on long-term ecological processes. However, the protection measures included in SLT, BMPs, and other environmental laws are designed to prevent major impacts to long-term ecological processes and adverse impacts would likely range from minor to moderate. Impacts could be both long and short term. The relative intensity of impacts to any one IRA would also depend upon the size of the IRA affected. There would be no indirect impacts to natural integrity.

Apparent Naturalness: Impacts from this disturbance would include the appearance of roads, well pads, and power lines. These impacts would be minor to moderate for large IRAs and moderate to major for smaller IRAs. Effects would be short term for seismic exploration and

exploratory wells and long term for a production field. There would be no indirect impacts to apparent naturalness.

Solitude and Primitive Recreation: Seismic exploration would disturb the solitude of IRAs and opportunities for primitive recreation, due primarily to noise from helicopters, buggies, and explosions. These impacts would be minor and temporary, with the duration limited to the length of the exploration. Exploratory wells and access roads would eliminate opportunities for solitude near the activity due to vehicular traffic, noise, and visual disruption of the landscape. The presence of these facilities would also reduce the primitive recreation experience. These impacts would be adverse and minor for most IRAs due to their large size relative to the area disturbed and the ability for the visitor to avoid these facilities; however, impacts would be more intense in the smaller IRAs. Impacts would be short term for exploratory wells and long term for a production field. Indirect impacts to solitude would be the same as described for Primitive, Semi-Primitive Non-Motorized, and Semi-Primitive recreation.

Challenging Experience: The opportunity for a challenging experience would primarily be impacted by the presence of roads. Roads would increase the ability of the public to access areas that otherwise would be accessible only through a challenging experience. This impact would be adverse and range from minor to moderate for most IRAs due to their large size relative to the roaded area. However, as with other resources, the impacts would be more intense for the smaller IRAs. Impacts would be both short term for exploration activities and long term for production facilities. There would be no indirect impacts to a challenging experience.

Special Features/Special Places/Special Values: As described for locally identified unique characteristics, the special features/places/values in the 38 individual IRAs are not described in this section or in Chapter 3. Any unique characteristics that may be present within IRAs on the Dixie National Forest are likely considered under the specific resource for which it is unique and therefore considered elsewhere in the document. Impacts may be direct or indirect with the intensity ranging from negligible to major depending upon the resource and interaction with the oil and gas activities. In general, seismic exploration would have the least amount of impacts, followed by exploratory wells and productions wells. Duration may be short term for exploration activities and long term for production facilities.

Wilderness Manageability and Boundaries: Seismic exploration would have no effect on the ability of an IRA to be managed as wilderness. Disturbance associated with well pads and access roads could change the shape of an IRA's boundary or could dissect an IRA into fragments that would be too small to be managed as wilderness (less than 5,000 acres). For example, an access road that bisects an IRA could fragment it into two sections that, by themselves, would be too small to be managed as wilderness areas. Alternatively, an access road could be built near the boundary of an IRA and although this may reduce the size of the IRA, it would not reduce it sufficiently to affect its wilderness potential. As a result, the intensity of effects would be dependent on the road placement and the amount of disturbance and could range from negligible to major. The effects would be most pronounced in some of the smaller IRAs. Impacts from exploratory wells and access roads would be short term and once disturbance is reclaimed the boundary would return to prior conditions. A production field would substantially alter boundaries in the long term. There would be no indirect effects to wilderness manageability and boundaries.

- *Measurement Indicator #2* MILES OF ROADS (RECONSTRUCTION AND NEW CONSTRUCTION) AND ACRES OF DISTURBANCE IN IRAS

New roads and reconstruction of National Forest System roads would disturb an area approximately 39 feet wide. There would be approximately 3.3 miles of new temporary roads that could occur within IRAs on the Pine Valley Ranger District, 9.9 miles on the Cedar City Ranger District, and 13.2 miles on each of the Powell and Escalante Ranger Districts. In addition, approximately 19.6 miles of existing National Forest System roads on the Pine Valley Ranger District, 58.8 miles on Cedar City Ranger District, and 78.4 on both the Powell and Escalante Ranger Districts would need to be temporarily widened. A production field would require an additional 10 miles of permanent roads.

Table 4.3-4 lists the amount of projected road disturbance that could occur in an IRA. For this analysis, it is assumed that the activity projected for any ranger district could occur entirely within an individual IRA located on that ranger district, although this is unlikely. The total amount of disturbance that could occur in an individual IRA would be 396.9 acres for IRAs on the Pine Valley Ranger District, 622.9 acres for IRAs on the Cedar City Ranger District, and 705.9 acres for IRAs on the Powell and Escalante Ranger Districts.

ELIGIBLE WILD AND SCENIC RIVERS

Measurement Indicators

- *Measurement Indicator #1* NARRATIVE DISCUSSION OF IMPACTS TO ELIGIBILITY AND "OUTSTANDINGLY REMARKABLE" VALUES

Death Hollow Creek, Mamie Creek, and Pine Creek are located within the Box-Death Hollow Wilderness Area and there would be no direct impacts to these eligible streams from oil and gas activities. Under SLT, seismic surveys, roads, exploratory wells, and production wells and associate facilities could occur within ¼-mile of Moody Wash, the North Fork of the Virgin River, and the East Fork of Boulder Creek. These activities would involve some degree of surface disturbance that could include vegetation removal, soil compaction, earthwork, and natural drainage pattern alteration, resulting in increased erosion. Some of the eroded material has the potential to enter streams, which would negatively impact native fish habitat and ecological conditions in Moody Wash and the East Fork of Boulder Creek. Having roads and wells near the stream corridor also increases the risk for contamination from spills of hydrocarbons, water produced by the drilling process, fuel, or chemical spills. Potential erosion and the effects of sediment on streams and fish habitat are discussed further in Sections 4.5 (fish and wildlife) and 4.7 (water and watershed resources). Roads and well pads would also adversely affect the scenic and recreational values identified for the North Fork Virgin River and the East Fork of Boulder Creek. The appearance of these features would interfere with the natural look of these streams and would decrease the desire to recreate in these areas.

SLT allows the Forest Service to require a lessee to move operations by up to 200 meters (656 feet) for resource management reasons. This would reduce the potential for impacts to the streams themselves and to the ecological values of Moody Wash, as well as the fishery values of Moody Wash and the East Fork of Boulder Creek. Movement by up to 200 meters (656 feet) would not, however, eliminate impacts to the scenic and recreational values of the North Fork of the Virgin River and the East Fork of Boulder Creek. Furthermore, any road construction within ¼-mile of these streams would make them ineligible for inclusion in the National Wild and Scenic River System as Wild, which would be a major, adverse impact. As a result, adverse impacts would range from minor to major if roads are built within ¼-mile of these streams. The

impacts would be short term for disturbance from seismic exploration and exploratory wells and long term for a production field.

Concerning indirect effects, oil and gas activity on land beyond the ¼-mile buffer on either side of eligible streams would not make the streams ineligible for inclusion as wild (in the case of Moody Wash and the East Fork of Boulder Creek). However, it could degrade the scenic and recreational values of the North Fork of the Virgin River and the East Fork of Boulder Creek. These impacts would be negligible for seismic activity and mostly minor and temporary for exploratory wells and roads. However, the development associated with a production field could lead to moderate to major impacts.

- *Measurement Indicator #2* MILES OF ROADS (RECONSTRUCTION AND NEW CONSTRUCTION) AND ACRES OF DISTURBANCE WITHIN ¼-MILE OF ELIGIBLE STREAM SEGMENTS

No road reconstruction would occur due to the lack of existing roads in the stream corridor. Approximately 3.3 miles of new, temporary roads would be required for exploratory wells on the Pine Valley Ranger District, 9.9 miles on the Cedar City Ranger District, and 13.2 miles on the Escalante Ranger District. However, it is unlikely that more than one exploratory well would occur within ¼-mile of an individual stream and actual road construction would likely be much less. This is particularly true for the North Fork Virgin River, which only has 0.7 miles eligible for inclusion in the National Wild and Scenic River System. A production field would require approximately 10 miles of permanent roads; however, it is unlikely that a production field would occur within ¼-mile of an eligible stream.

Total disturbance associated with oil and gas activity could be up to 396.9 acres on Pine Valley Ranger District, 622.9 acres on Cedar City Ranger District, and 705.9 acres on the Escalante Ranger District. It is highly unlikely that this disturbance would occur entirely within ¼-mile of an eligible river, and in the case of the North Fork of the Virgin River, it would be impossible given that the total buffered area only comprises 279 acres. Therefore, for the purpose of this analysis, total disturbance for the North Fork of the Virgin River is estimated to be the total acres available (279 acres), although it is highly unlikely this would occur.

4.3.5 Impacts by Alternative

The degree to which the impacts of connected actions (Section 4.3.4) would differ by alternative is discussed in this section. Alternatives involve leasing options, which would restrict the locations and the nature of oil and gas impacts that are allowed.

Table 4.3-5 shows the acres and percentage of each resource component under each leasing option by alternative. It is important to note that the past history of the 2001 Roadless Area Conservation Rule has been full of changes in applicability due to judicial actions. Due to the uncertainty in the future status of the rule, this section intends to evaluate the effects to IRAs under a broad range of protective leasing options ranging from NSO to SLT. This occurs for Alternatives C through E in which the impact evaluation is conducted under the NSO leasing option, consistent with the 2001 Roadless Area Conservation Rule and another leasing option that would allow new disturbances for oil and gas exploration and development. In Alternative C, both end members of the leasing option range are assumed to be NSO and so this is evaluated only as NSO. Alternatives D1, D2, E1, and E2 represent the dual analysis of Alternatives D and E. D1 and E1 represent the acres available with NSO in all IRAs. D2 and E2 represent the acres with leasing allowed in IRAs under a less restrictive leasing option.

Table 4.3-5 Acreage of Resource Components under each Leasing Option by Alternative

Resource Component	Leasing Option[3]	Alternative[1,2]						
		A	B	C	D1	D2	E1	E2
Inventoried Roadless Areas	NA	2,142	2,142	2,142	2,142	2,142	2,142	2,142
	NL	568,408	568,408	16,449	7	7		
	NSO			551,958	568,403	42,238	568,410	
	CSU					526,165		
	SLT							568,410
Eligible Wild and Scenic Rivers	NA	5,732	5,732	5,732	5,732	5,732	5,732	5,732
	NL	2,548	2,548					
	NSO			2,473	2,086	7	2,086	
	CSU			76	460	2,542		
	SLT						460	2,548

[1] Small discrepancies in the acreage presented for each alternative are due to the fact that the GIS database has limitations when applied over an extremely large area that result in an inability to calculate acreages that match exactly between alternatives. A more detailed table that separates the acreage by resource component and ranger district will be available in Appendix B.
[2] Alternatives D1, D2, E1, and E2 represent the dual analysis of Alternatives D and E. D1 and E1 represent the acres available with NSO in all IRAs. D2 and E2 represent the acres with leasing allowed in IRAs under a less restrictive leasing option.
[3] Areas not legally available (NA) for leasing (see Section 1.5.2) are included in the Table to provide context to the analysis.

In this section, impacts are discussed at the Forest-wide level and not by ranger district. This is done to avoid repetition and facilitate the comparison of impacts across alternatives. However, any pronounced differences in the impacts to a resource component between ranger districts is highlighted and discussed.

4.3.5.1 Alternative A

No new oil and gas leases would be authorized under Alternative A and there would be no direct or indirect impacts to IRAs or eligible Wild and Scenic Rivers as a result of oil and gas leasing activity. Current operations, including the Upper Valley oil field on the Escalante Ranger District (19 wells, including nine water-injector wells) would continue (USFS 2006g). In total, there are 13,454 acres of existing leases on the Dixie National Forest. Existing leases will expire and the potential number of wells that could be drilled on the Dixie National Forest would decrease over time.

4.3.5.2 Alternative B

Alternative B would apply a NL leasing option to 100 percent of IRAs and eligible Wild and Scenic Rivers and their associated buffers that are in areas available for leasing. As a result, there would be no direct impacts to IRAs or eligible Wild and Scenic Rivers. Indirect impacts to both IRAs and eligible Wild and Scenic Rivers would be the same as described for SLT (Section 4.3.4.6).

4.3.5.3 Alternative C

INVENTORIED ROADLESS AREAS

Under Alternative C, NSO would apply to all IRAs not within areas unavailable for leasing (2,142 acres are unavailable for leasing, less than 1 percent) and disturbance would be limited to activities that are not prohibited by the 2001 Roadless Area Conservation Rule, such as seismic exploration, which does not require road building or timber cutting. Exploratory drilling and oil and gas production activities would practically be eliminated by the prohibition on road construction or timber cutting. Direct impacts from seismic exploration would result in short-

term adverse effects that would range from negligible to moderate, as described for seismic exploration under NSO (Section 4.3.4.3). Indirect effects would be the same as described for SLT in Section 4.3.4.6.

ELIGIBLE WILD AND SCENIC RIVERS

Under Alternative C approximately 97 percent (2,473 acres) of the eligible Wild and Scenic Rivers and their buffers located outside wilderness would be under NSO. The remaining 3 percent (76 acres) has a CSU leasing option applied. The 76 acres are located within the buffer around Moody Wash on the Pine Valley Ranger District. Impacts are discussed in the measurement indicators below.

The impacts of seismic exploration on eligibility and outstandingly remarkable values (*Measurement Indicator #1*) are described under NSO (Section 4.3.4.3). On Moody Wash, well pads and associated facilities (excluding pipelines and power lines) could be located on 76 acres of the area within ¼-mile of either streambank if they do not jeopardize the eligibility of the stream for inclusion in the National Wild and Scenic River System. Given the small area available (5 percent of the area within ¼-mile of either streambank) and the CSU leasing option that prohibits constructing these facilities in a way that would jeopardize eligibility, only minor adverse impacts would be expected. Impacts could be short and long term. Overall, given the level of protection (NSO for 97 percent and CSU for 3 percent), adverse impacts to eligible Wild and Scenic Rivers would be negligible to minor, and would not be expected to jeopardize their eligibility for inclusion in the National Wild and Scenic River System.

No road construction or reconstruction would occur. Disturbance (*Measurement Indicator #2*) from seismic activity could be up to 60 acres on Moody Wash (Pine Valley Ranger District) and 120 acres on the North Fork of the Virgin River (Cedar City Ranger District) and the East Fork of Boulder Creek (Escalante Ranger District). Other facilities such as well pads could disturb 75.9 acres on Moody Wash

4.3.5.4 Alternative D1 (NSO in IRAs)

INVENTORIED ROADLESS AREAS

Under Alternative D1 (NSO in IRAs), the vast majority of IRAs would be under NSO (over 99 percent) with approximately 2,142 acres (less than 1 percent) within areas not legally available for leasing (NA), and 7 acres (less than 1 percent) under NL. Given that most of the available acres are under NSO, the impacts to IRAs would generally be the same as described for Alternative C.

ELIGIBLE WILD AND SCENIC RIVERS

Of the eligible Wild and Scenic Rivers outside wilderness (Moody Wash, the North Fork of the Virgin River, and the East Fork of Boulder Creek) approximately 82 percent (2,086 acres) would be under NSO and approximately 18 percent (460 acres) would be under CSU. The areas of CSU would apply to approximately 24 acres around the East Fork of Boulder Creek, approximately 273 acres on the North Fork of the Virgin River, and 163 acres around Moody Wash.

The impacts of seismic exploration on eligibility and outstandingly remarkable values (*Measurement Indicator #1*) are described under NSO (Section 4.3.4.3). The impacts under CSU are described in Section 4.3.4.5. Under CSU, the outstandingly remarkable values would not be degraded and the tentative classification of the eligible segments would not be affected.

Under this alternative, only a small portion of the East Fork of Boulder Creek (24 acres), the North Fork of the Virgin River (273 acres), and Moody Wash would be under CSU. The impacts under CSU would be adverse and minor as described for Moody Wash under Alternative C. As a result, the overall impacts to eligible Wild and Scenic Rivers would be negligible to minor, and would not be expected to jeopardize their eligibility for inclusion in the National Wild and Scenic River System.

Up to 60 acres could be disturbed (*Measurement Indicator #2*) by seismic exploration on Moody Wash (Pine Valley Ranger District) and 120 acres on the North Fork of the Virgin River and East Fork Boulder Creek (Cedar City and Escalante Ranger Districts, respectively). This disturbance estimate represents the maximum amount that may occur if all the seismic exploration predicted to occur by the RFDS were to occur within the ¼-mile buffer around eligible streams, which is unlikely. Also, up to 24 acres on the East Fork of Boulder Creek, 273 acres on the North Fork of the Virgin River, and up to 163 acres on Moody Wash could be disturbed by facilities such as well pads (under CSU).

4.3.5.5 Alternative D2 (CSU in IRAs)

INVENTORIED ROADLESS AREAS

Under this alternative, less than 1 percent (2,142 acres) of IRAs would be within areas not available to leasing or would have a NL leasing option applied (7 acres). Approximately 7 percent (42,238 acres) would be under NSO and 92 percent (526,165) under CSU. Only seismic exploration could occur on the 7 percent of IRAs under NSO. However, the majority of IRAs would be available under CSU. The impacts under CSU are described in Section 4.3.4.5 and would include seismic exploration, exploratory wells, and the clearing of vegetation. Impacts as a result of these activities would range from negligible to moderate.

ELIGIBLE WILD AND SCENIC RIVERS

NSO would apply to less than 1 percent (7 acres) of eligible Wild and Scenic Rivers, CSU to 31 percent (2,542 acres), and the remaining 69 percent (5,732 acres) are within wilderness and not available for leasing. The impacts of oil and gas activity to wild and scenic rivers under CSU are discussed in Section 4.3.4.5 and would be negligible to minor and short to long term.

4.3.5.6 Alternative E1 (NSO in IRAs)

INVENTORIED ROADLESS AREAS

The acres of IRAs available for leasing under NSO would be the same as for Alternative C. Impacts would also be the same.

ELIGIBLE WILD AND SCENIC RIVERS

Of areas not within wilderness, approximately 82 percent (2,086 acres) would be under NSO and the remaining 18 percent (460 acres) would be available under SLT. This would include 24 acres on the East Fork of Boulder Creek, 273 acres on the North Fork of the Virgin River, and 163 acres on Moody Wash. Impacts are described for the measurement indicators below.

The impacts of seismic exploration on eligibility and outstandingly remarkable values (*Measurement Indicator #1*) are described under NSO (Section 4.3.4.3). The impacts that could occur under SLT are described in Section 4.3.4.6 and include the degradation of outstandingly remarkable values and the possible loss of eligibility for inclusion in the National Wild and Scenic River System due to the construction of roads. Under this alternative, only a small

portion of each stream would be subject to these impacts and a large change to the outstandingly remarkable values is unlikely. However, the construction of roads and other facilities could make all or portions of these streams ineligible for inclusion as "wild" or "scenic." As a result, the adverse impacts under this alternative would be moderate to major, depending upon the location of the facilities and the amount of each stream that could lose eligibility. Impacts may be either long or short term depending upon whether the disturbance was from an exploratory well or a production field.

Disturbance from seismic activity (*Measurement Indicator #2*) could be up to 60 acres on Moody Wash (Pine Valley Ranger District) and 120 acres on the North Fork of the Virgin River (Cedar City Ranger District) and the East Fork Boulder Creek (Escalante Ranger District). Also, up to 24 acres on the East Fork of Boulder Creek, 273 acres on the North Fork of the Virgin River, and 163 acres on Moody Wash could be disturbed by the activities predicted to occur by the RFDS, including roads power lines, and pipelines.

4.3.5.7 Alternative E2 (SLT in IRAs)

INVENTORIED ROADLESS AREAS

All acres of IRAs would be available under SLT and impacts would be as described for SLT in Section 4.3.4.6.

ELIGIBLE WILD AND SCENIC RIVERS

The total acreage (2,548 acres) of eligible Wild and Scenic Rivers located outside wilderness would be available under SLT and would be impacted as described for SLT in Section 4.3.4.6.

4.4 Recreation Resources

4.4.1 Introduction

The terms used to describe the context and intensity of effects in this section are discussed in Section 4.1 and Table 4.1-1. Table 4.4-1 provides an example how these terms would apply to Recreation Resources.

Table 4.4-1 Terms used to Describe Effects to Recreation Resources

Attribute of Effect		Description relative to Recreation Resources
Quality	Beneficial	A change to ROS setting characteristics that would enhance the quality of the setting for recreational activities.
	Adverse	A change to ROS setting characteristics that would degrade the quality of the setting for recreational activities.
Magnitude (Intensity)	Negligible	A change to access, remoteness, naturalness, social encounters, visitor impacts, facilities and site development, and visitor management that is so small it would not have a measurable effect on the existing inventoried ROS setting.
	Minor	A change to access, remoteness, naturalness, social encounters, visitor impacts, facilities and site development, and visitor management that would result in recreational setting characteristics that are still fully compatible or normal for the existing inventoried ROS setting.
	Moderate	A change to access, remoteness, naturalness, social encounters, visitor impacts, facilities and site development, and visitor management that would result in recreational setting characteristics that are inconsistent with the existing inventoried ROS setting.

Attribute of Effect		Description relative to Recreation Resources
	Major	A change to access, remoteness, naturalness, social encounters, visitor impacts, facilities and site development, and visitor management that would result in recreational setting characteristics that are inconsistent with and unacceptable to the existing inventoried ROS setting.
Duration	Temporary	A change to access, remoteness, naturalness, social encounters, visitor impacts, facilities and site development, and visitor management during construction of a facility (i.e., road, well pad) that would not occur once construction is completed.
	Short-term	A change to access, remoteness, naturalness, social encounters, visitor impacts, facilities and site development, and visitor management due to exploration activities (i.e., construction of exploratory well pads or access roads). The change to the ROS setting would be limited only to the time needed for exploration and reclamation, 10 years or less.
	Long-term	A change to access, remoteness, naturalness, social encounters, visitor impacts, facilities and site development, and visitor management due to ongoing exploration and operation of production facilities (i.e., a production field and associated roads). The change to the ROS setting would be similar to the life of the production field and would exceed 10 years.

4.4.2 Measurement Indicators

- *Measurement Indicator #1* CHANGES TO ROS RECREATION SETTING INDICATOR CHARACTERISTICS
- *Measurement Indicator #2* POTENTIAL DECREASE IN USE AND QUALITY OF THE RECREATION EXPERIENCE

4.4.3 Impacts Common to All Action Alternatives

Under Alternatives B, C, D, and E, it is assumed that activities described under the Reasonable Foreseeable Development Scenario (RFDS) would occur. Activities described under the RFDS include 60 to 120 acres (depending on ranger district) of overland travel associated with seismic surveys, 80 to 330 acres (depending on ranger district) of land clearing surface disturbance associated with road and pad building for exploration wells, and 254 acres of land clearing surface disturbance for a production field. The locations of these activities are not yet known. In general, impacts to recreation resources are described in terms of human ("user") reactions. In some cases (i.e., for ROS classes and dispersed areas), impacts are described in terms of the character of the resource area itself. The following sections contain descriptions of biotic and abiotic features that comprise the physical setting for recreation activities, including: visual resources (Sections 3.2 and 4.2), fish and wildlife (Sections 3.5, 3.6, 4.5, and 4.6), water (Sections 3.7 and 4.7), soils (Sections 3.8 and 4.8), vegetation (Sections 3.9 and 4.9), and air quality (Sections 3.12 and 4.12).

Various phases of oil and gas development would impact recreation resources differently, depending on their duration and on the amount and type of disturbance involved. The following phases are discussed in terms of possible impacts to all recreation resources under an SLT leasing option: seismic activity, exploratory drilling, production, and road construction.

Seismic Activity: Seismic exploration involves covering moderate distances by all-terrain buggy or helicopter and detonating small explosives in selected locations, creating temporary noise and human disturbances in those locations as well as temporary disturbances along the

route as it is traversed by the equipment. Noise would be produced mainly by the explosives used to generate vibrations. Moving the equipment along the route using buggies would involve less noise disturbance relative to using helicopters, although helicopters may accomplish the seismic survey in less time. Seismic activities would have temporary impacts on recreation with intensity depending on the presence and nature of recreation resources in the area. In general, individuals utilizing recreation resources are not likely to be displaced as a result of seismic activities.

Exploratory Drilling: Exploratory drilling involves the construction of drill pads and access roads, which removes areas used for recreation. Disturbances to recreation resources caused by construction and intermittent human presence on an exploration well would be short term, lasting for the duration of operations, and would extend as far as the operations were visible and audible to humans. Impacts to visual resources are discussed in detail in Section 4.2. Recreational users who seek to observe wildlife may be displaced further in some cases, due to reduced wildlife densities surrounding oil and gas disturbances (refer to Sections 4.5 and 4.6). Noise disturbances from the actual drilling would be temporary. Visual disturbances and human presence associated with the well would last for the duration of operations, which would be short term unless a production field was developed. These disturbances would cause some individuals utilizing recreation resources in the vicinity to be displaced and seek alternative recreation opportunities; individuals may or may not return to these areas after reclamation.

Production: A production field would involve the largest amount of disturbance and the most adverse impacts to recreation resources. The actual disturbed area, in addition to the visual and acoustic reach around the production field, could be incompatible with many recreation resources due to human presence, visual disturbances, and levels of noise. Impacts to displaced recreational users due to disturbance from the well pads and roads would be long term because production activities would last longer than 10 years. During initial field development, well drilling and field construction activities would produce the most potential for incompatibility with recreation locally. After production wells are drilled and the field constructed, human presence, traffic and noise would continue at a moderate level.

Road Construction: Road construction and reconstruction would accompany drilling in most cases. New roads could increase access levels to certain areas, which would increase the number of users and adversely modify some recreation resources. Road construction may also prevent access to recreation resources temporarily (during construction) or for the duration of operations: short term for exploration wells or long term for a production field. Changes in access would adversely impact some recreation resources in that values such as solitude would be compromised.

Potential changes to ROS recreation setting indicators and in the use and quality of the recreation experience (*Measurement Indicators #1* and *#2*, respectively) will be discussed by recreation resource component (Table 4.4-2) as appropriate below.

Table 4.4-2 lists the leasing options assigned to each recreation resource component under each alternative. Descriptions of leasing options (and associated impacts on recreation resources) are described in Section 4.4.4. Each assigned leasing option would either allow or restrict certain oil and gas activities (described under the RFDS) wherever the applicable resource component occurs on the Dixie National Forest.

Table 4.4-2 Leasing Options by Alternative for Recreation Resources

Recreation Resource Component	Alternative				
	A	B	C	D	E
ROS: Primitive	NL	NL	NL	NSO	SLT
ROS: Semi-Primitive Non-Motorized Setting	NL	NSO	NSO	CSU	SLT
ROS: Semi-Primitive Motorized Setting	NL	CSU	CSU	CSU	SLT
ROS: Roaded Natural Setting	NL	CSU	CSU	SLT	SLT
Designated Dispersed Areas	NL	NSO	CSU	SLT	SLT
Developed Sites (with appropriate buffer): Recreation Sites, Campgrounds, Guard Stations, etc.	NL	NSO	NSO	CSU	SLT
Administrative Sites	NL	NSO	NSO	CSU	SLT
Recreation Residences (with 0.25-mile buffer)	NL	NSO	NSO	NSO	SLT

Although the resource components listed in the table above specifically address dispersed recreation, dispersed recreation is not discussed as a separate resource in this section. Rather, dispersed recreation is indirectly assessed through the ROS class inventory and the inherent setting indicators of access, remoteness, naturalness, social encounters, visitor impacts, and visitor management. The ROS class settings are the backdrop against which a variety of dispersed recreation activities occur. Designated Dispersed Areas remain in the GIS model to provide a complete picture of the location of mapped resources on the Dixie National Forest.

4.4.4 Impacts of Connected Actions by Leasing Option

Leasing options would dictate the conditions under which impacts from connected actions (described under the RFDS) may occur. Impacts from connected actions under each leasing option are discussed in this section. Impacts to recreation considering leasing option overlaps (i.e., overlaps with more restrictive leasing options assigned to other resources) are discussed in Section 4.4.5 (Impacts by Alternative). Under all leasing options and alternatives, oil and gas activity would be subject to the Best Management Practices (BMPs) listed in the *Dixie National Forest Oil and Gas Construction and Operating Standards and Well Site Design Requirements* contained in Appendix C and the BLM and USFS *Surface Operating Standards and Guidelines for Oil and Gas Exploration and Development – The Gold Book* (BLM and USFS 2007).

4.4.4.1 Not Legally Available (NA)

NA applies to lands that are not legally available for leasing, including Brian Head Ski Permit Area, wilderness areas, and areas surrounding the Box-Death Hollow Wilderness Area that were withdrawn from leasing by the Utah Wilderness Act of 1984. No oil and gas leasing would occur in these areas and no disturbance to recreation resources in these areas would occur. NA does not apply to any of the recreation resource components under any alternative.

4.4.4.2 No Lease (NL)

Under the no lease option, no new leases would be issued and as existing leases expire or terminate, those lands would no longer be administratively available for oil and gas exploration or development. No disturbance, and therefore no impacts, to recreational resources would

occur under NL. Under Alternative A, NL would apply to all recreation resource components listed in Table 4.4-2.

4.4.4.3 No Surface Occupancy (NSO)

With the exception of seismic activities, NSO would prohibit occupancy or use of the land for oil and gas related activities (i.e., construction of well pads, central tank batteries, access roads, pipelines, power lines, and other linear structures).

Under this leasing option, oil and gas leases within applicable recreation sites would be issued with the leasing option that no surface occupancy is allowed. Excluding impacts related to seismic activities, there would be no direct or indirect impacts to recreation resources under NSO.

Measurement Indicators

DEVELOPED SITES, ADMINISTRATIVE SITES, RECREATION RESIDENCES, AND DISPERSED RECREATION

- *Measurement Indicator #2* POTENTIAL DECREASE IN USE AND QUALITY OF THE RECREATION EXPERIENCE

Though the impacts from seismic activities would be minor and temporary, recreationists in these areas may feel that their recreation experience was compromised because of the noise and possible sight of Off Highway Vehicles (OHVs), helicopters, and blasting noise.

ROS: PRIMITIVE SETTING

- *Measurement Indicator #1* CHANGES TO ROS RECREATION SETTING INDICATOR CHARACTERISTICS

Under NSO, the presence and use of motorized vehicles for seismic activities and blasting itself would be inconsistent or unacceptable with the ROS Primitive setting indicators for access, remoteness, and naturalness. These indicators state that motorized trails and use are unacceptable in Primitive settings. The distant sight and/or sound of human activity and visual intrusion in high scenic areas are both inconsistent with Primitive settings and would change the character of these inventoried areas. These effects would be minor to moderate and temporary in nature.

ROS: SEMI-PRIMITIVE NON-MOTORIZED SETTING

- *Measurement Indicator #1* CHANGES TO ROS RECREATION SETTING INDICATOR CHARACTERISTICS

Under NSO, the presence and use of motorized vehicles for seismic activities, and blasting itself, would be inconsistent with the ROS Semi-Primitive Non-Motorized setting indicator for access and possibly remoteness. These indicators state that Semi-Primitive Non-Motorized settings are inconsistent with motorized trails and the distant sight and/or sound of human activity. These effects would be negligible to minor and temporary in nature.

4.4.4.4 Timing Limitation (TL)

A TL leasing option would not apply to any recreation resource components directly.

4.4.4.5 Controlled Surface Use (CSU)

CSU provides for controlled surface use on all or portions of a lease. Operations would be held to special operational constraints that may otherwise exceed the mitigation provided by SLT, regulations, and operating orders. Under this leasing option, oil and gas leases would be issued with leasing options that allow surface occupancy of the leasehold, but with specific controls on oil and gas activities (see Appendix D). Proposed oil and gas activities could be located so they would not be obvious to recreation users and minimize intrusive sights and sounds from facilities and roads. Vehicular access would be limited to established roadways and well pads. Proposed well sites would be individually sited on a case-by-case basis (within 200 meters (656 feet) of the original site) to take advantage of vegetative or topographic screening. A CSU leasing option would apply to the recreation resource components as shown in Table 4.4-2.

Measurement Indicators

ALL RECREATION RESOURCE COMPONENTS

- *Measurement Indicator #2* POTENTIAL DECREASE IN USE AND QUALITY OF THE RECREATION EXPERIENCE

Long-term effects from oil and gas activities on recreation resources would be minor. CSU leasing options in these areas would minimize intrusive interactions with recreationists. Some users may feel that their recreation experience was compromised because of the noise and possible sight of vehicles and personnel.

ROS: SEMI-PRIMITIVE NON-MOTORIZED SETTING

- *Measurement Indicator #1* CHANGES TO ROS RECREATION SETTING INDICATOR CHARACTERISTICS

Under CSU, the presence and use of motorized vehicles for ongoing operations would be inconsistent with the ROS Semi-Primitive Non-Motorized setting indicator for access and possibly remoteness. These indicators state that Semi-Primitive Non-Motorized settings are inconsistent with motorized trails and primitive roads and the distant sight and/or sound of human activity. These effects would be minor to moderate and short term or long term.

ROS: SEMI-PRIMITIVE MOTORIZED SETTING

- *Measurement Indicator #1* CHANGES TO ROS RECREATION SETTING INDICATOR CHARACTERISTICS

Under CSU, the presence and use of motorized vehicles for ongoing operations would be compatible with the ROS Semi-Primitive Motorized setting indicator for access and remoteness. These effects would likely be negligible to minor and short term or long term.

ROS: ROADED NATURAL SETTING

- *Measurement Indicator #1* CHANGES TO ROS RECREATION SETTING INDICATOR CHARACTERISTICS

Under CSU, the presence and use of motorized vehicles for ongoing operations would be fully compatible with the ROS Roaded Natural setting indicator for access and remoteness. These effects would likely be negligible to minor and short term or long term.

4.4.4.6 Standard Lease Terms (SLT)

Impacts in this section are discussed assuming no restrictions or leasing option other than those listed on BLM Lease Form 3100-11 (SLT), the environmental protection measures that would be implemented by other laws and regulations as described in Section 1.8.5.2, and the BMPs listed in Section 4.4.4. As a minimum, all leases are governed by SLT and the impacts described in this section represent the maximum amount of disturbance that could occur as a result of oil and gas activities.

Under Alternative D, SLT would apply to ROS Roaded Natural, including within IRAs if the 2001 Roadless Area Conservation Rule was not in effect. Under Alternative E, SLT would apply to all the recreation resource components, including within IRAs if the 2001 Roadless Area Conservation Rule was not in effect.

The main conflict between oil and gas activities and recreation resources is a potential change in adjacent land use. Oil and gas activities may conflict with adjacent developed recreation sites or areas that are inventoried as suitable settings for certain recreational activities and experiences (ROS Classes). The potential conflict would be proportional to the total area available for that recreation resource, and for the purposes of this analysis, within each ranger district. The maximum amount of recreation acreage losses within ranger districts, assuming exploration and production developments occurred in each area, is presented in Table 4.4-3. Percentages in the table were calculated using the maximum number of disturbed acres predicted within each ranger district divided by the total number of acres of the resource within that ranger district.

Table 4.4-3 Maximum Percentage of Possible Recreation Area Disturbance on the Dixie National Forest

Resource	Pine Valley[1]	Cedar City[1]	Powell[1]	Escalante[1]
ROS: Primitive Setting[2]	<1%	100%	100%	21%
ROS: Semi-Primitive Non-Motorized Setting	<1%	1%	<1%	<1%
ROS: Semi-Primitive Motorized Setting	<1%	<1%	1%	<1%
ROS: Roaded Natural Setting	1%	1%	1%	1%
Developed Sites	17%	42%	64%	80%
Administrative Sites	100%	--	100%	100%
Recreation Residences	100%	100%	--	--

[1] Assumes the greatest amount of disturbance predicted in a ranger district occurred within each area
[2] Acres in wilderness (not available for lease) are not counted in percentages of ROS:Primitive that could be disturbed.

At developed recreation sites, short-term impacts from exploratory activities would not cause users to modify their behavior or be dissatisfied with their experience because developed sites carry an inherent expectation of some noise, built structures, and other human-caused disturbance. However, for most developed recreation sites (including mapped developed areas and administrative sites), impacts from disturbance-related conflicts would likely occur as a result of a production field. Development of a production field on ground set aside for developed recreation sites, or in direct proximity to developed recreation sites, would likely require these sites to be relocated in order to reduce user conflicts and preserve user experience. On the Powell and Escalante Ranger Districts, where a production field is more likely to occur, these impacts would be moderate to major and long term in nature. Impacts would be slightly less intense within developed sites on the Pine Valley and Cedar City Ranger

Districts (as a production field is less likely to occur on these ranger districts); these impacts would be minor and moderate, respectively, and relocation may not be necessary. Recreation residences could be avoided under SLT by the ability to move activities by up to 200 meters (656 feet). However, a production field on land adjacent to recreation residences would disturb users as described for developed recreation sites.

Regarding dispersed recreation activities (including camping, hiking, equestrian use, mountain biking, OHV use, and hunting and fishing), either exploration or production activities would cause short (exploration) or long term (production) impacts to users engaging in dispersed recreation activities. Seekers of dispersed recreation usually carry an expectation of solitude, quiet, and naturalness that would be disrupted by noise and human presence from oil and gas activities. Impacts would depend on the specific ROS class of the area, discussed below, as user expectations and thus the assessment of the quality of the recreational experience would differ in each area.

Measurement Indicators

ROS: PRIMITIVE SETTING

- *Measurement Indicator #1* CHANGES TO ROS RECREATION SETTING INDICATOR CHARACTERISTICS

Under SLT, several indicator characteristics of a Primitive setting could be compromised by oil and gas activities, including access, remoteness, and naturalness. All aspects of oil and gas activity, including exploration, production field development, and road construction would fundamentally conflict with the setting indicators for Primitive areas. These activities would compromise the natural-appearing setting and apparent remoteness of Primitive areas to some degree by introducing artificial elements and noises into the landscape. Activities under SLT could have moderate to major, long-term impacts in terms of compatibility with inventoried Primitive areas and the recreation activities that are generally associated with them. Impacts would be short to long term depending on whether or not wells were developed for production.

- *Measurement Indicator #2* POTENTIAL DECREASE IN USE AND QUALITY OF THE RECREATION EXPERIENCE

The potential for oil and gas activities to decrease dispersed recreation use in Primitive areas and overall recreation experience is moderate to major. The Cedar City and Powell Ranger Districts have the least amount of Primitive lands available, so oil and gas development in these districts would have a disproportionate potential to affect primitive recreation in these areas (Table 4.4-3). Exploration and construction activities in new locations would likely be followed by a decrease in recreation use as some users may feel that their recreation experience would be compromised because of intrusive sights and sounds not compatible with the setting. Use levels may or may not rebound after exploration is completed or production wells are in place. There is a strong possibility in Primitive areas that displaced users would not return to these areas after being affected by disturbances.

ROS: SEMI-PRIMITIVE NON-MOTORIZED SETTING

- *Measurement Indicator #1* CHANGES TO ROS RECREATION SETTING INDICATOR CHARACTERISTICS

Under SLT, several indicator characteristics of a Semi-Primitive Non-Motorized area could be compromised by oil and gas activities. These characteristics primarily include setting access, remoteness, and naturalness. Road construction would cause the most intense adverse

impacts to the Semi-Primitive Non-Motorized setting by violating the basic character of a non-motorized area. Production field development would also require a high level of site disturbance. Any oil and gas activity would compromise the natural-appearing setting and apparent remoteness of a Semi-Primitive Non-Motorized area to some degree by introducing artificial elements and noises into the landscape. Activities under SLT could have moderate to major, long-term impacts in terms of compatibility with inventoried Semi-Primitive Non-Motorized areas and the recreation activities that are generally associated with them. Impacts would be short to long term, depending on whether or not wells were developed for production.

- *Measurement Indicator #2* POTENTIAL DECREASE IN USE AND QUALITY OF THE RECREATION EXPERIENCE

The potential for oil and gas activities to decrease dispersed recreation use in Semi-Primitive Non-Motorized areas and overall recreation experience is moderate to major. Exploration and construction activities in new locations would likely be followed by a decrease in recreation use as some users may feel that their recreation experience would be compromised because of intrusive sights and sounds not compatible with the setting. Use levels may or may not rebound after exploration drilling is completed and reclaimed or once wells are in place. It is possible that users displaced from Semi-Primitive Non-Motorized areas due to oil and gas activities would not return to these areas after being affected by disturbances.

ROS: SEMI-PRIMITIVE MOTORIZED SETTING

- *Measurement Indicator #1* CHANGES TO ROS RECREATION SETTING INDICATOR CHARACTERISTICS

Under SLT, affected setting indicator characteristics of Semi-Primitive Motorized areas would include access, remoteness, and naturalness. Effects would be similar to those in Semi-Primitive Non-Motorized areas with the exception of road construction. Road construction from oil and gas activities, in some cases, would be compatible with the setting in Semi-Primitive Motorized areas. Primitive roads are permissible in these areas, but would not be adequate to support oil and gas traffic, which requires a graded road with two lanes and imported fill (i.e., gravel). Because highly modified roads should be located 0.5 miles from a Semi-Primitive Motorized area, ROS compatibility would need to be evaluated on a case-by-case basis.

Any oil and gas activities under SLT could have minor to moderate, long-term impacts in terms of compatibility with inventoried Semi-Primitive Motorized areas and the recreation activities that are generally associated with them. Impacts would be short to long term, depending on whether or not wells were developed for production.

- *Measurement Indicator #2* POTENTIAL DECREASE IN USE AND QUALITY OF THE RECREATION EXPERIENCE

The potential for oil and gas activities to decrease dispersed recreation use in Semi-Primitive Motorized areas and overall recreation experience is minor to moderate. Exploration and construction activities in new locations would likely be followed by a decrease in recreation use as some users may feel that their recreation experience would be compromised because of intrusive sights and sounds not compatible with the setting. Use levels may rebound after exploration drilling is completed and reclaimed or once wells are in place.

ROS: ROADED NATURAL SETTING

- *Measurement Indicator #1* CHANGES TO ROS RECREATION SETTING INDICATOR CHARACTERISTICS

Under SLT, production field development is most likely to compromise the naturalness setting characteristic of Roaded Natural areas. This means that the proposed development would be comprised of moderate to dominant visual elements in the landscape compared to the existing landscape character. This level of contrast would be compatible with areas of High, Moderate, and Low scenic integrity that may overlap Roaded Natural areas. Oil and gas development activities would need to be evaluated on a case-by-case basis to determine if they are compatible with Roaded Natural setting characteristics. In most cases, impacts would likely be minor and short to long term, depending on whether or not wells were developed for production.

- *Measurement Indicator #2* POTENTIAL DECREASE IN USE AND QUALITY OF THE RECREATION EXPERIENCE

Impacts to users and recreation experience in Roaded Natural areas would likely be negligible to minor because of the expectations of these users in Roaded Natural areas that already have noticeable modification and intrusive sights and sounds. It is unlikely that there would be a decrease in dispersed recreational use or changes in use patterns for Roaded Natural areas.

DEVELOPED SITES

- *Measurement Indicator #2* POTENTIAL DECREASE IN USE AND QUALITY OF THE RECREATION EXPERIENCE

Oil and gas activities under SLT may lead to decreases in the usage and quality of certain developed recreation sites because most users would not expect the visual contrast, noise, or activities associated with oil and gas development. Developed sites usually serve as destinations or hubs for recreation activities in the immediate area. Viewing oil and gas developments within the natural setting of a developed recreation site may cause users to be dissatisfied with their recreation experience. Oil and gas activities that occur in close proximity to developed sites would likely impact these areas greatly. Another factor is the type of activities that are pursued at a given developed site. For example, areas used as base camps for OHV use may not be as affected as family picnic areas or group campsites. Under SLT, the impacts on developed recreation sites from noise and increased traffic due to oil and gas activities would be minor to moderate, depending on individual perception. Since traffic levels and noise are relatively high in the vicinity of these areas (many users present at one time and adjacent to major roads) the increase in noise and traffic levels would be perceptible and may cause users to abandon the site or be dissatisfied with their experience, depending on individual perceptions. Impacts to developed sites would be short to long term depending on whether or not wells were developed for production.

RECREATION RESIDENCES

- *Measurement Indicator #2* POTENTIAL DECREASE IN USE AND QUALITY OF THE RECREATION EXPERIENCE

Oil and gas activities under SLT would have a similar impact on recreation residences as on developed sites. Visual impacts from oil and gas developments would be minor because these visual interruptions are not likely to lead to discontinued use of the residence. In most cases, recreation residence users stay for less than a week per visit and would tolerate visual interruptions in the area, although some may be dissatisfied with their experience and complain. Impacts would be minor to moderate and short to long term, depending on proximity to residences and whether or not wells were developed for production.

Recreation residences occur in three tracts and are adjacent to paved or well-maintained unpaved roads. An increase in traffic due to oil and gas activities could be perceptible to many

users of recreation residences, particularly in the case of semi trucks transporting drills or oil tankers transporting oil from producing wells. Impacts from major traffic in the vicinity of recreation residences would be minor and intermittent over the long term. Noise from oil and gas activities would not be expected by users of recreation residences, but would not likely lead to discontinued use of the residence. Some users may be dissatisfied with their recreational experience due to noise from oil and gas activities, particularly if a production field or primary access route to the field were developed in the vicinity of a residence. In other locations, noise impacts would be negligible to moderate. Impacts from noise would be short term in the case of exploration wells, while production field development would involve intermittent noise disturbances over the long term.

4.4.5 Impacts by Alternative

The degree to which the connected action impacts (Section 4.4.4) would differ by alternative is discussed in this section. Each alternative involves a unique set of leasing options for each resource component, which would restrict the locations and the nature of oil and gas activities that are allowed wherever these resources occur.

Table 4.4-4 shows the acres of each resource component for recreation under each leasing option, by alternative. When different leasing options for the same area overlap (due to more than one resource being present), the more restrictive leasing option takes precedence. Alternatives D1, D2, E1, and E2 represent the dual analysis of Alternatives D and E. D1 and E1 represent the acres available with NSO in all IRAs. D2 and E2 represent the acres with leasing allowed in IRAs under a less restrictive leasing option. A more detailed table that separates the acreage by resource component and ranger district is available in Appendix B.

In this section, impacts are discussed mainly at the Forest-wide level and not by ranger district. This is done to avoid repetition and facilitate the comparison of impacts across alternatives. However, any pronounced differences among ranger districts are highlighted. Impacts by measurement indicators are summarized in Table 4.4-5, and differences between alternatives regarding recreation resource components are outlined in the text.

Table 4.4-4 Acreage of Resource Components under each Leasing Option by Alternative

Resource Component	Leasing Option[3]	Alternative[1,2]						
		A	B	C	D1	D2	E1	E2
ROS: Primitive	NA	84,512	84,512	84,512	84,512	84,512	84,512	84,512
	NL	19,404	19,404	19,404				
	NSO				19,404	19,404	16,443	
	CSU							
	SLT						2,961	19,404
ROS: Semi-Primitive Non-Motorized	NA	1,516	1,516	1,516	1,516	1,516	1,516	1,516
	NL	699,436	566,400	5				
	NSO		133,047	699,490	451,278	24,693	443,771	
	CSU				248,220	674,805		
	SLT						254,148	699,436
ROS: Semi-Primitive Motorized	NA	888	888	888	888	888	888	888
	NL	559,149	359,405	2				
	NSO		137,246	353,631	138,677	49,000	96,993	
	CSU		62,498	205,517	420,474	510,152		
	SLT						462,156	559,149

Resource Component	Leasing Option[3]	Alternative[1,2]						
		A	B	C	D1	D2	E1	E2
ROS: Roaded Natural	NA	692	692	692	692	692	692	692
	NL	263,721	171,086	1				
	NSO		74,279	201,856	58,116	48,227	11,184	
	CSU		18,356	62,021	169,516	179,404		
	SLT				36,247	36,247	252,537	263,721
Developed Sites (with appropriate buffer)	NA	1	1	1	1	1	1	1
	NL	4,923	3,824	1				
	NSO		1,098	4,922	1,062	1,016	52	
	CSU				3,861	3,906		
	SLT						4,870	4,923
Administrative sites	NA							
	NL		772	113				
	NSO		76	735	456	455	2	
	CSU				392	393		
	SLT						846	848
Recreation Residences (with ¼ mile buffer)	NA	42	42	42	42	42	42	42
	NL	777	431					
	NSO		347	777	777	777		
	CSU							
	SLT						777	777

[1] Small discrepancies in the acreage presented for each alternative are due to the fact that the GIS database has limitations when applied over an extremely large area that result in an inability to calculate acreages that match exactly between alternatives. A more detailed table that separates the acreage by resource component and ranger district will be available in Appendix B.
[2] Alternatives D1, D2, E1, and E2 represent the dual analysis of Alternatives D and E. D1 and E1 represent the acres available with NSO in all IRAs. D2 and E2 represent the acres with leasing allowed in IRAs under a less restrictive leasing option.
[3] Areas not legally available (NA) for leasing (see Section 1.5.2) are included in the Table to provide context to the analysis.

4.4.5.1 Alternative A

There would be no oil and gas activities on the Dixie National Forest within areas not currently leased. Alternative A would continue present management activities as pertaining to oil and gas leasing. The Forest Supervisor under this alternative would not make any new leasing decisions and no new oil and gas leasing would be allowed on the Dixie National Forest. Current operations, including the Upper Valley oil field on the Escalante Ranger District (19 wells, including nine water-injector wells) would continue (USFS 2006g). In total, there are 13,454 acres of existing leases on the Dixie National Forest. Existing leases will either be developed or expire and the potential number of wells that could be drilled on the Dixie National Forest would decrease over time. Under Alternative A, there would be no adverse impacts to recreation resources on the Dixie National Forest.

4.4.5.2 Alternative B

Impacts to recreation resources under Alternative B would be negligible for the most part because the most lands on the Dixie National Forest would be NSO or NL under this alternative, including Primitive (100 percent NL or NA) and Semi-Primitive Non-Motorized (19 percent NSO, 81 percent NL or NA) ROS settings. Developed and administrative sites and recreation residences would be covered predominantly by NL or NA leasing options and seismic activities allowed under NSO are unlikely to cause impacts to these areas. Thus, impacts would be negligible. Seismic activities would be allowed on 133,000 acres of Semi-Primitive Non-

Motorized settings, 137,000 acres of Semi-Primitive Motorized settings, and 74,000 acres of Roaded Natural settings covered by NSO under Alternative B; impacts in terms of ROS class and user experience could be minor and would be short term within Semi-Primitive Non-Motorized and Semi-Primitive Motorized. Within Roaded Natural settings, seismic activities would not have a measurable impact on ROS class. Very small portions of Semi-Primitive Motorized and Roaded Natural settings would be available for all oil and gas activities subject to CSU constraints under Alternative B. Within these areas covered by CSU, oil and gas activities would be possible and may cause minor impacts with regard to user experience (*Measurement Indicator #2*), but not likely to ROS class (*Measurement Indicator #1*) within Roaded Natural. Impacts in terms of user experience would be short to long term depending on whether exploration (short term) or production activities (long term) occurred.

4.4.5.3 Alternative C

Alternative C with NSO in IRAs would have similar impacts for recreation resources as described for Alternative B. For developed and administrative sites and recreation residences, impacts between Alternative B and Alternative C are similar because these areas have the same leasing options under the two alternatives and both areas would be open to some potential disturbance from seismic activities (under NSO) that would most likely have negligible impacts. Impacts in Primitive settings are also similar because these areas are still covered by NL or NA. A larger proportion of Semi-Primitive Non-Motorized settings are NSO under this alternative; however, impacts from seismic activities would be the same as under Alternative B: potentially minor and short term. Impacts to Semi-Primitive Motorized and Roaded Natural settings would also be similar under Alternatives B and C, although a larger proportion of these areas would be available for all oil and gas activities (subject to CSU constraints) and a small proportion of these areas would be NSO (relative to Alternative B). Impacts under Alternative C would still be largely negligible and minor and short to long term, depending on the activity (i.e., production activities would have long-term impacts).

4.4.5.4 Alternative D1 (NSO in IRAs)

Alternative D has less restrictive leasing options than Alternative C and more restrictive options than Alternative E. Impacts under Alternative D1 (NSO in IRAs) would likely not be measurably different than under Alternative D2 (CSU in IRAs) (below) in intensity or duration for any recreation resources, with the exception of Semi-Primitive Non-Motorized areas. Due to the substantial overlap with IRAs, the intensity of impacts within these areas would be reduced relative to Alternative D2 because fewer acres would be available for road building and other oil and gas developments that could compromise the Semi-Primitive Non-Motorized setting.

4.4.5.5 Alternative D2 (CSU in IRAs)

Impacts under this alternative would be only slightly more adverse than under Alternative C, with the possible exception of Semi-Primitive Non-motorized areas, which could have moderate impacts. Recreation residences would be NA or NSO under this alternative, as under Alternative C, thus impacts in terms of potential decrease in use and quality of the recreation experience (*Measurement Indicator #2*) would be the same as under Alternative C (negligible) because seismic activities are temporary and unlikely to diminish users' recreation experience. Primitive areas would be 19 percent NSO (rather than NL as under Alternative C); impacts from seismic activities could be short term and minor in terms of affecting ROS class and users' recreation experience. Developed and administrative sites and ROS Semi-Primitive Motorized and Non-motorized areas would have CSU leasing options under this alternative that would cover most of these areas because only a small portion of the Forest is NSO under this

alternative. CSU leasing options are designed for each resource component (see Appendix D) to minimize adverse impacts that may result from oil and gas activities, thus impacts to most resources from oil and gas activities covered by CSU would be minor. Roaded Natural settings would have similar impacts to SLT because these areas do not carry special leasing options under Alternative D, and unrestricted oil and gas activities are less likely to have adverse affects on these resource components.

4.4.5.6 Alternative E1 (NSO in IRAs)

Alternative E has the least restrictive leasing options of Alternatives A through E. The intensity and duration of impacts to recreation resources would be similar to impacts described in Section 4.4.4.6 because most resources do not overlap with IRAs substantially. Impacts within Semi-Primitive Non-motorized settings would be moderate as opposed to moderate to major under SLT (Alternative E2 with SLT in IRAs; Section 4.4.4.6) because fewer acres would be available for road building and other oil and gas developments that could compromise the Semi-Primitive Non-Motorized character.

4.4.5.7 Alternative E2 (SLT in IRAs)

Impacts to recreation resources would be as described in Section 4.4.4.6 Standard Lease Terms.

Table 4.4-5 Impacts to Recreation Resources with respect to Measurement Indicators #1 and #2

Resource	*Measurement Indicators*	ALT A	ALT B	ALT C	ALT D1	ALT D2	ALT E1	ALT E2
ROS: Primitive	*MI #1*	negligible ST	negligible ST	negligible ST	neg-minor ST	neg-minor ST	moderate ST-LT	mod-major ST-LT
	MI #2	negligible ST	negligible ST	negligible ST	neg-minor ST	neg-minor ST	moderate ST-LT	mod-major ST-LT
ROS: SPNM	*MI #1*	negligible ST	neg-minor ST	neg-minor ST	minor ST-LT	minor-mod ST-LT	moderate ST-LT	mod-major ST-LT
	MI #2	negligible ST	neg-minor ST	neg-minor ST	minor ST-LT	minor-mod ST-LT	moderate ST-LT	mod-major ST-LT
ROS: SPM	*MI #1*	negligible ST	neg-minor ST	neg-minor ST-LT	minor ST-LT	minor ST-LT	moderate ST-LT	moderate ST-LT
	MI #2	negligible ST-LT	neg-minor ST-LT	minor ST-LT	minor ST-LT	minor ST-LT	moderate ST-LT	moderate ST-LT
ROS: RN	*MI #1*	negligible ST-LT	negligible ST-LT	negligible ST-LT	minor ST-LT	minor ST-LT	minor ST-LT	minor ST-LT
	MI #2	negligible ST-LT	neg-minor ST-LT	neg-minor ST-LT	minor ST-LT	minor ST-LT	minor ST-LT	minor ST-LT
Developed sites	*MI #2*	negligible ST	negligible ST	negligible ST	minor ST	minor ST	mod-major ST	mod-major ST
Recreation residences	*MI #2*	negligible ST	negligible ST	negligible ST	negligible ST	negligible ST	mod-major ST	mod-major ST

LT = long term; ST = short term; neg = negligible; mod = moderate

4.5 Fish and Wildlife

4.5.1 Introduction

The terms used to describe the context and intensity of effects in this section are discussed in Section 4.1 and Table 4.1-1. Table 4.5-1 provides an example how these terms would apply to fish and wildlife resources.

Table 4.5-1 Terms used to Describe Effects to Fish and Wildlife

Attribute of Effect		Description relative to Fish and Wildlife Resources
Quality	Beneficial	An increase in the amount or quality of suitable habitat for a species.
	Adverse	A decrease in the amount or quality of suitable habitat for a species.
Magnitude (Intensity)	Negligible	A modification in habitat amount or quality that is too small to be perceptible by a species. *Example: Loss of 1% of available habitat.*
	Minor	A modification in habitat amount or quality that would only affect some individuals of a species and would not affect the reproductive rate of the population. *Example: Loss of 10% of available habitat. Example: Increase in invasive plants within suitable habitat.*
	Moderate	A modification in habitat amount or quality that would affect enough individuals of a species that the reproductive rate of the population could be affected. Population decline or a loss of viability would be possible. *Example: Extended noise disturbance that affects many reproducing individuals.*
	Major	A modification in habitat amount or quality that would affect the reproductive rate of a population of a species and is likely to lead to a population decline or loss of viability. *Example: An irretrievable loss of critical habitat that would affect a population. Example: A hazardous materials spill that renders several miles of aquatic habitat unsuitable.*
Duration	Temporary	A habitat modification that only occurs during construction of a facility (i.e., road, well pad). Original habitat condition is immediately restored once construction is completed. *Example: Noise disturbance from seismic blasts.*
	Short Term	A habitat modification that occurs during exploration activities (i.e., construction of exploratory well pads or access roads) or that may last for one or a few reproductive seasons. The habitat modification lasts 10 years or less. Original habitat condition would likely be restored within this time frame. *Example: Noise disturbance from exploration activities.*
	Long Term	A habitat modification that occurs during extended exploration activities or during production activities. The habitat modification lasts more than 10 years and original condition may or may not be restored. *Example: Noise disturbance from a production well.*

4.5.2 Measurement Indicators

- *Measurement Indicator #1* ACRES OF DIRECT DISTURBANCE OF HABITAT AND INDIRECT HABITAT LOSS AS COMPARED TO AVAILABLE HABITAT
- *Measurement Indicator #2* NUMBER OF VISITS AND NOISE LEVELS
- *Measurement Indicator #3* ESTIMATES OF INCREASED SEDIMENT PRODUCTION AND AMOUNT THAT COULD REACH AQUATIC HABITATS
- *Measurement Indicator #4* NUMBER AND TYPE OF STREAM, RIPARIAN AREA, AND WETLAND CROSSINGS
- *Measurement Indicator #5* POTENTIAL CHANGES TO AQUATIC HABITAT CONDITION (AQUATIC CONDITION INDICATORS)
- *Measurement Indicator #6* INCREASES IN INVASIVE PLANTS

4.5.3 Impacts Common to All Action Alternatives

Under Alternatives B, C, D, and E it is assumed that activities described under the RFDS would occur. These activities include 60 to120 acres (per ranger district) of overland travel associated with seismic surveys, 80 –to 330 acres (per ranger district) of land clearing surface disturbance associated with road and pad building for exploration wells, and 254 acres of land clearing surface disturbance for a production field. The locations of activities are not yet known.

The main impacts to fish and wildlife that are possible from land clearing include mortality, injury, and habitat modification, fragmentation, and loss. For wildlife, the destruction of occupied burrows or nests, displacement, and the direct disturbance of habitat during land clearing would result in direct impacts. The loss of forested habitats, and in some cases sagebrush, would generally be long term, while the loss of grassland or forbs could be short term if areas revegetate with native species. For fish, land clearing in the vicinity of an occupied stream can increase the potential for delivery of sediment, salts, organics, and nutrients (Trombulak and Frissel 2000) in surface water runoff because vegetation is no longer present to block or dilute such introductions. Roads are often located closer to streams than well pads and are more likely to cause erosion or provide a channel for delivery of spilled hazardous substances (fuel, coolant, lubricants, drilling and well construction materials). These occurrences can degrade habitat and ecosystem functioning, which may affect fish habitat (e.g., water temperature, stream bank vegetation, macroinvertebrates, large woody debris). Operating procedures (Appendix C) are designed to avoid these impacts.

Wildlife tends to avoid areas with noise and human presence if possible, so the area of affected wildlife habitat could be larger than the area directly occupied by oil and gas activities. Avoidance and stress responses by wildlife extend the influence of each well pad, road, and facility up to a quarter mile for some terrestrial species and more for others. Wildlife could be displaced from an area of this size or larger. This creates a larger population within a smaller area of undisturbed habitat that is likely to be less suitable than what was disturbed. Under these conditions, wildlife are likely to become further stressed by increased competition in the new area due to the increased density of individuals vying for limited resources. Increased mortality from large predators that feed in the congregation areas could also occur. Depending

on the ecological importance of the habitat and the timing of disturbance, individuals may experience lower reproductive success or mortality. Small, isolated disturbances within non-limiting habitats may be of minor consequence within most ecosystems. However, larger-scale developments within habitats that are of a more direct importance to the productivity of wildlife have the potential to be substantial because the undisturbed habitat surrounding the disturbance is less likely to be as suitable (WFGD 2004).

Fragmentation of wildlife habitats is a concern with oil and gas disturbances due to the linear extent of many activities, including seismic exploration and roads connecting to well pads. For larger mammals, fragmentation may hinder metapopulation dynamics such as migration and dispersal. At a smaller scale, wildlife such as small mammals and reptiles are affected by single roads that may block short-range movements or split a population and prevent migration in and out. Road crossings in streams can create barriers to fish movement (Trombulak and Frissel 2000), which can isolate fish populations. Fragmentation of fish and wildlife populations leads to reduced genetic diversity and increased susceptibility to population decline. This is particularly true for migratory species that habitually move long distances.

Impacts to wildlife and fisheries resources from the different phases of oil and gas development depend on the duration, amount, and type of disturbance involved. The following phases are discussed in terms of possible impacts to all wildlife species under SLT: seismic activity, exploratory drilling and road construction, and production.

Seismic Activity: Seismic exploration involving both buggies and helicopters would temporarily disturb wildlife, due to noise and human presence, in the vicinity of operations. Noise would be produced mainly by the explosives used to generate vibrations. Mobile wildlife are likely to move away from the disturbance, and most would be expected to return to the area when humans were no longer present. Long-term impacts to wildlife species from seismic activities could occur if habitat becomes less suitable due to noxious weed invasion (via drill-mounted buggies; see Section 4.9) or habitat changes to key vegetation components. Seismic activities would have a negligible impact on fisheries because surface disturbance is minimal and vibrations would be temporary. In terms of habitat impacts, seismic activities would involve temporary impacts because vegetation crushed by overland travel would likely recover or resprout soon after. For wildlife, areas with crushed vegetation would not be suitable as cover in the short term.

Exploratory Drilling and Road Construction: Exploratory drilling involves the construction of dill pads and access roads, which removes wildlife habitat (land clearing), impacts stream channels, and increases the potential for the introduction of sediment and hazardous materials to the aquatic system. Disturbance to wildlife caused by intermittent human presence on an exploration well would be short term, lasting for the duration of operations. Direct mortality may occur to smaller species, such as rodents, reptiles, and (nesting) birds, during construction of the pad and roads. Noise disturbances from the actual drilling would be temporary. Human presence and noise could cause mobile individuals in the vicinity to be displaced; individuals may or may not return to the area after reclamation. Fish could be affected by construction across streams (culverts), and by the potential for habitat degradation, caused by increases in sediment yield, short-term pulses of turbidity, and chemical contamination that are the result of construction and use of roads or well pads near streams. Prolonged noise disturbances could also apply to fish if drilling occurred close to a stream.

Production: A production field would involve the largest amount of disturbance and the most adverse impacts to wildlife. The disturbed area and surrounding habitat (at least ¼ mile radius)

around each production well could be unsuitable for many wildlife species due to human presence and noise during production well drilling activity, which would last for several months. Direct mortality could occur during construction to any small, less mobile wildlife individuals within disturbance footprints. Impacts to larger, more mobile individuals that are displaced due to drilling and construction noise would be temporary. Fish could be impacted during this time by noise and any additional road building in proximity to or across occupied streams (see habitat degradation, above). Impacts to displaced individuals due to habitat disturbance from the well pads and roads could be long term. After production wells are constructed, human presence and noise would continue at a moderate level.

Table 4.5-2 lists the leasing options assigned to active raptor nests and migratory birds under each alternative. Aquatic species would be covered by leasing options for streams, lakes, and riparian and wetland areas (see Section 4.7); leasing options for these areas are not discussed in this section. Each assigned leasing option would either allow or restrict certain oil and gas activities (described under the RFDS) wherever the applicable resource component occurs on the Dixie National Forest.

Table 4.5-2 Leasing Options Assigned under each Alternative for Wildlife Resources

Resource	Alternative				
	A	B	C	D	E
Active raptor nests	NL	CSU	CSU	CSU	SLT
Migratory birds (nests)	NL	CSU	CSU	LN	SLT
Streams, lakes, riparian, etc. (see Section 4.7)	NL	NL 500 ft buffer NSO 300 ft buffer	NSO 300 ft buffer	CSU 300 ft buffer	SLT

Locations of raptor/migratory bird nests, native fishes, and other aquatic species discussed in this section are either unknown, only partially mapped, or not mapped. Leasing options would apply to currently unmapped areas wherever they are found.

4.5.4 Impacts of Connected Actions by Lease Option

Leasing options would dictate the conditions under which connected actions (described under the RFDS) would be allowed, and under which, impacts may occur. Impacts from connected actions under each leasing option are discussed in this section. Impacts to fish and wildlife resources considering leasing option overlaps (i.e., overlaps with more restrictive leasing options assigned to other resources) are discussed in Section 4.5.5 (Impacts by Alternative). Under all leasing options and alternatives, oil and gas activity would be subject to the Best Management Practices (BMPs) listed in the *Dixie National Forest Oil and Gas Construction and Operating Standards and Well Site Design Requirements* contained in Appendix C and the BLM and USFS *Surface Operating Standards and Guidelines for Oil and Gas Exploration and Development – The Gold Book* (BLM and USFS 2007).

4.5.4.1 Not Legally Available (NA)

NA applies to lands that are not legally available for leasing, including Brian Head Ski Permit Area, wilderness areas, and areas surrounding the Box-Death Hollow Wilderness Area that were withdrawn from leasing by the Utah Wilderness Act of 1984. No oil and gas leasing is being considered in these areas and no disturbance to wildlife or fisheries resources in these

areas would occur. This leasing option does not apply directly to any of the fish and wildlife resource components under any alternative.

4.5.4.2 No Lease (NL)

NL applies to lands where no new leases would be authorized. These lands would not be administratively available for leasing. No disturbances associated with oil and gas leasing would occur on lands with an NL leasing option.

Under Alternative A, NL would apply to migratory bird and raptor nests. Because no new leases would be authorized under the NL option, there would be no surface disturbance related to oil and gas activities within these areas and thus no direct or indirect impacts to these resources.

4.5.4.3 No Surface Occupancy (NSO)

With the exception of seismic activities, NSO would prohibit occupancy or use of the land for oil and gas related activities (e.g., construction of well pads, central tank batteries, access roads, pipelines, power lines, and other linear structures). Under Alternative C, linear features (e.g., roads, pipelines) would be allowed as perpendicular stream crossing under NSO. A NSO leasing option would not apply to fish and wildlife resources directly under any alternative.

4.5.4.4 Timing Limitation (TL)

TL prohibits surface activities during specified time periods, usually to avoid direct and indirect impacts to fish or wildlife species during sensitive periods. This leasing option 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. A TL would not apply to fish and wildlife resources directly under any alternative.

4.5.4.5 Controlled Surface Use (CSU)

CSU provides for controlled but generally allowed surface use on all or portions of a lease. Operations would be held to special operational constraints that may otherwise exceed the mitigation provided by SLT, regulations, and operating orders. With regard to wildlife and fisheries, CSU leasing options would ultimately allow agencies (e.g., a Dixie National Forest biologist) to control where and when oil and gas activities occurred within a lease.

Under Alternatives B, C, and D, a CSU would apply to active raptor nests and occupied territories. CSU would apply to migratory bird nests under Alternatives B and C. CSU would also apply to aquatic habitats and would thus affect aquatic species under Alternative D. Impacts to these species under CSU with regard to applicable measurement indicators are described below. Refer to Appendix D for descriptions of each CSU.

MIGRATORY BIRDS

Measurement Indicators

- *Measurement Indicator #1* ACRES OF HABITAT DISTURBANCE RELATIVE TO AVAILABLE HABITAT

Mitigations (determined by a Dixie National Forest biologist) may be required if migratory bird nests are found in the area during pre-construction surveys; these may include a timing restriction (see Appendix D). Under the CSU, habitat disturbance for migratory birds could

occur outside of specified timing restrictions and these impacts would be as described under SLT (Section 4.5.4.6).

- *Measurement Indicator #3* NUMBER OF VISITS AND NOISE LEVELS

If migratory bird nests are detected during surveys and avoided during the specified nesting period and distance (for raptors), noise and human presence impacts would be negligible because activities would be restricted while birds were nesting under CSU. The Dixie National Forest would be in compliance with the Migratory Bird Treaty Act under CSU if unintentional take was minimized.

AQUATIC SPECIES

Measurement Indicators

- *Measurement Indicator #3* ESTIMATES OF INCREASED SEDIMENT PRODUCTION AND AMOUNT THAT COULD REACH AQUATIC HABITATS

Impacts to aquatic species from increases in sediment production under CSU would be lower than under SLT, due to soil protection measures that are part of this particular stipulation. Oil and gas facilities within 300 feet of aquatic habitats (streams, lakes, riparian areas, etc.) would be placed on wooden platforms to reduce soil disturbance, thus vehicles and other operations would not make contact with the soil and potentially introduce sediments into adjacent aquatic habitats. Impacts to aquatic species with regard to increased sediment production under CSU would be short (exploration activities) to long term (production activities) and negligible to minor. Impacts could be minor because a small amount of sediment, that may affect some individuals of various aquatic species, may still be introduced into aquatic habitats during installation and removal of the platforms.

- *Measurement Indicator #4* NUMBER AND TYPE OF STREAM, RIPARIAN AREA, AND WETLAND CROSSINGS

Impacts from stream, riparian, or wetland crossings under CSU would be the same as SLT because stream crossings are not restricted under this leasing option and would be installed following standard specifications (e.g., BLM and USFS 2007), as under SLT. Impacts would be short (exploration) to long (production) term and minor because it is likely that only some individuals (of any aquatic species) would be affected by a stream, riparian, or wetland crossing at any one location. There would be no impacts to populations of aquatic species from crossings.

- *Measurement Indicator #5* POTENTIAL CHANGES TO AQUATIC HABITAT CONDITION (AQUATIC CONDITION INDICATORS)

Impacts to aquatic habitat condition would be the same under this CSU as under SLT, because operations could be in a similar proximity to aquatic habitats. Impacts to aquatic habitat conditions under SLT have the potential to be major because populations would almost certainly be affected by an unanticipated event such as a spill, although this type of event is unlikely. Adverse impacts to aquatic species populations would be certain to lower the reproductive rate of the population and could put the persistence of the species on the Dixie National Forest in an uncertain position. Impacts under SLT would be short to long term and moderate to major, depending on the location of disturbance, present condition of the aquatic habitat, and the severity of the impact.

4.5.4.6 Lease Notice (LN)

A lease notice provides more detailed information concerning existing limitations, regulations, or orders, or addresses special considerations. A LN does not impose new restrictions on oil and gas activities and would be attached to leases regardless of other leasing options.

A lease notice would be attached to any lease that occurred within 0.5 miles of a known golden eagle or bald eagle nest from 1 January to 31 August. This would be the case for any lease within Dixie National Forest lands regardless of leasing options. The purpose of the LN in this case is to ensure compliance with the Bald and Golden Eagle Protection Act, which prohibits take (including disturbance) of bald and golden eagles. The LN would list avoidance or minimization measures specific to bald and golden eagle nests that may occur in the vicinity. In order to comply with the Bald and Golden Eagle Protection Act, surveys for bald and golden eagles would be conducted in any area leased for oil and gas exploration that occurs within or near suitable habitat. The Bald and Golden Eagle Protection Act prohibits take, possession, and commerce of bald and golden eagles; so, to comply with the Act, oil and gas activities would not be allowed in the vicinity of active nests.

A lease notice would be attached to any lease within the nesting season for migratory birds. This is the case for any lease within Dixie National Forest lands regardless of leasing options. The purpose of the LN in this case is to ensure compliance with the Migratory Bird Treaty Act, which prohibits take of migratory birds. Direction from the US Fish and Wildlife Service (USFWS) regarding migratory birds on USFS lands, however, states that activities occurring within migratory bird habitats should "minimize direct take of individual migratory birds when feasible." Since conservation of populations is emphasized, a low level of incidental take is assumed. The LN would list avoidance or minimization measures specific to migratory bird nests that may occur in the vicinity. Mitigations would ultimately be determined by a Dixie National Forest biologist on a case-by-case basis if migratory bird nests are encountered.

4.5.4.7 Standard Lease Terms (SLT)

Impacts in this section are discussed assuming no restrictions or leasing options other than those listed on BLM Lease Form 3100-11 (SLT), the environmental protection measures that would be implemented by other laws and regulations as described in Section 1.8.5.2, and the BMPs listed in Section 4.5.4. As a minimum, all leases are governed by SLT and the impacts described in this section represent the maximum amount of disturbance that could occur as a result of oil and gas activities.

All leaseholders would be required to comply with the Bald and Golden Eagle Protection Act and the Migratory Bird Treaty Act under SLT (see Section 4.5.4.6). Under Alternative E, SLT would apply to all raptor nests (including bald and golden eagle) and migratory birds as the default leasing option.

In general, disturbance to fish and wildlife habitats would be "minimized" under SLT, avoiding "unreasonable or unnecessary disturbances during construction of pads, access, and other facilities, and during operations." Disturbed terrestrial habitat would be reshaped and re-vegetated after use. Roads and drainage structures would be located to minimize impacts on water quality, such as on benches upslope from streams, lakes, ponds, riparian areas, and floodplains (BLM and USFS 2007). A Spill Prevention Control and Countermeasures (SPCC) Plan would be approved before operations are authorized, and sediment control structures would be used at the base of fill slopes. Regarding potential noise disturbances to wildlife, operators would be required to "centralize production facilities, use telemetry to monitor wells,

and delay non-essential maintenance activities in important wildlife habitat during critical seasons of use to reduce the number of vehicle trips to the sites and activity that could disturb or stress wildlife." In addition, all vehicles and other gasoline or diesel-powered equipment must be equipped with properly functioning mufflers (Appendix C). Regarding potential disturbances to fish and aquatic species, facilities are to be located on benches upslope from streams, lakes, ponds, riparian areas, and floodplains to the extent feasible. A SPCC Plan, which addresses the potential for spills to occur, must be filed with the Forest Service and approved by the authorized officer before construction or operations begin. Stream crossings designed to allow fish passage would be "planned and constructed to minimize disturbance of the riparian and aquatic habitats by locating crossings at the most advantageous location and by crossing near the perpendicular (Appendix C).

Measurement indicators are discussed below for all fish and wildlife resources, as SLT is the default leasing option and would cover all areas of the Dixie National Forest.

Measurement Indicators

ALL WILDLIFE

Measurement Indicator #1 ACRES OF DIRECT AND INDIRECT HABITAT DISTURBANCE RELATIVE TO AVAILABLE HABITAT

The primary adverse impact to wildlife from oil and gas activities is a loss of habitat and habitat effectiveness. Disturbances created by excavations, roads, facilities, equipment, human activity, and noise physically eliminate some habitat as well as impair the effectiveness of a larger (otherwise suitable) habitat area. Because oil and gas developments are typically configured as point and linear disturbances scattered throughout broader areas, the direct disturbance is relatively small compared to the amount of impaired, surrounding habitat. The number and timing of wells projected on each ranger district is presented in Section 2.2.1. The disturbance expected from post-leasing activities is presented as Tables 2.2-1 and 2.2-2. In summary, the RFDS predicts between 396 and 706 acres of disturbance on each ranger district over the next 15 years. The Pine Valley Ranger District would have the least disturbance and the Powell and Escalante Ranger Districts would have the most. It is likely that the area of unsuitable habitat surrounding the actual disturbance would be much greater. For terrestrial species, the impacts of habitat disturbance in the event that development and production occurs on a well field (254 acres) could be long term and moderate at that location. Moderate impacts could occur to some terrestrial wildlife species because a substantial number of individuals would be affected and these impacts may carry over to the population level. Exploration activities that do not result in development would be short term (less than 10 years) and could be moderate, depending on the species, if enough individuals are affected. Minor impacts would result if population-level impacts, such as a decline in the reproductive rate, did not occur and only some or a few individuals were affected.

Impacts to aquatic species from a loss of suitable stream habitat would be minor to moderate, depending on the number of individuals affected. If a high-quality area of aquatic habitat used by many individuals of a species were lost, impacts would be moderate because a population could be affected by the loss of habitat. Aquatic habitat losses could also be permanent because aquatic habitats are not easily restored after a disturbance (see *Measurement Indicator #5*, Aquatic species and habitat).

MIGRATORY BIRDS

Migratory birds are most sensitive to human disturbance during the nesting and fledging periods. Oil and gas activities could cause direct impacts (disturbance) to nests, or cause adult birds to abandon nests containing eggs and young. Pre-construction surveys would be conducted before exploration on a site to determine the presence of raptor nests, and if found, Agencies would have the authority to relocate oil and gas activities up to 200 meters (656 feet) from a requested location or delay operations for up to 60 days in order to avoid impacts to individual nesting birds. For non-raptors (e.g., passerines or songbirds), compliance with the Migratory Bird Treaty Act is required, which may involve pre-construction surveys for species of concern. Although take of individual birds is to be minimized, some unintentional or "incidental take" of migratory birds (i.e., passerines) would be expected within suitable habitat even when surveys are conducted. Incidental take, by definition, occurs as an unintended consequence of lawful activities. Any migratory birds that nest in open country and on the ground, such as burrowing owls, ferruginous hawks, and many passerine birds, may be more vulnerable to incidental take because oil and gas activities tend to occur in these habitats. USFS 2007g describes specific direction from the USFWS for compliance with the Migratory Bird Treaty Act on the Dixie National Forest and states that conservation of populations and habitats are to be prioritized over conservation of individuals.

- *Measurement Indicator #1* ACRES OF DIRECT AND INDIRECT HABITAT DISTURBANCE RELATIVE TO AVAILABLE HABITAT

Direct and indirect adverse impacts to migratory birds would occur if suitable habitats were disturbed and habitat effectiveness was impacted. For raptors, suitable nesting habitat would be disturbed if snags or large trees were removed. Cliff habitat is less likely to be disturbed because drilling is less feasible in these areas. Foraging habitat for most raptors, nesting habitat for ground-nesting species such as burrowing owls, and nesting habitat for migratory passerines would be removed wherever open areas (grassland, shrublands) were disturbed by oil and gas activities. Impacts would be minor because migratory bird habitats are generally common vegetation types and only a small percentage of these habitats would be removed by oil and gas activities, thus a substantial amount of undisturbed suitable habitat would likely be available outside the disturbance area. Disturbance of migratory bird habitats would be short to long term depending on the type of vegetation (i.e., impacts grasses and some shrub habitats would be short term; impacts to forest would be long term) and the activity (i.e., exploration activities would be short term; production activities would be long term). Compliance with the Migratory Bird Treaty Act requires the Dixie National Forest to conserve habitats and populations of migratory birds. Habitat impacts, if they occurred, may affect individuals and these impacts would be minor. Moderate impacts, in which populations may be affected, are not likely to occur under compliance with the Act.

- *Measurement Indicator #2* – NUMBER OF VISITS AND NOISE LEVELS

For some raptors, avoidance and stress responses extend the influence of each well pad, road, and facility up to several hundred meters during egg laying and early incubation (USFS 1995a). Species of migratory birds differ in their sensitivity to noise (distances for raptors listed in Romin and Muck 2002). For ferruginous hawk, northern harrier, Cooper's hawk, red-tailed hawk, sharp-shinned hawk, Swainson's hawk, merlin, and Turkey vulture, a half-mile buffer is recommended during nesting; for burrowing owl and prairie falcon, a quarter-mile buffer is recommended (Romin and Muck 2002). Oil and gas activities within a few hundred meters are likely to disturb bird nests in the vicinity. Daily traffic and intermittent drilling for less than one

year would be expected during the exploratory phase. Under SLT, Agencies could move operations up to 200 meters (656 feet) from an active nest or delay operations up to 60 days.

For raptors, noise impacts from drilling and traffic during exploration would most likely be temporary and minor, unless these activities led to impacts on nesting success, or if only a few raptors were impacted while nesting or foraging. If noise disturbances from either exploration or production activities affected enough individual raptors to affect a population, noise could cause moderate impacts. Under SLT, a large number of individual birds could be affected because 200-meter (656-foot) and 60-day allowances may not be sufficient to prevent noise disturbances that would be possible within a larger radius (i.e., one quarter or one half mile) and for a longer period. Noise levels during production are high during production drilling and well field construction; this level of noise would be most likely to cause raptors nesting within a quarter mile to be impacted. Impacts from production activities within this radius are likely to be moderate. Subsequent noise levels on a production field would be lower after construction and drilling and may be tolerable to nesting raptors. In the years following well field construction, impacts to nesting raptors from daily visits by field workers and tanker vehicles would be negligible to minor as individual raptors may or may not modify their behavior as a result of a low-level noise disturbance.

For migratory passerines, oil and gas activities in the vicinity of nesting birds may cause adverse noise impacts that could lead to impacts on nesting success. Oil and gas activities would not be in proximity to enough passerine nests that populations would be affected; however, oil and gas activities within a 100 to 200 foot radius of a nest could result in take due to stress on birds or the masking of predator arrival or associated alarm calls (Slabbekoorn and Ripmeester 2008). Because populations of migratory passerines are unlikely to be affected under compliance with the Migratory Bird Treaty Act, impacts of take due to noise would be minor and short term.

AQUATIC SPECIES AND HABITAT

- *Measurement Indicator #3* – ESTIMATED INCREASES IN SEDIMENT PRODUCTION

Predicting the amount of increase in sediment delivery from oil and gas activities is difficult due to the number of variables involved. Both the quantity of the source (the eroded material) and the quantity that arrives at a stream are highly dependent upon site-specific factors such as soil characteristics, ground slope, distance between the disturbance and stream, and vegetation characteristics between the disturbance and stream. Once sediment has reached a stream, the distance and timing of its downstream progression is highly dependent upon factors such as flow patterns, velocity, substrate, and channel morphology. In addition, locally increased runoff due to drainage pattern alterations (i.e., along roads) can increase in-stream erosion and sediment transport. For these reasons, it is not possible to estimate specific sediment quantities for disturbances whose locations are not known; these estimates would be assessed during the NEPA process for specific proposals. More information on water quality is available in Section 4.7 (Water and Watershed Resources).

Sediment increases in streams degrade habitat for macroinvertebrates, the primary food source for most fish species. Increases in sediment may shift the macroinvertebrate community to a more sediment-tolerant community that includes less desirable species. For salmonids, increased sedimentation could substantially degrade spawning habitat, which would reduce spawning success and recruitment by reducing trout embryo survival rates, as well as decrease rearing and overwintering habitat (see Section 4.6). Impacts from sedimentation under SLT would be short to long term and minor to moderate depending on the level of sedimentation.

Moderate impacts would result if enough individuals were affected to lower the reproductive rate of a population of an aquatic species.

- *Measurement Indicator #4* – NUMBER OF CROSSINGS

Direct impacts to fish, amphibians, or mollusks could occur from mortality during construction of stream crossings (Section 4.7). Stream crossings could be allowed in more locations under SLT and would have the greatest potential for direct adverse impacts to aquatic habitat outside of an unanticipated accident or spill (see *Measurement Indicator #5*). The number and location of stream crossings that would be associated with oil and gas activities is not known. Stream crossings would be planned and constructed to minimize disturbance to riparian and aquatic habitats, including stream substrate, by locating crossings at the most advantageous location and by crossing at or near perpendicular to the stream channel (Appendix C). Culverts and structures would be designed to allow fish passage and to maintain habitat. When no longer needed for operations, crossings would be removed and the stream and banks restored to pre-disturbance conditions and stream hydraulics. Timing restrictions during installation and removal may be needed to protect fisheries, in coordination with UDWR and Utah Division of Water Rights (Stream Alteration Program). Recommended specifications for culverts across streams, wetlands, and low water crossings associated with oil and gas activities are contained in BLM and USFS (2007). Impacts from road crossings under SLT would be short (exploration) to long (production) term and minor because it is likely that only some individuals would be affected by a stream crossing at any one location. Impacts to sensitive trout species from improperly installed culverts could be moderate (see Section 4.6).

- *Measurement Indicator #5* – CHANGES TO AQUATIC HABITAT CONDITION

In general, impacts to aquatic species from adverse changes to aquatic habitat have the potential to be long term or permanent because aquatic habitats are not easily restored to the original functioning condition after a disturbance.

Channel disturbance, the clearing of vegetation, and construction and use of roads and pads in the vicinity of aquatic habitats could adversely impact aquatic habitat conditions. Impacts could occur due to sedimentation (see *Measurement Indicator #3*), the introduction of spilled hazardous substances, loss of streamside vegetation (decreased bank stabilization and increased water temperature), and removal of large woody debris. These impacts, if they occurred, would be short to long term and minor to moderate depending on the quantity of sedimentation or hazardous materials introduced, the amount of vegetation removed, the type of aquatic habitat (river, stream, pond), and the current condition of the aquatic habitat. Fish, amphibians, and mollusks would be adversely affected by a negative change in aquatic habitat condition. Impacts to mollusks could occur via changes in water quality or impacts to springs (see Section 4.7). Impacts to aquatic species would be minor if only some individuals were affected; impacts would be moderate if a substantial enough number of individuals were affected so as to reduce the reproductive rate of an aquatic species population.

Although unlikely, the greatest potential for an adverse change in the aquatic habitat condition would be in the event of an oil spill resulting from a haul truck overturning or a pipeline failing and the released oil discharging to a drainage. The consequences of such unanticipated events have the potential to be greater under SLT because oil and gas activities are more likely to be closer to streams. However, under SLT resource protection measures and Clean Water Act compliance would reduce the chance of these impacts occurring. Introduction of a substantial quantity of oil to a stream would have major adverse impacts to fisheries and aquatic species for some distance downstream. The deposition of oil on channel banks and substrate could inhibit

algal growth and could result in ongoing contamination of the water. While short-term effects could be severe, long-term damage would be minimal if clean-up efforts are implemented at the time of the accident (USFS 1995a). Operating procedures regarding site placement, design, and proper road crossings are designed to minimize such occurrences (Appendix C) although these types of events are more likely under SLT because more miles of road may be closer to streams. Oil spill impacts would be long term and could be major, depending on the amount of spilled oil that enters the aquatic system and the effectiveness of clean-up efforts, because populations of aquatic species would almost certainly be affected by a large-scale spill that was not effectively mitigated.

Although the Dixie National Forest could require an operator to move a well as far away from a stream as allowed (200 meters, 656 feet), this is the maximum possible buffer that would be enforced if an operator wished to drill in close vicinity to a stream. Stream crossings could also be moved up to 200 meters (656 feet) in order to minimize impacts to relatively high-quality reaches. Allowances under SLT may or may not be sufficient in preventing adverse impacts to aquatic habitats.

In summary, due to the greater potential for adverse impacts resulting from accidents or unanticipated events, including those that take place in more sensitive aquatic areas (see Section 4.7), impacts to aquatic habitat conditions under SLT have the potential to be major. Major impacts would result if populations were certain to be affected by an event. Adverse impacts to aquatic species populations would be certain to lower the reproductive rate of the population and could put the persistence of the species on the Dixie National Forest in an uncertain position. In areas where the aquatic habitat is already degraded from fire effects, further degradation could have long-term impacts that would further impede recovery of these habitats (see Cumulative Effects, Section 5.5). Impacts under SLT would be short to long term and moderate to major, depending on the location of disturbance, present condition of the aquatic habitat, and the severity of the impact.

- *Measurement Indicator #4* INCREASES IN INVASIVE PLANTS

In some riparian areas, tamarisk (*Tamarix ramoissima*), whitetop (*Cardaria draba)*, and Russian olive (*Elaeagnus angustifolia*) are replacing native riparian vegetation such as willows (*Salix* spp.) and cottonwoods (*Populus* spp.). Invasive grasses and species such as rabbitbrush also replace native vegetation and create fewer shaded areas and less stable banks. As a result, higher water temperatures and higher rates of sedimentation characterize the habitat, both of which degrade aquatic habitats from an optimally functioning condition. Impacts from the spread of invasive plants would be long term and minor, because it is unlikely that populations of aquatic species would be affected.

4.5.5 Impacts by Alternative

The degree to which the connected action impacts (Section 4.5.4) would differ by alternative is discussed in this section. Alternatives involve leasing options, which would restrict the locations and the nature of oil and gas impacts that are allowed. In general, impacts are discussed at the Forest-wide level and not by ranger district. This is done to avoid repetition and facilitate the comparison of impacts across alternatives. However, any pronounced differences in the impacts to a resource component between ranger districts is highlighted and discussed.

Impacts to migratory birds, aquatic species, and habitat impacts to other wildlife (with no leasing options) are described below. Aquatic species would generally be protected by lease options applied to water and riparian areas (Section 4.7). Colorado and Bonneville cutthroat trout

habitat carries special leasing options and is discussed in Section 4.6 (Special Status Species). All uses of measurement indicators in the following alternatives comparison follow Section 4.5.4.6: *Measurement Indicator #2* applies to migratory birds, and *Measurement Indicators #3*, *#4*, and *#5* apply only to aquatic species. *Measurement Indicator #1* is discussed for all terrestrial wildlife. *Measurement Indicator #6* applies to native fishes and aquatic species.

4.5.5.1 Alternative A

There would be no oil and gas activities on the Dixie National Forest within areas not currently leased. Alternative A would continue present management activities as pertaining to oil and gas leasing. The Forest Supervisor under this alternative would not make any new leasing decisions and no new oil and gas leasing would be allowed on the Dixie National Forest. Current operations, including the Upper Valley oil field on the Escalante Ranger District (19 wells, including nine water-injector wells) would continue (USFS 2006g). In total, there are 13,454 acres of existing leases on the Dixie National Forest. Existing leases will expire and the potential number of wells that could be drilled on the Dixie National Forest would decrease over time. Under Alternative A, adverse impacts to fish and wildlife species and habitats would be negligible.

4.5.5.2 Alternative B

Chapter 2 of the EIS describes how many acres of the Dixie National Forest would fall under each leasing option under Alternative B (Table 2.5-2) and where those acres are located (Figure 2.5-2a-d). Approximately 65 percent of the Dixie National Forest would not be available for lease (NA) or would have a NL option applied under Alternative B. Of the leasable lands, 20 percent would be NSO and 5 percent would be CSU. As under all alternatives, 5 percent of the Forest is legally unavailable for leasing (NA).

Noise impacts (*Measurement Indicator #2*) to migratory birds would be negligible because CSU leasing options would be in place that would prevent disturbance to nesting raptors, and other migratory birds of interest (see Appendix D). Habitat disturbance impacts (*Measurement Indicator #1*) to migratory birds would be short to long term and minor because: 1) 1,670 acres of maximum disturbance, over a 15-year period, is relatively small (0.1%) when compared to the amount of habitat available on the Dixie National Forest, and 2), the Migratory Bird Treaty Act requires that the Dixie National Forest conserve populations of migratory birds; thus impacts would likely be minor to moderate (moderate impacts would occur if populations may be affected). Impacts from unintentional take of migratory passerines would be minor. Impacts to other wildlife species (not protected by leasing options or laws) from potential habitat losses (*Measurement Indicator #1*) under Alternative B would be as described under SLT (Section 4.5.4.6): potentially long term and moderate. Long term and moderate impacts would occur to a wildlife species if a production field was developed in suitable habitat and the habitat loss had the potential to affect the species at the population level.

Impacts to fish and aquatic species would be unlikely under Alternative B due to a NL condition on a 300-foot buffer around streams, lakes, reservoirs, and springs and a NSO leasing option to 500-feet around these resources (Section 4.7). NSO buffer zones would not allow use or occupancy, including road building. Impacts to fish and aquatic species with regard to *Measurement Indicators #3*, *#4*, *#5*, and *#6* under Alternative B would be negligible.

4.5.5.3 Alternative C

Alternative C has less restrictive leasing options than Alternative B and more restrictive options than Alternative D. Chapter 2 of this EIS describes how many acres of the Dixie National Forest would fall under each leasing option under Alternative C (Table 2.5-3) and where those acres are located (Figure 2.5-3 (a-d)). Under Alternative C, 73 percent of the Dixie National Forest would be NSO, 12 percent would be CSU, and 3 percent would be TL from 15 May to 5 July. Five percent would be NA. In addition, linear features (e.g., roads, pipelines) would be allowed as perpendicular stream crossings under NSO.

Impacts to migratory birds would be as described under Alternative B due to CSU leasing options. Impacts to other wildlife species from potential habitat losses (*Measurement Indicator #1*) would also be as described under Alternative B (and as described under SLT; Section 4.5.4.6).

Most potential impacts to fish and aquatic species would be unlikely under Alternative C due to NSO buffer zones that would not allow, with the exception of perpendicular road crossings, use or occupancy within 300 feet of streams (see Section 4.7). Impacts to fish and aquatic species with regard to *Measurement Indicators #3,* and *#5* under Alternative C would be negligible. Under Alternative C, the NSO leasing option would allow for perpendicular stream crossings (*Measurement Indicator #4*); thus, stream crossing impacts would be as described under SLT (Section 4.5.4.6): long term and minor. Indirect impacts to fish with regard to the spread of invasive plants (*Measurement Indicator #6*) would be long term and minor because it is likely that only individuals, and not populations of native fishes or other aquatic species, would be affected by the potential spread of invasive plants via seismic activities that may indirectly degrade aquatic habitats.

4.5.5.4 Alternative D1 (NSO in IRAs)

Alternative D has less restrictive leasing options than Alternative C and more restrictive options than Alternative E. Chapter 2 describes how many acres of the Dixie National Forest would fall under each leasing option under Alternative D with NSO/CSU in IRAs (Table 2.5-4) and where those acres are located (Figures 2.5-4 (a-d)). Under Alternative D with NSO in IRAs, 33 percent of the Dixie National Forest would be NSO. Five percent would be NA.

Impacts to raptors in terms of habitat disturbance (*Measurement Indicator #1*) and noise (*Measurement Indicator #2*) would be as described under Alternative B, due to CSU leasing options. The Migratory Bird Treaty Act would be in effect under all alternatives. Therefore, noise impacts to migratory birds would be minor, as populations would not be affected due to compliance with the Act. Habitat impacts for migratory birds would be the same as under Alternative B, potentially long term and minor, because populations would not be affected if key habitats are conserved. Impacts to other wildlife from potential habitat losses (*Measurement Indicator #1*) could be as described under Alternative B: potentially long term and moderate.

Impacts to aquatic species would be more likely under Alternative D1 than Alternatives A to C, because operations under CSU would allow operations to be at a similar proximity to streams as SLT. There would thus be less potential for increase in sedimentation (*Measurement Indicator #3*) under Alternative D, relative to Alternative E. However, the potential for adverse changes to the aquatic habitat condition (*Measurement Indicator #5*; see Section 4.5.4.6) would be similar. Direct and indirect impacts to aquatic species from stream crossings (*Measurement Indicator #4*) and increases in invasive plants (*Measurement Indicator #6*) would be as described under Alternative C. Overall, impacts to aquatic species under Alternative D would the same as under

SLT, potentially major, due to the similar potential for a catastrophic event with operations in close proximity to aquatic habitats.

4.5.5.5 Alternative D2 (CSU in IRAs)

Under Alternative D2, 8 percent of the Dixie National Forest would be NSO. Impacts to fish and wildlife species would be the same as described for Alternative D1 because no areas with assigned leasing options are within IRAs.

4.5.5.6 Alternative E1 (NSO in IRAs)

Alternative E has the least restrictive leasing options. Chapter 2 of this EIS describes how many acres of the Forest would fall under each leasing option under Alternative E1 (Table 2.5-5) and where those acres are located (Figures 2.5-5 (a-d)). Thirty three percent of the Dixie National Forest is within IRAs and would be NSO. Five percent of the Dixie National Forest would be NA.

Impacts to fish and wildlife would be the same as under Alternative E2 with SLT in IRAs because no areas with assigned leasing options are within IRAs. Any fish or wildlife habitat without leasing options that happens to overlap IRAs could only be affected by seismic activities. General impacts to fish and wildlife from seismic activities are described in Section 4.5.3.

Impacts to migratory birds would also be as described under SLT: short to long term, depending on whether exploration (short term) or production activities (long term) took place in suitable habitat, and potentially moderate because a higher number of individual nests could be disturbed and as a result, a relatively higher level of unintentional take could occur. Some impacts to aquatic species (*Measurement Indicators #3* and *#5*) would be as described under SLT (Section 4.5.4.6): long term and moderate to major. Direct and indirect impacts to aquatic species from stream crossings (*Measurement Indicator #4*) and increases in invasive plants (*Measurement Indicator #6*) would be as described under Alternative C.

4.5.5.7 Alternative E2 (SLT in IRAs)

Impacts to fish and wildlife species would be the same as described in Section 4.5.4.6. Under Alternative E2, leasing would be allowed on 95 percent of the Dixie National Forest.

Table 4.5-3 Impacts with respect to Measurement Indicators #1 - #5

Resource		ALT A	ALT B	ALT C	ALT D1	ALT D2	ALT E1	ALT E2
All wildlife (no leasing options or legal protection)	*MI #1*	neg ST-LT	minor-mod ST-LT	minor-mod ST-LT	minor-mod ST-LT	minor-mod ST-LT	minor-mod ST-LT	minor-mod ST-LT
Migratory birds	*MI #1*	neg ST-LT	minor ST-LT	minor ST-LT	minor ST-LT	minor ST-LT	minor ST-LT	minor ST-LT
	MI #2	neg ST	negligible ST	negligible ST	negligible ST	negligible ST	minor-mod ST	minor-mod ST
Aquatic species	*MI #3*	neg ST-LT	negligible ST-LT	negligible ST-LT	neg-minor ST-LT	neg-minor ST-LT	minor-mod ST-LT	minor-mod ST-LT
	MI #4	neg ST-LT	negligible ST-LT	minor ST-LT	minor ST-LT	minor ST-LT	minor ST-LT	minor ST-LT
	MI #5	neg ST-LT	negligible ST-LT	negligible ST-LT	mod-major ST-LT	mod-major ST-LT	mod-major ST-LT	mod-major ST-LT
	MI #6	neg LT	negligible LT	minor LT	minor LT	minor LT	minor LT	minor LT

LT = long term; ST = short term; neg = negligible; mod = moderate

4.6 Special Status Species

4.6.1 Introduction

The terms used to describe the context and intensity of effects in this section are discussed in Section 4.1 and Table 4.1-1. Table 4.6-1 provides an example how these terms would apply to special status wildlife and plant species.

Table 4.6-1 Terms used to Describe Effects to Special Status Species

Attribute of Effect		Description relative to Special Status Species
Quality	Beneficial	An increase in the amount or quality of suitable habitat for a species.
	Adverse	A decrease in the amount or quality of suitable habitat for a species.
Magnitude (Intensity)	Negligible	A modification in habitat amount or quality that is too small to be perceptible by a species. *Example: Loss of 1% of available habitat.*
	Minor	A modification in habitat amount or quality that would only affect some individuals of a species and would not affect the reproductive rate of the population. *Example: Loss of 10% of available habitat. Example: Increase in invasive plants within suitable habitat.*
	Moderate	A modification in habitat amount or quality that would affect enough individuals of a species that the reproductive rate of the population could be affected. Population decline or a loss of viability would be possible. *Example: Extended noise disturbance that affects many reproducing individuals.*
	Major	A modification in habitat amount or quality that would affect the reproductive rate of a population of a species and is likely to lead to a population decline or loss of viability. *Example: An irretrievable loss of Critical Habitat that would affect a population. Example: A hazardous materials spill that renders several miles of aquatic habitat unsuitable.*
Duration	Temporary	A habitat modification that only occurs during construction of a facility (i.e., road, well pad). Original habitat condition is immediately restored once construction is completed. *Example: Noise disturbance from seismic blasts.*
	Short Term	A habitat modification that occurs during exploration activities (i.e., construction of exploratory well pads or access roads) or that may last for one or a few reproductive seasons. The habitat modification lasts 10 years or less. Original habitat condition would likely be restored within this time frame. *Example: Noise disturbance from exploration activities.*
	Long Term	A habitat modification that occurs during extended exploration activities or during production activities. The habitat modification lasts more than 10 years and original condition may or may not be restored. *Example: Noise disturbance from a production well.*

4.6.2 Measurement Indicators

- *Measurement Indicator #1* ACRES OF DIRECT DISTURBANCE OF HABITAT AND INDIRECT HABITAT LOSS AS COMPARED TO AVAILABLE HABITAT
- *Measurement Indicator #2* NARRATIVE DISCUSSION ON POTENTIAL EFFECTS RELATED TO FRAGMENTATION OF EXISTING HABITATS AND POPULATIONS.
- *Measurement Indicator #3* NUMBER OF VISITS AND NOISE LEVELS
- *Measurement Indicator #4* ROAD DENSITY BY SUBWATERSHED (6TH LEVEL HUC)
- *Measurement Indicator #5* INCREASES IN INVASIVE PLANTS
- *Measurement Indicator #6* IMPACTS DETERMINATIONS (BA AND CHANGES IN VIABILITY FOR SENSITIVE SPECIES)
- *Measurement Indicator #7* COMPLIANCE WITH UDWR POPULATION OBJECTIVES
- *Measurement Indicator #8* COMPLIANCE WITH FISHERIES CLASSIFICATION SYSTEM (UTAH) FOR STREAMS
- *Measurement Indicator #9* COMPLIANCE WITH LAND AND RESOURCE MANAGEMENT PLAN STANDARDS AND GUIDELINES FOR MIS

4.6.3 Impacts Common to All Action Alternatives

Under Alternatives B, C, D, and E, it is assumed that activities described under the RFDS would occur. Activities described under the RFDS include 60 to 120 acres (depending on ranger district) of overland travel associated with seismic surveys, 80 to 330 acres (depending on ranger district) of land clearing surface disturbance associated with road and pad building for exploration wells, and 254 acres of land clearing surface disturbance for a production field. The locations of these activities are not yet known. Section 4.5 contains a discussion of general impacts to wildlife and fisheries related to oil and gas activities (i.e., seismic, exploration, road building, and production). Like other wildlife species, impacts to special status species associated with oil and gas generally include a direct loss of habitat in addition to behavioral avoidance of a larger area around the direct disturbance, due to human presence and noise. The amount of habitat lost to human presence and noise depends on the species' tolerance of such disturbances. Nesting spotted owls and other raptors, for example, are relatively sensitive to noise. Continuous noise disturbances, such as from the initial drilling of a well, would create a larger avoidance zone than would noise created by seismic surveys, which involve short blasts.

The direct disturbance (killing) of TEC species from oil and gas-related activities would be unusual, and a violation of the Endangered Species Act. A Biological Assessment (BA) would be completed at the time operations are proposed; this document would disclose all potential impacts to TEC species and compliance with the Endangered Species Act (see Lease Notice, Section 4.6.4.6). A Biological Evaluation would also be completed at the time operations are proposed; this document would disclose all potential impacts to Forest Service Sensitive species. Compliance with the Land and Resource Management Plan (USFS 1986) in terms of potential impacts to MIS and with regard to *Measurement Indicator #8* are discussed at the end of Section 4.6.4.7.

Table 4.6-2 lists the leasing options by special status species, for each alternative. Leasing options are described in Section 4.6.5.

Table 4.6-2 Leasing options by Alternative for Special Status Species

Resource	Alternative				
	A	B	C	D	E
TEC					
Threatened, endangered, and candidate species and suitable habitat	NL	LN	LN	LN	SLT
California condor rim habitat (451,759 acres)	NL	CSU	CSU	TL Feb 1 – Aug 31	SLT
Desert tortoise habitat (1,853 acres)	NL	NSO	TL Feb 16 – Nov 30	TL Feb 16 – Nov 30	SLT
Designated Critical desert tortoise habitat (79 acres)	NL	NSO	NSO	NSO	SLT
Utah prairie dog colonies (49,820 acres)	NL	NSO	NSO	NSO	SLT
Designated Critical Mexican spotted owl habitat (18,048 acres)	NL	NL	LN	LN	SLT
Potential Mexican spotted owl habitat (48,138 acres)	NL	CSU	CSU	CSU	SLT
Mexican spotted owl PAC (732 acres)	NL	NSO	NSO	CSU	SLT
Sensitive and MIS					
Sensitive species and suitable habitat	NL	NSO	CSU	CSU	SLT
Fisheries habitat (5,383[1] acres)	NL	NL 500 ft	NSO 300 ft	CSU 300 ft	SLT
Pygmy rabbit habitat (60,752 acres)	NL	NSO	CSU	CSU	SLT
Sensitive bat habitat (2,461 acres)	NL	NSO	CSU	CSU	SLT
Goshawk nest areas (63,013 acres)	NL	NSO 0.5-mile radius	NSO 0.5-mile radius	CSU 0.3-mile radius	SLT
Goshawk PFA (84,406 acres)	NL	CSU	CSU	CSU	SLT
Peregrine falcon nests (4,836 acres)	NL	NSO	NSO	CSU	SLT
Peregrine falcon rim habitat (451,759 acres)	NL	CSU	CSU	TL Feb 1 – Aug 31	SLT
Bald eagle winter concentration areas (13,947 acres)	NL	NSO	NSO	CSU	SLT
Bald eagle nests	NL	LN	LN	LN	SLT
Flammulated owl habitat (436,860 acres)	NL	NSO	CSU	CSU	SLT
Sage grouse leks (9,365 acres)	NL	NL	NSO	NSO	SLT

Resource	Alternative				
	A	B	C	D	E
Sage grouse summer, nesting, and brood rearing habitat (57,105 acres)	NL	NL	CSU	TL May 1 – July 15	SLT
Sensitive plant species and suitable plant habitat (127,720 acres)	NL	NSO	CSU	LN	SLT
Crucial and substantial elk and mule deer winter range (177,713 acres)	NL	NL	CSU	TL Dec 1 – April 15	SLT
Crucial elk and mule deer summer range (425,949 acres)	NL	NL	TL May 15 – July 5	TL May 15 – July 5	SLT

[1] Includes a 300-foot buffer; total acres under Alternative B (500-ft buffer) = 8,869.

4.6.4 Impacts of Connected Actions by Leasing Option

Leasing options would dictate the conditions under which impacts from connected actions (described under the RFDS) may occur. Impacts from connected actions under each leasing option are discussed in this section. Impacts to special status species considering leasing option overlaps (i.e., overlaps with more restrictive leasing options assigned to other resources) are discussed in Section 4.6.5 (Impacts by Alternative). Under all leasing options and alternatives, oil and gas activity would be subject to the Best Management Practices (BMPs) listed in the *Dixie National Forest Oil and Gas Construction and Operating Standards and Well Site Design Requirements* contained in Appendix C and the BLM and USFS *Surface Operating Standards and Guidelines for Oil and Gas Exploration and Development – The Gold Book* (BLM and USFS 2007).

4.6.4.1 Not Legally Available (NA)

NA applies to lands that are not legally available for leasing, including Brian Head Ski Permit Area, wilderness areas, and areas surrounding the Box-Death Hollow Wilderness Area that were withdrawn from leasing by the Utah Wilderness Act of 1984. No oil and gas leasing is being considered in these areas and no disturbance to special status species in these areas would occur. This leasing option does not apply directly to any special status species resource component.

4.6.4.2 No Lease (NL)

NL applies to lands where no new leases would be authorized. These lands would not be administratively available for leasing. No disturbance to special status species would occur under NL. Under Alternative A, NL would apply to all special status species with assigned leasing options (listed in Table 4.6-2), and would also apply to Designated Critical Mexican spotted owl habitat, Sensitive fish habitat, sage grouse leks, sage grouse brooding habitat, and big game summer and winter range under Alternative B. Because no leases would be authorized under NL, there would be no disturbance related to oil and gas activities and thus no direct or indirect impacts to any special status species covered by this leasing option.

4.6.4.3 No Surface Occupancy (NSO)

With the exception of seismic activities, NSO would prohibit occupancy of the land for oil and gas related activities (e.g., construction of well pads, central tank batteries, access roads, pipelines, power lines, and other linear structures). Excluding those related to seismic activities,

no disturbance to special status species from other exploratory or production activities would occur under NSO, with the exception of sensitive fishes disturbed by the installation of perpendicular stream crossings.

Under Alternatives B, C, and D, NSO would apply to Utah prairie dog colonies and Designated Critical desert tortoise habitat. NSO would also apply to desert tortoise habitat (not Critical) under Alternative B and to Mexican spotted owl protected activity centers (PACs) under Alternatives B and C. Regarding Sensitive species, NSO would apply directly to fisheries habitat; sensitive bat habitat, goshawk nest areas, sage grouse leks, peregrine falcon nests, bald eagle winter concentration areas, and TESP plant habitat under at least one alternative (A, B, C, or a combination; see Table 4.6-2).

Impacts under NSO with regard to applicable measurement indicators are described below. *Measurement Indicator #1* (habitat loss) is discussed for all species; *Measurement Indicator #2* (Fragmentation of Habitat) is not discussed under NSO because seismic activities do not result in complete vegetation removal and only result in narrow disturbance footprints; fragmentation of habitat is thus unlikely to occur as a direct result of seismic activities allowed under NSO. An exception may be sensitive trout under Alternative C because road crossings are allowed. In addition, if seismic surveys increase the incidence of invasive plants within identified habitats, the area may be at increased risk of wildfire, which could fragment habitat (see Cumulative Impacts, Section 5.6). *Measurement Indicator #3* (Number of Visits and Noise Levels) is discussed for all TEC species except Endangered fishes, as well as pygmy rabbit habitat, sage grouse leks, and raptors. *Measurement Indicator #6* (Effects determinations) is presented at the end of Section 4.6.5. *Measurement Indicator #5* (invasive plants) is discussed for all species.

Table 4.6-3 Impacts under NSO with regard to Measurement Indicators #1, #3, and #5

Resource Component	*MI #1 Habitat loss*	*MI #3 Noise*	*MI #5 Invasive plants*
TEC			
Utah prairie dog colonies	If seismic activities occurred, activities could remove 120 acres of colony area within the buffer (<1% of available). Impacts short term and minor because small area of disturbance would probably only affect individuals and take from seismic activities is unlikely.	If seismic activities occurred, seismic blasts may temporarily interrupt communications and individuals may be more susceptible to predator attacks. Impacts temporary and minor because only individuals would be affected.	If seismic activities occurred, activities may introduce invasive plants that would reduce the value of forage and diminish the functional value of vegetation relative to native forage, shade, and cover plants. Impacts could be long term because natives are unlikely to reestablish without management, and minor to major, depending on the location and state of the colony.
Desert tortoise habitat and Critical Habitat	If seismic activities occurred, activities would disturb 60 acres of habitat (3% of available suitable habitat; 76% of available Critical Habitat). Impacts to Critical Habitat would	If seismic activities occurred, seismic blasts under NSO may affect individual tortoises temporarily but would probably not have a measurable impact on	If seismic activities occurred, seismic surveys could introduce invasive plants that prevent the growth of perennial grasses and native annuals, which tortoises

Resource Component	*MI #1 Habitat loss*	*MI #3 Noise*	*MI #5 Invasive plants*
	be short term and moderate because Critical Habitat is the most important land on the Dixie National Forest for tortoises. Impacts would not be major because the amount of Critical Habitat on the Dixie National Forest is less than one percent of the amount in the Upper Virgin River recovery unit. Impacts to suitable habitat (not Critical) would be short term and minor because this habitat is not necessarily critical to the species survival.	many individuals. Reproduction would not be affected. Only some individuals may be affected, thus impacts from seismic noise would be negligible or minor.	use for food and cover, and also increases the incidence of fires, which kill tortoises and also fragment habitats. Brome grasses (*Bromus* spp.) can also invade the nares and jaws of tortoises which cause mechanical injuries (Boarman 2002). Impacts long term and would be minor to major depending on occupancy.
Mexican spotted owl PAC	If seismic activities occurred, activities could remove 120 acres of habitat (16% of available). Impacts short term and minor because most area is rock and would not be altered substantially. Disturbed vegetation would regenerate within one year.	If seismic activities occurred, seismic blasts would be most likely to cause impacts between March 1 and August 31 because spotted owls may be nesting. Impacts to nesting owls would be short term and moderate because reproduction would be affected for one season. Seismic blasts may cause displacement of roosting owls; these impacts would be negligible to minor and short term because roosting owls would return following the temporary blast.	If seismic activities occurred, buggy surveys could introduce invasive plants that may adversely impact prey habitat on mesa tops where Mexican spotted owls forage. Invasive plants do not provide the same forage quality for prey species as natives and adverse changes in vegetation composition may lead to a decrease in the prey base for Mexican spotted owl. Indirect impacts would be long term and minor because owl reproduction would not be affected.
Sensitive			
Fisheries habitat	If seismic activities occurred, activities would not remove stream habitat (stream crossings not allowed) and a riparian buffer would be in place. Impacts negligible.	Not applicable	If seismic activities occurred, activities may introduce invasive plants that would degrade the aquatic habitat (see CSU). Indirect impacts would be long term and moderate because populations could be affected, as described for CSU (below).
Pygmy rabbit habitat	If seismic activities occurred, activities could remove 60-120 acres of	If seismic activities occurred, seismic blast impacts would be	If seismic activities occurred, invasive plants may spread; impacts could

Resource Component	*MI #1 Habitat loss*	*MI #3 Noise*	*MI #5 Invasive plants*
	habitat (0-1% of available). Impacts short term and negligible to minor due to the small area of disturbance relative to available habitat.	temporary and minor because pygmy rabbits would be unlikely to abandon their burrows. Reproductive rates would not be affected.	be long term (see CSU). Impacts would be minor to moderate because reproduction could be affected by this level of habitat change.
Sensitive bat habitat	If seismic activities occurred, activities could remove 60-120 acres of habitat (9-40% of available). Impacts minor and short term because impacts would most likely be to foraging habitat and would affect only some individuals.	If seismic activities occurred, seismic blast impacts may disturb many individual bats but not populations and would not affect reproduction because noises would be temporary. Impacts to bats would be minor.	If seismic activities occurred, buggy surveys could introduce invasive plants that may adversely impact prey habitat where bats forage. Adverse changes in vegetation composition within prey habitat may lead to a decrease in the prey base. Indirect impacts would be long term and minor because reproduction would not be affected.
Sage grouse leks	If seismic activities occurred, seismic activities could remove 60-120 acres of habitat (2-40% of available). Impacts short term and moderate to major due to the limited amount of lek habitat available.	A TL would be in place during the breeding season within a one-mile radius of leks, so that if seismic activities occurred, there would be no noise impacts. Impacts negligible.	If seismic activities occurred, invasive plants may spread; impacts could be long term (see TL). Impacts would be minor because reproduction would probably not be affected.
Goshawk nest areas	If seismic activities occurred, activities could remove 60-120 acres of habitat (0-4% of available). Impacts negligible to minor due to the small area of disturbance relative to available habitat.	If seismic activities occurred, seismic blasts may cause temporary impacts to roosting raptors that would return to the roost following the blast. Impacts to roosting raptors would be negligible to minor, because individuals would only be temporarily affected. Impacts to nesting raptors would be short term and moderate because reproduction would be affected for one season.	If seismic activities occurred, buggy surveys could introduce invasive plants that may adversely impact prey habitat where raptors forage. Invasive plants do not provide the same forage quality for prey species as natives and changes in vegetation composition may lead to a decrease in the prey base for raptors. Indirect impacts would be long term and minor because raptor reproduction would not be affected.
Peregrine falcon nests	If seismic activities occurred, activities could remove 60-120 acres of habitat (4-6% of available). Impacts negligible to minor due to the small area of disturbance relative to available habitat.		

Resource Component	*MI #1 Habitat loss*	*MI #3 Noise*	*MI #5 Invasive plants*
Bald eagle wintering habitat	If seismic activities occurred, activities could remove 60-120 acres of habitat (2-7% of available). Impacts negligible to minor due to the small area of disturbance relative to available habitat.		
Sensitive plant habitat and locations	If seismic activities occurred, activities could remove 60-120 acres of habitat (0-1% of available). Impacts negligible to minor due to the small area of disturbance relative to available habitat and the likelihood that sensitive plant populations could be avoided.	Not applicable	Seismic activities could introduce invasive plants that would directly compete with sensitive plants and reduce the area and resources available for sensitive species. Invasive species are likely to replace native plants if both are present. These impacts would be long term and minor to moderate, depending on the sensitive plant species and amount of suitable habitat.

4.6.4.4 Timing Limitation (TL)

A TL leasing option prohibits surface activities during specified time periods, and so would avoid direct and indirect impacts to special status species during sensitive periods, such as on a seasonal habitat for a particular species during the season of use. This leasing option 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.

Timing Limitations (see Table 4.6-2) would apply directly to California condor rim habitat under Alternative D and desert tortoise habitat (not Critical) under Alternatives C and D. Regarding Sensitive species, Timing Limitations would apply directly to sage grouse brooding habitat, peregrine falcon rim habitat, and big game winter and summer range. Impacts to these species under TL with regard to applicable measurement indicators are described in Table 4.6-4 and below. *Measurement Indicator #1* (habitat loss), *Measurement Indicator #2* (fragmentation of habitat), and *Measurement Indicator #3* (noise) are discussed for all species. *Measurement Indicators #4* and *#7* (Road Density and Compliance with UDWR population objectives) are discussed below with regard to big game. Refer to Appendix D for descriptions of each TL.

Table 4.6-4 Impacts under TL regarding Measurement Indicators #1-#3

Resource Component	*MI #1 Habitat loss*	*MI #2 Fragmentation*	*MI #3 Noise*
TEC			
California condor rim habitat	Oil and gas activities could still occur outside the TL (September 1 – January 31), thus habitat disturbance impacts would be as described under SLT.	If oil and gas activities occurred in rim habitat outside the TL, rim habitat could be disturbed for the long term and reduce the larger area of undisturbed habitat that is available for California condors. Condor habitat areas would be less continuous, with smaller undisturbed tracts, during and after oil and gas disturbances. Fragmentation impacts would be long term and minor.	If oil and gas activities occurred in rim habitat, TL would decrease the likelihood that nesting condors would be disturbed by noise. Condors may nest on the Dixie National Forest in the future, although none have been observed to date. Noise impacts to nesting condors under the TL would be negligible. Roosting condors may still be affected by noise outside of the TL period within a one-mile radius and may be displaced from cliffs by noise disturbances; these impacts would be short term and minor.
Desert tortoise habitat	If oil and gas activities occurred in desert tortoise habitat, impacts to desert tortoises under TL would be limited to habitat loss, as described in SLT because habitat disturbance associated with oil and gas activities would still occur outside the TL under SLT restrictions.	If oil and gas activities occurred in desert tortoise habitat, impacts to desert tortoises under TL regarding fragmentation would be as described in SLT because habitat disturbance associated with oil and gas activities could occur outside the TL.	If oil and gas activities occurred in desert tortoise habitat, impacts to desert tortoises under TL with regard to noise impacts are unlikely because all visits and noise would occur during the inactive season while tortoises are hibernating. Extended or repeated noise disturbances could rouse tortoises from their burrows, in which case emergent tortoises would lose valuable energy reserves needed to sustain through the period when forage may be unavailable. Only tortoises in the immediate vicinity of construction activities would risk being disturbed during the inactive season thus impacts to desert tortoises would be minor and short term.

Resource Component	*MI #1 Habitat loss*	*MI #2 Fragmentation*	*MI #3 Noise*
Sensitive			
Sage grouse brood rearing habitat	Oil and gas activities outside the TL could disturb up to 7% of available habitat. Impacts short to long term, depending on the activity, and minor to moderate because reproduction could be affected by a reduced amount of suitable habitat.	If oil and gas activities occurred in sage grouse brood rearing habitat, roads or linear disturbances constructed outside the TL period could fragment sage grouse brooding habitat by narrowing or blocking migration corridors; these impacts would likely be short to long term, depending on the activity, and moderate because the stress of taking an alternative (i.e., longer) route between seasonal ranges could impact a large number of individuals and thus affect the reproductive rate of the population.	If oil and gas activities occurred in sage grouse brood rearing habitat, noise disturbances from oil and gas activities outside the TL would not disturb sage grouse. Impacts negligible to minor.
Peregrine falcon rim habitat	Oil and gas activities outside the TL could disturb up to 1% of available habitat. Impacts short to long term, depending on the activity, and negligible to minor due to the relatively small amount of disturbance relative to the available habitat.	If oil and gas activities occurred within one mile of rim habitat, foraging areas for peregrine falcon would be reduced and territories may become less suitable. Individuals may be forced into less suitable territories that contain fewer prey species or a different community of other raptors that may be more competitive for prey items or that may prey directly on peregrine falcons. Fragmentation impacts would be long term and moderate because	If oil and gas activities occurred in rim habitat, noise disturbances from oil and gas activities outside the TL would not disturb nesting birds. Impacts negligible to minor.

Resource Component	*MI #1 Habitat loss*	*MI #2 Fragmentation*	*MI #3 Noise*
		reproduction and nesting success would be affected.	
Crucial and Substantial big game winter range	Oil and gas activities outside the TL could disturb up to 2% of the winter range in any one ranger district. Impacts short to long term, depending on the activity, and minor due to the relatively small amount of disturbance relative to the available habitat.	Fragmentation impacts would be as described under SLT.	If oil and gas activities occurred in winter range habitat, noise disturbances from oil and gas activities outside the TL would not cause adverse effects. Impacts negligible.
Crucial big game summer range	Oil and gas activities outside the TL could disturb up to 4% of the summer range in any one ranger district. Impacts short to long term, depending on the activity, and minor due to the relatively small amount of disturbance relative to the available habitat.	Fragmentation impacts would be as described under SLT..	If oil and gas activities occurred in summer range habitat, noise disturbances from oil and gas activities outside the TL would not cause adverse effects. Impacts negligible.

Measurement Indicators

DESERT TORTOISE HABITAT

TL for tortoises under Alternatives C and D would restrict oil and gas activities from occurring during the tortoise active season, February 16 to November 30. Oil and gas activities could occur during the inactive period when tortoises are hibernating in underground burrows. Restricting activities to the hibernating season greatly decreases the potential for taking desert tortoises as tortoises are not moving around and hibernaculums are easily discovered prior to oil and gas activities and thus avoidable during such activities.

- *Measurement Indicator #5* INCREASES IN INVASIVE PLANTS

Impacts to desert tortoises under TL regarding noxious weeds would be as described in SLT because weed increases associated with oil and gas activities could still occur outside the TL under SLT restrictions.

SAGE GROUSE BROOD REARING HABITAT

- *Measurement Indicator #5* INCREASES IN INVASIVE PLANTS

Under NSO, seismic activities would be allowed, which could spread invasive plants due to their linear nature and the relatively long distances covered during these activities (see Section 4.9). The spread of invasive plants would reduce the amount of functional habitat for sage grouse brood rearing because brome grasses could replace native sagebrush plants that provide effective food, shelter, and temporary cover for sage grouse. Impacts from the spread of invasive plants could be long term because the replacement of some sagebrush within sage

grouse habitat would diminish the functionality of this habitat until the invasive species could be eradicated, which could take more than ten years. Impacts would be moderate or major because the reproductive rate of the population could be affected if individuals are not able to seek out remaining areas of suitable, native forage and cover or if alternate vegetation is not available.

BIG GAME WINTER AND SUMMER RANGE

- *Measurement Indicator #4* ROAD DENSITY INCREASES

A substantial increase in road density outside the TL period would have the same impacts as described under SLT. If road density increased within a subwatershed with currently high road density, impacts could occur because habitat would be measurably less effective in providing a safe and isolated area for big game to move within. Impacts to big game from a road density increase could be moderate because if a road crossed a seasonal migration corridor and reduced the effectiveness of the habitat, a large number of individuals would be affected. The reproductive rate of the population could also be affected by a road density increase if the security of the population was compromised by the road and became less suitable as a fawning or calving area (see SLT).

- *Measurement Indicator #7* COMPLIANCE WITH UDWR POPULATION OBJECTIVES

Compliance with UDWR population objectives would be the same as described under SLT. Impacts would be negligible because big game populations are currently above objectives and not at risk.

4.6.4.5 Controlled Surface Use (CSU)

CSU provides for controlled but generally allowed surface use, including exploration and development, on all or portions of a lease. Operations would be held to special operational constraints that may otherwise exceed the mitigation provided by SLT, regulations, and operating orders. With regard to special status species, CSU leasing options would ultimately allow Agencies (e.g., a Dixie National Forest biologist) to control where and when oil and gas activities occurred within a desired area/lease.

Under Alternatives B, C, and D, a CSU would apply to potential Mexican spotted owl habitat. Under Alternative D a CSU would apply to Mexican spotted owl PACs, and under Alternatives C and D, a CSU would apply to California condor rim habitat. Regarding Sensitive species, CSU leasing options would apply to fisheries (sensitive trout) habitat, pygmy rabbit habitat, sensitive bat habitat, goshawk nest areas, goshawk PFAs, sage grouse brooding habitat, peregrine falcon rim habitat, bald eagle winter concentration areas, flammulated owl habitat, TESP plant habitat, and big game winter range under at least one alternative (see Table 4.6-2).

Impacts to these species under CSU with regard to applicable measurement indicators are described below. Refer to Appendix D for descriptions of each CSU.

Table 4.6-5 Impacts under CSU with regard to Measurement Indicators #1-#3

Resource Component	*MI #1 Habitat loss*	*MI #2 Fragmentation*	*MI #3 Noise*
TEC			
Potential Mexican spotted owl habitat	If oil and gas activities occurred in potential habitat and if Mexican spotted owls are not detected, habitat losses would occur from oil and gas activities and impacts would be as described under SLT. Due to the large amount of potentially suitable habitat available on the Dixie, impacts from a loss of up to 706 acres of potential, unverified habitat would be short term and minor.	If oil and gas activities occurred within potential habitat, fragmentation impacts would be as described under SLT.	If oil and gas activities occurred in potential habitat and if Mexican spotted owls are not detected, noise impacts may occur if owls are present in the habitat. The most likely use of "potential" habitat by spotted owls is for foraging or roosting, and impacts to foraging or roosting habitat from seismic or other noise would be negligible to minor and short term. Impacts would be minor because temporary displacement in foraging or roosting habitat could not affect the reproductive rates of owls and would only affect a few individuals if the impact occurred. Impacts would be moderate if nesting owls in potential habitat were disturbed. Impacts to nesting owls would be short term because only one reproductive season would be affected.

Resource Component	*MI #1 Habitat loss*	*MI #2 Fragmentation*	*MI #3 Noise*
California condor rim habitat	If oil and gas activities occurred in rim habitat under the CSU, activities would disturb up to 706 acres, depending on the ranger district, which could affect <1% percent of suitable rim habitat for California condor. Impacts would be negligible.	Fragmentation impacts to California condor would be long term and minor as described under TL.	If oil and gas activities occurred in rim habitat under the CSU, surveys would be conducted in rim habitat. If an active condor territory were located during surveys, activities may be limited between February 1 and August 31 in the area.. Noise impacts to nesting condors under CSU would be negligible. Roosting condors may still be affected by noise from oil and gas activities outside of the restriction period. Roosting condors within a one-mile radius may be displaced from cliffs by noise disturbances; these impacts could be short term and minor.
Sensitive			
Fisheries habitat	Impacts as under SLT	Impacts as under SLT	Not applicable
Sensitive bat habitat	If oil and gas activities occurred in sensitive bat habitat, activities could disturb up to 100% of available habitat in some ranger districts. No disturbance would occur near cave entrances or winter hibernacula due to CSU; impacts short to long term depending on the activity and minor because only foraging habitat is likely to be lost, which would not affect the reproductive rate of populations.	Fragmentation impacts would be as described under SLT.	If oil and gas activities occurred in sensitive bat habitat, noise disturbances to sensitive bats would not occur under CSU because activities in the vicinity of caves or hibernacula would be restricted. Impacts limited to those from seismic activities, which would be temporary and minor to moderate because reproduction could be affected.

Resource Component		MI #1 Habitat loss	MI #2 Fragmentation	MI #3 Noise
Pygmy rabbit habitat		If oil and gas activities occurred in pygmy rabbit habitat under the CSU, colonies would be protected but up to 8% of available suitable habitat could be disturbed. Impacts short to long term depending on the activity and minor due to the relatively small amount of disturbance relative to the available habitat.	If oil and gas activities occurred in pygmy rabbit habitat, up to 8% of suitable habitat could be disturbed and these disturbances could reduce larger areas of suitable habitat such that the remaining portions may be unsuitable for pygmy rabbit. Impacts would be as described under SLT.	If oil and gas activities occurred in pygmy rabbit habitat some noise disturbances to pygmy rabbits could occur because activities would be allowed; however, activities around colonies would be restricted under CSU and noise disturbances that do occur would be unlikely to cause pygmy rabbits to leave their burrows. Only some individuals may be affected by noise; therefore, impacts would be minor, and short to long term depending on the activity.
Sage grouse brood rearing habitat		If oil and gas activities occurred in sage grouse brooding habitat under the CSU, less than 1% of available habitat could be disturbed outside of the TL. Impacts short to long term depending on the activity and minor due to the relatively small amount of disturbance relative to the available habitat.	If oil and gas activities occurred in sage grouse brooding habitat under the CSU, because less habitat could be disturbed, fragmentation impacts would be of lower intensity than under SLT. Impacts minor and short to long term depending on the activity.	If oil and gas activities occurred in sage grouse brooding habitat under the CSU, oil and gas activities would be restricted during the brooding period. Noise disturbances from oil and gas activities outside this TL (see Appendix D) would not disturb sage grouse during the brooding period. Impacts negligible.
Raptor habitat	Goshawk nest areas	Impacts in terms of habitat loss would be as described under SLT.	Fragmentation impacts would be as described under SLT.	If oil and gas activities occurred in raptor habitat noise disturbances outside the TL that is part of CSU for these resource components would not disturb nesting birds. Disturbance to nesting birds would be negligible.
	Goshawk PFA			
	Peregrine falcon rim			
	Bald eagle (winter)			
	Flammulated owl			
Sensitive plant habitat and locations		If oil and gas activities occurred in sensitive plant habitat under the CSU, plant populations that are essential to the persistence of the	Fragmentation impacts would be as described under SLT.	Not applicable

Resource Component	*MI #1 Habitat loss*	*MI #2 Fragmentation*	*MI #3 Noise*
	species would likely be avoided. Impacts would be minor to moderate and long term because plants may still be disturbed by oil and gas activities and small populations could be affected.		
Crucial and substantial big game winter range	If oil and gas activities occurred in big game winter range habitat under the CSU, less than 2,500 acres could be disturbed by oil and gas activities (which include a 0.25-mile radius around actual disturbance) outside of the TL. Impacts short to long term depending on the activity and negligible to minor due to the relatively small amount of disturbance relative to the available habitat.	Fragmentation impacts would be as described under SLT, although of slightly lesser intensity than under the TL because less habitat could be disturbed. Fragmentation impacts would be long term and moderate to major under CSU.	If oil and gas activities occurred in winter range habitat, noise disturbances outside the TL that is part of CSU for this resource component would not disturb big game during winter. Impacts negligible.

MEXICAN SPOTTED OWL PAC

A CSU leasing option in PACs would require a monitoring review prior to oil and gas activities, and NSO within the PAC, thus impacts to this species regarding *Measurement Indicator #1* (Acres of Habitat Disturbance), and *Measurement Indicator #3* (Number of Visits and Noise Levels) would be as described under NSO.

POTENTIAL MEXICAN SPOTTED OWL HABITAT

A CSU leasing option in "potential, unverified" habitat would require a site validation visit to assess habitat suitability, followed by owl surveys if the habitat is suitable. If owls are found during surveys, impacts to this species would be as described under NSO (for PACs, described above) as only seismic activities would be allowed.

CALIFORNIA CONDOR RIM HABITAT

A CSU leasing option in California condor rim habitat would require surveys on suitable habitat during the nesting season: February 1 to August 31. If active or occupied territories are found, an NSO or CSU leasing option (following leasing options for peregrine nests) would apply, depending on the alternative (see Table 4.6-2).

FISHERIES HABITAT

- *Measurement Indicator #5* INCREASES IN INVASIVE PLANTS

In some riparian areas, tamarisk (*Tamarix ramoissima*), whitetop (*Cardaria draba)*, and Russian olive (*Elaeagnus angustifolia*) are replacing native riparian vegetation such as willows (*Salix* spp.) and cottonwoods (*Populus* spp.). Invasive grasses and species such as rabbitbrush also replace native vegetation and create fewer shaded areas and less stable banks. As a result, higher water temperatures and higher rates of sedimentation characterize the invaded habitat, both of which make habitat less suitable for sensitive trout species that require cold, clear water to spawn. Indirect impacts from the spread of invasive species would be long term and major, because populations of sensitive trout would be affected by a degradation of aquatic habitat. Impacts under CSU would be of this magnitude because seismic activities are allowed (as under NSO) and have the greatest potential to spread invasive species (see Section 4.9). Adverse impacts from the spread of invasive plants in aquatic habitat could be long term because the functionality of this habitat would be diminished until the invasive species could be eradicated, which could take more than ten years.

SAGE GROUSE BROOD REARING AND PYGMY RABBIT HABITATS

- *Measurement Indicator #5* INCREASES IN INVASIVE PLANTS

Under CSU, oil and gas activities could spread noxious weeds outside of the sensitive period for controlled surface use. As under TL for sage grouse, the spread of invasive plants would reduce the amount of functional sagebrush habitat used by these species. Impacts from the spread of invasive plants within either sage grouse or pygmy rabbit habitat would be minor to moderate and long term for reasons described under NSO (for sage grouse).

BIG GAME WINTER RANGE

- *Measurement Indicator #4* ROAD DENSITY INCREASES

A substantial increase in road density could still occur under CSU and would have the same impacts as described under SLT (below) and TL (above): minor to moderate and long term.

- *Measurement Indicator #7* COMPLIANCE WITH UDWR POPULATION OBJECTIVES

Compliance with UDWR population objectives would be the same as described under SLT (below) and for TL (above): negligible.

4.6.4.6 Lease Notice (LN)

A lease notice provides more detailed information concerning existing limitations, regulations, or orders, or addresses special considerations. A LN does not impose new restrictions on oil and gas activities and would be attached to leases regardless of other leasing options.

A LN would be attached to any lease in the vicinity of a TEC species or its habitat, bald or golden eagle, or migratory bird habitat. This is the case for any lease within Dixie National Forest lands regardless of leasing options. The LN would list avoidance or minimization measures specific to each TEC species, bald or golden eagle, or migratory bird that may occur in the vicinity.

Endangered/Threatened/Candidate Species – In order to comply with the Endangered Species Act, surveys for TEC species would be conducted in any area leased for oil and gas exploration that occurs within or near suitable habitat. The Endangered Species Act prohibits destruction or "take" of a Listed species and significant modifications to its habitat. Surveys would be conducted and at the time operations are proposed in a specific location, a BA specific to that lease would be submitted to the USFWS disclosing the impacts to TEC species that may occur

as a result of oil and gas activities. Also at this time, consultation would occur between the Dixie National Forest and the USFWS, and a Biological Opinion rendered regarding mitigations necessary to offset incidental take that may occur as a result of lawful operations by the lease holder.

Bald eagle winter concentration areas and bald eagle nests – A lease notice (LN) would be attached to any lease that occurred in the vicinity of winter concentration areas for bald eagle or bald eagle nest. This is the case for any lease within Dixie National Forest lands regardless of leasing options. The purpose of the LN in this case is to ensure compliance with and to notify the operator of the Bald and Golden Eagle Protection Act, which prohibits take (including disturbance) of bald eagles, and the Migratory Bird Treaty Act, which prohibits take of migratory birds, including raptors. The LN would list avoidance or minimization measures specific to bald eagle nests that may occur in the vicinity. In order to comply with the Bald and Golden Eagle Protection Act, surveys for bald eagles would be conducted in any area leased for oil and gas exploration that occurs within or near suitable bald eagle habitat. The Bald and Golden Eagle Protection Act prohibits take, possession, and commerce of bald and golden eagles; so to comply with the Act, oil and gas activities would not be allowed in the vicinity of active nests or concentration areas.

Migratory Birds – A lease notice would be attached to any lease within the nesting season for migratory birds. This is the case for any lease within Dixie National Forest lands regardless of leasing options. The purpose of the LN in this case is to ensure compliance with the Migratory Bird Treaty Act. The lease notice would notify the operator of the Migratory Bird Treaty Act, which prohibits take (including disturbance) of migratory birds. Direction from the USFWS regarding migratory birds on USFS lands, however, states that activities occurring within migratory bird habitats should “minimize direct take of individual migratory birds when feasible.” Since conservation of populations is emphasized, a low level of incidental take is assumed. The LN would list avoidance or minimization measures specific to migratory bird nests that may occur in the vicinity. Mitigations would ultimately be determined by the Dixie National Forest biologist on a case-by-case basis if migratory bird nests are encountered.

4.6.4.7 Standard Lease Terms (SLT)

Impacts in this section are discussed assuming no restrictions or leasing options other than those listed on BLM Lease Form 3100-11 (SLT), the environmental protection measures that would be implemented by other laws and regulations as described in Section 1.8.5.2, and the BMPs listed in Section 4.6.4. As a minimum, all leases are governed by SLT and the impacts described in this section represent the maximum amount of disturbance that could occur as a result of oil and gas activities.

All leaseholders would be required to comply with the Endangered Species Act under SLT (see Lease Notice). Under Alternative E, SLT would apply directly to all special status species resource components as the default leasing option. All leaseholders would be required to comply with the Bald and Golden Eagle Protection Act and the Migratory Bird Treaty Act under SLT (see Lease Notice).

In general, disturbance to all fish and wildlife habitats, including special status species, would be “minimized” under SLT, avoiding “unreasonable or unnecessary disturbances during construction of pads, access, and other facilities, and during operations.” Disturbed terrestrial habitat would be reshaped and re-vegetated after use. Roads and drainage structures would be located to “minimize impacts on water quality,” such as “on benches upslope from streams,

lakes, ponds, riparian areas and floodplains" (Appendix C). A SPCC Plan would be approved before operations are authorized, and sediment control structures would be used at the base of fill slopes. Regarding potential noise disturbances to wildlife, operators would be required to "centralize production facilities, use telemetry to monitor wells, and delay non-essential maintenance activities in important wildlife habitat during critical seasons of use to reduce the number of vehicle trips to the sites and activity that could disturb or stress wildlife." In addition, all vehicles and other gasoline or diesel-powered equipment must be equipped with properly functioning mufflers (Appendix C).

Acres of habitat disturbance, fragmentation effects, number of visits and noise levels, road density changes, increases in invasive plants, impacts determinations, compliance with UDWR population objectives, compliance with fisheries classification system, and compliance with MIS Guidelines (*Measurement Indicators #1, #2, #3, #4, #5, #6, #7, #8,* and *#9* respectively) will be discussed by species, as appropriate. Impacts from acres of habitat disturbance (*Measurement Indicator #1*) are discussed with regard to all species. The amounts of habitat disturbance relative to available habitat of special status species (*Measurement Indicator #1*) are summarized in Table 4.6-6. Impacts determinations (*Measurement Indicator #6*) are listed with regard to all TEC species in Table 4.6-11 and Sensitive species in Table 4.6-12. Fragmentation effects (*Measurement Indicator #2*) are discussed for all species. Road density changes (*Measurement Indicator #4)* and compliance with UDWR population objectives (*Measurement Indicator #7)* are discussed under big game. Invasive plant increases (*Measurement Indicator #5)* apply to desert tortoises, Utah prairie dogs, pygmy rabbit, sage grouse, and Sensitive and MIS trout. Number of visits and noise levels (*Measurement Indicator #3)* are discussed for all TEC species (except fish) and big game, raptors, pygmy rabbit, bats, and sage grouse. Compliance with State of Utah fisheries classification system (*Measurement Indicator #8)* applies only to sensitive fish and compliance with MIS Guidelines (*Measurement Indicator #9)* applies only to MIS.

Measurement Indicators

ENDANGERED FISH

Direct impacts to woundfin and Virgin River chub are not expected because these species do not occur on the Dixie National Forest, and are not expected to occur in the future due to dewatered conditions (both natural and human-caused). Designated Critical Habitat for both species occurs 14 miles downstream from the Dixie National Forest (southeast of the Pine Valley Ranger District), however, and it could be indirectly affected by actions on the Forest that degrade water quality or reduce flows to the Virgin River via Ash Creek. Under SLT, the potential for water quality impacts exists because relatively few restrictions on the location and operation of oil and gas facilities are in place. Basic restrictions that protect water quality are part of SLT, but these restrictions are not site-specific or designed with special considerations for endangered fish downstream of the Dixie National Forest. There is the potential for long-term and minor to moderate impacts to woundfin and Virgin River chub under SLT as a result of water quality impacts caused by accidents associated with oil and gas activities, such as an oil spill. The potential for water-related impacts are described in more detail in Sections 4.5 (fish and wildlife) and 4.7 (water and watershed resources).

Table 4.6-6 Maximum Percentage of Possible Habitat Disturbance for Special Status Species

Resource	Pine Valley[1]	Cedar City[1]	Powell[1]	Escalante[1]
TEC				
California condor rim habitat	1%	1%	1%	<1%
Desert tortoise habitat	21%	--	--	--
Designated Critical desert tortoise habitat	100%	--	--	--
Utah prairie dog colonies	--	10%	2%	6%
Designated Critical Mexican spotted owl habitat	--	--	--	4%
Potential Mexican spotted owl habitat	2%	7%	9%	8%
Mexican spotted owl PAC	--	--	--	96%
Sensitive				
Fisheries habitat	19%	100%	100%	27%
Pygmy rabbit habitat	3%	6%	3%	8%
Sensitive bat habitat	63%	100%	100%	82%
Crucial & Substantial elk & mule deer winter range	2%	2%	1%	1%
Crucial elk and mule deer summer range	<1%	1%	<1%	4%
Goshawk nest areas (0.5-mile buffer)	27%	2%	4%	4%
Goshawk PFA	18%	2%	3%	3%
Sage grouse leks (1-mile buffer)	--	13%	16%	100%
Sage grouse brood rearing habitat	--	5%	2%	7%
Peregrine falcon nests (0.5-mile buffer)	--	22%	34%	--
Peregrine falcon rim habitat	1%	1%	1%	<1%
Bald eagle winter concentration areas	11%	9%	40%	41%
Flammulated owl habitat	1%	<1%	1%	<1%
Sensitive plant species and suitable habitat	4%	3%	2%	1%

[1] Assumes that the greatest amount of disturbance predicted in a ranger district occurred within each habitat area

CALIFORNIA CONDOR

Direct impacts to nesting California condors are not expected because condors are not known or expected to nest on the Dixie National Forest; however, roosting condors may be affected (see noise, below).

- *Measurement Indicator #1* ACRES OF HABITAT DISTURBANCE RELATIVE TO AVAILABLE HABITAT

Potential habitat for condors may be affected by oil and gas activities. Habitat losses would be negligible to minor and short term because there is a large amount of habitat on the Forest (Table 4.6-6) that could be utilized the following year if condors were displaced by any oil and gas disturbances. Because oil and gas activities are unlikely to occur on or near cliffs, rim habitat losses are unlikely. In the event that rim habitat was disturbed under SLT and an abundance of equally suitable habitat was not in the vicinity, impacts would be short term and minor as individual condors would be displaced to another area that may be less preferable for roosting.

- *Measurement Indicator #2* FRAGMENTATION OF HABITAT

Fragmentation impacts to California condor would be as described under TL and CSU: long term and minor due to the reduced size of potential territories within rim habitat.

- *Measurement Indicator #3* NUMBER OF VISITS AND NOISE LEVELS

Noise from oil and gas activities under SLT would adversely impact California condors if activities occurred within one mile of cliffs where condors were roosting. Disturbance of nests is unlikely because condors are not known or expected to nest on the Dixie National Forest. However, if nesting condors were present and disturbed by noise from oil and gas activities (i.e., drilling or traffic; see Section 4.11), displacement impacts would be short term and moderate if a nest were affected because a wild condor population could be affected by the disruption of one or a few individual nests. Roosting condors within one mile of oil and gas disturbances on the Dixie National Forest may also be displaced. Noise from seismic activities (blasting), drilling, and production setup and drilling are the most likely adverse impacts. If roosting condors were located in the vicinity of such noises and were displaced, impacts from displacement would be short term and minor.

DESERT TORTOISE

Associated roads would remove habitat in addition to increasing the potential for direct impacts (mortality) from vehicles. In general, impacts from disturbances that occurred during the inactive season (December 1 – February 15) would be less likely to result in take of desert tortoises

- *Measurement Indicator #1* ACRES OF HABITAT DISTURBANCE RELATIVE TO AVAILABLE HABITAT

Because desert tortoise habitat is limited within the Dixie National Forest, the impact of habitat losses could be relatively adverse. More than 20 percent of potential tortoise habitat, and all Designated Critical Habitat (Table 4.6-6), could potentially be lost if a production field were developed within tortoise habitat on the Pine Valley Ranger District. These impacts would be long term and could be moderate because Critical Habitat is the most important land on the Dixie National Forest for tortoises and the most likely to affect the species at a population level if lost. Impacts would not be major because the amount of Critical Habitat on the Dixie National Forest is less than one percent of the amount in the Upper Virgin River recovery unit. Impacts from seismic activities or exploration wells, in terms of habitat loss, would be short term and minor to moderate because seismic activities would result less complete vegetation removal than production wells.

- *Measurement Indicator #2* FRAGMENTATION OF HABITAT

Fragmentation is a major contributor to population declines in desert tortoises because tortoises have large home ranges (over 1.5 square miles of habitat per tortoise; USFWS 1994). When home ranges are fragmented, tortoise movements are restricted and tortoises are less able to self regulate population densities and find mates outside an isolated pool. This creates relatively small populations that are more susceptible to extinction. Impacts to desert tortoises from fragmentation created by roads could be long term and moderate to major because populations would be affected by changes in density (affecting freedom of movement, energy expenditures, and number of mate choices). Impacts could be short to long term even if disturbances did not lead to production well developments and were reclaimed within ten years.

- *Measurement Indicator #3* NUMBER OF VISITS AND NOISE LEVELS

Visits and noise associated with exploration and production activities may adversely impact desert tortoises. Visits alone would probably not disturb tortoises, but extended or repeated noise or vibrations could interfere with the incidental noises of approaching predators. Impacts

to desert tortoises from noise would be minor and short term. Impacts would be minor because although individual tortoises may be affected by noise, the reproduction of tortoises would not be affected.

- *Measurement Indicator #5* INCREASES IN INVASIVE PLANTS

Impacts to desert tortoise from invasive species would be similar to those described for seismic activities because these activities are the most likely to lead to a weed invasion (described under NSO, Section 4.6.4.3). Under SLT, the spread of invasive plants would also be possible in conjunction with any ground disturbance or overland travel associated with oil and gas development or production.

UTAH PRAIRIE DOG

Direct impacts to Utah prairie dogs from mortality due to construction of roads and other oil and gas facilities could be long term and moderate to major. These impacts are possible under SLT because although surveys would be conducted in suitable habitat, operators are not required to modify or move operations beyond 200 meters (656 feet). Colonies could still be impacted under the 200 meter allowance because most colonies are large and would extend beyond this distance. Direct impacts to Utah prairie dogs may occur under SLT because there are a large number of colonies on the Dixie National Forest.

- *Measurement Indicator #1* ACRES OF HABITAT DISTURBANCE RELATIVE TO AVAILABLE HABITAT

Less than 10 percent of the colony areas on the Dixie National Forest could be disturbed by a production development (Table 4.6-6); however, a loss of a colony area in this case would constitute serious impacts unlike habitat losses that can be weighed against available habitat.

- *Measurement Indicator #2* FRAGMENTATION OF HABITAT

If oil and gas activities occurred within prairie dog colony areas, the remaining areas of continuous suitable habitat for prairie dogs would be smaller. Utah prairie dog families generally occupy territories about one acre in size (Rodriguez 2008), thus oil and gas disturbances such as well pads and roads would reduce the size of potential territories if prairie dogs avoided the facilities and limit the distribution or number of prairie dogs that could occupy a habitat area, or that could disperse into a new area. Fragmentation impacts within colony areas would be long term and moderate.

- *Measurement Indicator #3* NUMBER OF VISITS AND NOISE LEVELS

Extended noise disturbances would adversely affect Utah prairie dogs by interrupting communications. Utah prairie dogs are highly social animals and noise from oil and gas activities in the vicinity may mask the sounds of approaching predators or other communications necessary for social interaction or survival. The reproduction of individuals would be affected by noise, and the reproductive rate of the population may also be adversely affected, thus impacts from visits and noise would be moderate to major, and could be long term if production wells were constructed.

- *Measurement Indicator #5* INCREASES IN INVASIVE PLANTS

Impacts to Utah prairie dog from invasive species would be similar to those described for seismic activities because these activities are the most likely to lead to a weed invasion (described under NSO; Section 4.6.4.3). Under SLT, the spread of invasive plants would also

be possible in conjunction with any ground disturbance or overland travel associated with oil and gas development or production.

MEXICAN SPOTTED OWL

A loss of canyon habitats would have more severe impacts than a loss of forest, relative to the habitat preferences of Mexican spotted owls in Utah.

- *Measurement Indicator #1* ACRES OF HABITAT DISTURBANCE RELATIVE TO AVAILABLE HABITAT

Under SLT, oil and gas activities would have a short term and minor impact on Mexican spotted owls if they occurred within potential, unverified habitat that was not a PAC or Designated Critical Habitat because these areas may be used for foraging or roosting and possibly nesting. Less than 10 percent of the "potential, unverified" habitat area (regardless of ranger district) would be disturbed if all activities occurred in this habitat.

Impacts within PACs on the Escalante Ranger District could be relatively more adverse because PACs are limited on the Dixie National Forest. Impacts within Designated Critical Habitat could be relatively more adverse because in general, Designated Critical Habitat has been deemed essential for a species' survival. Approximately 96 percent of PACs and 4 percent of Designated Critical Habitat on the Dixie National Forest would be disturbed if all activities occurred in one of these areas. Disturbances within PACs or Designated Critical Habitat could be long term and moderate to major.

- *Measurement Indicator #2* FRAGMENTATION OF HABITAT

If oil and gas activities occurred in suitable habitats for Mexican spotted owls, foraging areas for Mexican spotted owls would be reduced and territories may become less suitable. Individuals may be forced into less suitable territories that contain fewer prey species, more raptors competing for prey items, or a greater number of predatory raptors. Fragmentation impacts would be long term and moderate because reproduction and nesting success would be affected.

- *Measurement Indicator #3* NUMBER OF VISITS AND NOISE LEVELS

Adverse impacts to Mexican spotted owls could occur if noise disturbances were within 0.5 miles of a Mexican spotted owl from March 1 to August 31 (following Romin and Muck 2002). Owls have been detected during summer and winter months on the Dixie National Forest. Noise impacts from seismic activities (blasting), exploratory drilling, and production setup and drilling are the activities most likely to be adverse and cause displacement (see Section 4.10 for predicted number of visits per activity). These impacts would be minor to moderate and short term in "potential habitat" because the site would be suitable again (with regard to noise) within 10 years for foraging, roosting, and possibly nesting. The large amount of potential habitat on the Dixie National Forest means that owls are also likely to find equally suitable habitat nearby. Within PACs or Critical Habitat, it is more likely that owls would be nesting, and less likely that owls would find equivalent suitable habitat available on the Dixie National Forest; thus, displacement from noise impacts in PACs or Critical Habitat could be long term and moderate to major. Impacts could be major because a spotted owl population could be affected by one or a few nest failures.

WESTERN YELLOW-BILLED CUCKOO

- *Measurement Indicator #1* ACRES OF HABITAT DISTURBANCE RELATIVE TO AVAILABLE HABITAT

Under SLT, marginally suitable habitat for yellow-billed cuckoos on the Dixie National Forest would be lost if activities occurred in forested riparian habitat. These impacts could be minor and long term, because riparian habitats are not likely to recover from disturbances (see Section 4.7). Direct impacts to yellow-billed cuckoos are not expected because habitat is marginal and the species is not known to occur on the Dixie National Forest.

SENSITIVE TROUT

General impacts to fisheries resources are discussed in Section 4.5. Specific impacts to sensitive trout species are discussed below.

Under SLT, the ability to move operations by up to 200 meters (656 feet) should prevent most direct impacts to Colorado River and Bonneville cutthroat trout (sensitive trout). Habitat loss (*Measurement Indicator #1*) may occur by the construction of road crossings, by sedimentation inputs, or by other actions that cause adverse changes to water quality or habitat such that the aquatic habitat is no longer suitable. It is likely under SLT that roads crossings will have to be built on several streams, including streams with sensitive trout. Impacts from road crossings are described in Section 4.5. Given the preference of sensitive trout for high water quality, the impacts of these disturbances would be negligible to minor for short-term turbidity increases and moderate to major for any hazardous substance spills (see Section 4.5, and general water and watershed impacts in Section 4.7).

Regarding sedimentation, pool depth can be reduced by increases in sediment delivery to streams or decreases in stream flow. In a study of cutthroat trout in Colorado and New Mexico, Harrig and Fausch (2002) found that the presence of large deep pools was one of the most important habitat features. Further, Colorado River cutthroat trout in Wyoming are most associated with deep pools, particularly those formed by large woody debris (Young 1996). Sediment and reduced flows can also decrease the suitability of spawning gravels by limiting oxygen supply to developing eggs and increasing temperature. Overall, roads have the greatest potential to increase sediment levels in streams, with seismic exploration having the least potential. Although adherence to Best Management Practices (BMPs) should limit most impacts, impacts could still range from negligible to minor for small disturbances such as seismic activity and minor to major for road development. Impacts to aquatic species from sedimentation in streams are analyzed as part of Section 4.5. Impacts to watershed from sedimentation in streams are analyzed as part of Section 4.7.

- *Measurement Indicator #2* FRAGMENTATION OF HABITAT

Culverts and bridges can serve as migration barriers to upstream movement by sensitive trout. Fragmentation of watersheds reduces opportunities for mixing of genetic diversity, colonization of new habitat, access to areas that provide refuge for fish species in case of disturbances such as fire, and natural recolonization of populations following disturbance. While most culverts and bridges would be expected to be constructed to allow for fish passage, failure to do so could result in the decreased persistence of cutthroat trout populations. These impacts would be long term and could be major because the reproductive rate of populations would be affected if a substantial number of individuals were blocked from moving up- or downstream to spawn or seek out more suitable habitat.

- *Measurement Indicator #5* INCREASES IN INVASIVE PLANTS

Under SLT, the spread of invasive plants would be possible (particularly for seismic activities) in conjunction with any ground disturbance or overland travel associated with oil and gas

development or production. Invasive plants would diminish the value of fisheries (sensitive trout) habitat due to raised water temperatures and increased sedimentation, as described under CSU (Section 4.6.4.5). Indirect impacts would be long term and could be moderate for sensitive trout.

- *Measurement Indicator #8* STATE OF UTAH FISHERIES CLASSIFICATION SYSTEM

Oil and gas activities would not be expected to result in the reclassification of any streams containing Colorado River or Bonneville cutthroat trout.

PYGMY RABBIT

Direct impacts to pygmy rabbit are possible if occupied habitat (i.e., burrows and rabbits) were disturbed by oil and gas activities. Direct mortality impacts would be short to long term and minor to major depending on the number of individuals impacted.

- *Measurement Indicator #1* ACRES OF HABITAT DISTURBANCE RELATIVE TO AVAILABLE HABITAT

Under SLT, a loss of unoccupied suitable habitat would occur if areas within mapped habitat for pygmy rabbit (50,000 acres) were disturbed. Direct impacts to pygmy rabbit from a loss of suitable habitat under SLT would be short term and minor, due to the amount of habitat remaining (greater than 90%; Table 4.6-6), unless a production field was constructed in which case impacts would be long term and moderate to major.

- *Measurement Indicator #2* FRAGMENTATION OF HABITAT

Impacts to pygmy rabbits from fragmentation would be long term and moderate because pygmy rabbit populations are generally vulnerable to isolation and local extinction due to their short dispersal distances and slow pace of re-colonization in new habitats, thus populations could be affected. Increased competition or predation in the remaining habitat may also lead to reproductive effects.

- *Measurement Indicator #3* NUMBER OF VISITS AND NOISE LEVELS

Under SLT, site visits and noise from connected actions in the vicinity of burrows could interfere with rabbits' ability to detect predators and communicate. Noise from oil and gas activities would have population-level impacts if activities took place in a high-density area and many pygmy rabbits were exposed to predators or were forced into adjacent, less-suitable habitat. Population-level impacts under SLT would be moderate to major, and short to long term, depending on whether exploration (short term) or production activities (long term) occurred in suitable habitat.

- *Measurement Indicator #5* INCREASES IN INVASIVE PLANTS

Under SLT, the spread of invasive plants would be possible (particularly for seismic activities) in conjunction with any ground disturbance or overland travel associated with oil and gas exploration or production. Invasive plants would decrease the amount of functional sagebrush habitat for pygmy rabbit, such as if brome grasses replaced native sage, because brome grasses are not as nutritious a forage plant and cannot provide shelter or cover for pygmy rabbits and increases in the threat of catastrophic wildfire. Adverse impacts from the spread of invasive plants in pygmy rabbit habitat could be long term because the functionality of this habitat would be diminished until the invasive species could be eradicated, which could take

more than ten years. Impacts would be minor to moderate because individuals would be forced to seek out remaining areas of native sagebrush, impacts could affect reproductive rates or populations of pygmy rabbits if suitable habitat were available and predators were not abundant. The necessity of seeking out native plants for forage may eventually lead to the habitat no longer being suitable; these indirect impacts, if they occurred, would be moderate because populations and reproductive rates could be affected if many pygmy rabbits were forced to leave their burrows in search of more suitable habitat. Moderate impacts are unlikely but possible.

SENSITIVE BATS

Direct impacts to sensitive bats would occur if activities took place in close proximity to occupied cliffs or caves, such as in the Cedar City Ranger District. Disturbance to hibernacula inside caves would cause adverse impacts to bat populations (Rodriguez 2004a). See Section 4.8 (Soils and Geologic Hazards) for a more detailed discussion regarding impacts to cave resources. Destruction of hibernacula in the Cedar City Ranger District would be long term and moderate to major because the reproductive rate of the population could be affected if bats were forced to abandon the site when energy levels are low.

- *Measurement Indicator #1* ACRES OF HABITAT DISTURBANCE RELATIVE TO AVAILABLE HABITAT

Under SLT, a loss of suitable habitat would occur if areas within mapped habitat for sensitive bats (1,400 acres) were disturbed. Over 1,000 acres of additional mapped habitat occurs within wilderness areas (Pine Valley and Death Hollow) and would not be disturbed. Impacts to sensitive bat habitat from exploratory well pad and road construction would be short term and moderate to major within the Cedar City or Powell Ranger Districts, because a smaller amount of habitat is available (Table 4.6-6). Impacts to sensitive bat habitat in the Pine Valley or Escalante Ranger Districts would be minor because more habitat is available in these areas, thus more suitable habitat would be available to displaced individuals. Impacts would be long term if a production field were constructed in sensitive bat habitat.

- *Measurement Indicator #2* FRAGMENTATION OF HABITAT

If oil and gas activities occurred within sensitive bat habitat, foraging areas for bats would be reduced. Individuals may be forced into less suitable areas that contain fewer prey species or more bats, or a greater number of predators. Fragmentation impacts would be long term and moderate because reproduction could be affected by a reduced quality of forage.

- *Measurement Indicator #3* NUMBER OF VISITS AND NOISE LEVELS

Under SLT, noise disturbances from oil and gas activities could adversely affect sensitive bats if activities took place in the vicinity of active roosts or hibernacula. Noise disturbances could be moderate because a large number of individuals typically utilize a single roost or hibernacula site, and noise could cause a large number of individuals to abandon the area. Abandonment of a suitable roost could have population-level impacts on the reproductive rate if a number of individuals do not find alternate suitable habitat and do not successfully reproduce. Population-level impacts resulting from noise would be moderate to major and short term from exploratory well pad and road construction; impacts would be moderate to major and long term if a production field were constructed in sensitive bat habitat.

BIG GAME (MIS)

Under SLT, impacts to mule deer and elk from oil and gas activities would occur as a result of habitat loss (*Management Indicator #1*), fragmentation (*Measurement Indicator #2*), number of

visits and noise levels (*Measurement Indicator #3*), and road density increases (*Measurement Indicator #5*). Impacts would be more adverse if activities occurred within crucial/substantial value winter or summer ranges during the season of use.

- *Measurement Indicator #1* ACRES OF HABITAT DISTURBANCE RELATIVE TO AVAILABLE HABITAT

Oil and gas activities that occurred within big game seasonal ranges during the season of use would force animals into smaller areas of habitat that may be less suitable than what was disturbed and have a higher density of predators. Impacts on winter range during winter would have the most adverse impacts on big game because animals are most likely to be stressed during this period. When effective winter range sizes are reduced, increases in population density cause increased competition for forage and may reduce the likelihood of calf/fawn survival and general over-winter carrying capacity of the remaining winter range (WFGD 2004). Elk have been found to move up to two miles from disturbance on open winter range and avoid geophysical activities by moving to areas with more cover and also to return to disturbed areas after activities were completed (USFS 1995b). Deer may react similarly as elk and avoid areas where activities are occurring.

In general, impacts from the loss of crucial and substantial winter and summer ranges would be site specific with a number of variables influencing the outcome. Thus, disturbance from seismic and exploration drilling and other exploratory activities would be relatively small (Table 4.6-6) and impacts in terms of habitat loss would be minor. Because these activities would last less than ten years and habitats would be restored after use, impacts would be short term. Oil and gas development and production has a greater potential for habitat disturbance impacts because these activities would last for longer than ten years (i.e., long term) and would disturb more acres.

- *Measurement Indicator #2* FRAGMENTATION OF HABITAT

Oil and gas disturbances such as well pads and roads in big game habitats diminish the effectiveness of the remaining range that is available. Fragmentation disintegrates the value of the range complex and leads to decreased productivity on the range and ultimately a loss of carrying capacity for the elk or mule deer herds. If migration routes are altered, big game animals would be forced to expend large amounts of energy to seek out new movement patterns and functional corridors and would not be able to rely on migration memory to utilize the range effectively. Fragmentation impacts from oil and gas disturbances in crucial and substantial big game habitats would be long term and major because populations would be affected by changes in range effectiveness.

- *Measurement Indicator #3* NUMBER OF VISITS AND NOISE LEVELS

Avoidance and stress responses by wildlife extend the influence of each well pad, road, and facility up to a quarter mile radius for mule deer to more than a half mile for elk on open winter ranges (USFS 1995b). This increases the amount of habitat disturbed substantially beyond the actual footprints of oil and gas activities. When disturbed, elk will usually move to areas of dense cover away from roads and people (UDWR 2005a). Displacement during blasting (seismic activities) would be temporary because big game would return to the area after completion of the activity. Displacement during exploration activities would be short term and would be most severe during drilling; these impacts would be minor because only individuals would likely be affected, returning to the site following the disturbance. Displacement during the initial construction and drilling stages of production would cause the most severe noise-related

impacts. If such production activities occurred on crucial winter ranges during winter and a substantial number of individuals became stressed, impacts would be moderate because many individuals would be displaced from the largest possible area (of any oil and gas activity) and if most experience adverse reproductive effects, such noise disturbances could impact the population.

Elk with new calves and deer with new fawns are particularly sensitive to noise. Direct loss of calves and fawns could occur if substantial noise disturbance occurred during birthing periods (in the vicinity of mothers and calves or fawns) because displacement of mothers and calves/fawns into less favorable habitat could increase the likelihood of calf/fawn mortality from predation, accidents, or disease (USFS 1995b). Because the majority of the Dixie National Forest contains fawning habitat (total = 1,401,429 acres), displacement impacts to mule deer due to noise would be isolated and likely minor. Impacts to elk in the Escalante Ranger District would be relatively more severe because there is less suitable habitat; impacts to calves in this ranger district could be moderate if a large number of calves do not survive due to noise and related human disturbance impacts, thus impacting the population. Noise impacts to calving and fawning areas under SLT would be short term because high-level noise disturbances would not last for more than six months to a year (refer to Section 4.5).

- *Measurement Indicator #4* ROAD DENSITY INCREASES

Seismic operations, exploration wells, and new field development may all require new roads or upgrading of existing roads. Roads can both fragment habitat and put individual animals at higher mortality risk from increased collisions and/or hunting. Regarding fragmentation, any reduction in the ability of mule deer or elk to move about freely on winter ranges reduces their options for coping with a variety of environmental conditions (e.g., snow depth, predator avoidance, wind, etc.) and human disturbances (see general discussion of fragmentation impacts to wildlife in Section 4.5). Flexibility in movement across ranges is ultimately reflected in the survival and productivity of the population, in that populations can regulate density, and this enhances their ability to recover from population declines (WFGD 2004). In addition to fragmentation impacts, new road construction into previously isolated areas has the potential to impact big game species because roads would create increased public access and traffic, which may lead to intentional or unintentional harassment, poaching, and increased harvest levels by legal hunting. In this way the security of the habitat is diminished. Road kills may also increase. Elk may adjust to low levels of vehicular traffic, particularly if there are visual barriers between the elk and the road (USFS 1995b). Mule deer have been shown to avoid areas within 660 feet of roads, the level of avoidance being greater in shrub habitats than in conifer woodlands (USFS 1995b).

Less than one mile of new roads per well would be constructed. This could be below the threshold of two miles per square mile of habitat; however, these may be additive and increase the density well above this threshold in some areas. Increases in road density within the subwatersheds that have the greatest road density, such as in the Cedar City and Powell Ranger Districts, have the potential to substantially impact mule deer and elk. A substantial increase in road density, such as road development for a production field, within the subwatersheds that occur within crucial winter ranges for mule deer or elk, would have long-term impacts (impacts from roads reclaimed within ten years would be short term). Impacts to big game from roads would be moderate to major because (population-level) habitat effectiveness and security would be diminished.

- *Measurement Indicator #7* COMPLIANCE WITH UDWR POPULATION OBJECTIVES

Oil and gas disturbances would be in compliance with UDWR population objectives for mule deer and elk because a high level of mortality from oil and gas activities is not expected. A production field in the vicinity of crucial winter range has the potential to impact mule deer or elk on a population level if a large herd is displaced into less suitable habitat and experience adverse reproductive effects. Population-level impacts that reduce the population to levels substantially below objectives are not likely, however, because mule deer and elk populations on the Dixie National Forest are currently at (or above) objectives and are not considered to be at risk. Impacts under SLT with regard to population objectives would be neutral.

SENSITIVE RAPTORS

General impacts to raptors are described in Section 4.5

- *Measurement Indicator #1* ACRES OF HABITAT DISTURBANCE RELATIVE TO AVAILABLE HABITAT

Habitat impacts to flammulated owls (ponderosa pine, Douglas-fir) and peregrine falcon (rim habitat) would be short to long term, whether exploration (short term) or production activities (long term) occurred in suitable habitat, and on vegetation type (grasses and some shrubs would generally be short term impacts; forests would be long term impacts). Impacts would be minor to moderate (Table 4.6-6). Much of the goshawk habitat in the Pine Valley Ranger District is located either in recreation areas, conifer stringers on the North and South range of Pine Valley Mountain, campgrounds or just off of the wilderness boundary where little to no oil and gas disturbance will occur, so in this ranger district, impacts to goshawk would be negligible to minor.

- *Measurement Indicator #2* FRAGMENTATION OF HABITAT

If oil and gas activities occurred within a 0.5-1 mile radius of nesting habitat for raptors, foraging areas would be reduced and previously suitable home ranges may become less suitable. Raptors may be forced into areas that contain fewer prey species or a different community of other raptors that may be more competitive for prey items or that may prey directly on sensitive raptors species. Fragmentation impacts would be long term and moderate to major because reproduction and nesting success would be affected by these changes.

- *Measurement Indicator #3* NUMBER OF VISITS AND NOISE LEVELS

Noise impacts to sensitive raptors would be similar to those described for raptors in Section 4.5. Impacts from seismic activities and exploratory drilling under SLT are likely to be temporary, but could be moderate, depending on the species and the number of individuals affected. Extended noise disturbances could have moderate to major impacts if birds were nesting; these would be population-level impacts if enough individuals were affected. Influence buffers for sensitive raptors are listed below, following Romin and Muck (2002) and the Dixie LRMP Goshawk Amendment for nesting raptors. Within these dates and buffer zones, noise impacts could be moderate. Moderate noise impacts leading to nest impacts would be short term because raptors are likely to use a different nesting location the following year.

Table 4.6-7 Respective Buffer Zones and Sensitive Periods for Sensitive Raptors that May Correlate to Adverse Noise Impacts

Species	Zone of influence (miles)	Sensitive period	Activity
Bald eagle	1.0	1 Dec – 15 Feb	nesting
Peregrine falcon	1.0	1 Feb – 31 Aug	nesting
Northern goshawk	0.5	1 Mar – 30 Sept	nesting
Flammulated owl	0.25	1 Apr – 30 Sept	nesting

Information for all species taken from Romin and Muck (2002) and the Dixie National Forest Plan Goshawk Amendment.

GREATER SAGE GROUSE

Effects of oil and gas developments on sage grouse populations are not well known, but appear to adversely impact sage grouse in the short term (Connelly et al. 2000). The most adverse potential impact under SLT is disturbance of leks, and any oil and gas activities that occurred within two miles of a lek may also disturb sage grouse nesting and brooding activities (80% of all nests occur within this radius; USFS 1995b). A loss of leks or active nests could limit breeding opportunities and recruitment, thus leading to declines in sage grouse populations.

- *Measurement Indicator #1* ACRES OF HABITAT DISTURBANCE RELATIVE TO AVAILABLE HABITAT

A loss of summer brooding habitat would have a minor impact on sage grouse because less than 10 percent of the habitat would be disturbed under a worst-case scenario (Table 4.6-6); a loss of leks would have a moderate to major impact because these areas are limited (Table 4.6-6) and would be long term because sage grouse would probably not return to reclaimed leks.

- *Measurement Indicator #2* FRAGMENTATION OF HABITAT

Impacts of fragmentation on wildlife are discussed in Section 4.5. Construction of roads and linear facilities within suitable sage grouse habitat would result in fragmentation. Because many sage grouse populations are migratory and populations that are non-migratory utilize large home ranges (Connelly et al. 2000), linear disturbances that isolate portions of habitat disrupt seasonal movements and prevent sage grouse from utilizing all parts of their habitat. Areas that currently contain a substantial number of roads, on the Cedar City and Powell Ranger Districts, are the most vulnerable to fragmentation impacts. Fragmentation can lead to increased mortality as population pressures would increase within condensed areas. Fragmentation impacts from oil and gas disturbance in these areas would be short to long term, depending on whether exploration activities led to development and production, and moderate to major because population-level impacts could result if large numbers of individuals are restricted in their movements or number of mate choices. In addition, increased mortality rates would directly reduce population sizes.

- *Measurement Indicator #3* NUMBER OF VISITS AND NOISE LEVELS

Noise from seismic activities, exploration drilling, and production field development would displace sage grouse from the vicinity of operations. Sage grouse may return to a disturbed site after oil development activities have ceased, but may not attain pre-disturbance population levels. In general, disturbed leks and breeding areas will not be as productive as undisturbed sites (Connelly 2000) and many studies have documented lek abandonment and lower lek attendance by males and yearling females caused by oil and gas activities (Beck 2006). Noise impacts from oil and gas activities under SLT in the vicinity of leks (within one mile) or brooding

areas (between 1 May to 15 July) could be moderate or major and long term because lek or habitat abandonment is more likely at this distance and abandonment would be a population-level impact. Noise impacts only in brooding habitat that did not affect actual leks could be moderate to major if a substantial number of sage grouse were displaced from 1 May to 15 July because the reproductive rate of the population could be affected during this time.

- *Measurement Indicator #5* INCREASES IN INVASIVE PLANTS

Under SLT, the spread of invasive plants would be possible (particularly for seismic activities) in conjunction with any ground disturbance or overland travel associated with oil and gas development or production. Invasive plants would diminish the value of sage grouse habitat (sagebrush) because species such as brome grasses and other annuals are not as nutritious a forage plant and cannot provide shelter or cover for sage grouse as effectively as sagebrush. Adverse impacts from the spread of invasive plants in sage grouse brooding habitat could be long term because the functionality of this habitat would be diminished until the invasive species could be eradicated, which could take more than ten years (i.e., long term), as described for pygmy rabbit. Impacts would be moderate to major because adults and juveniles would be forced to move to other areas, could be more vulnerable to predators, and areas that they move into may be less suitable habitat due to fires, urbanization, roads or trails, or relatively poor sagebrush health.

THREE-TOED WOODPECKER

- *Measurement Indicator #1* ACRES OF HABITAT DISTURBANCE RELATIVE TO AVAILABLE HABITAT

Impacts to three-toed woodpeckers from habitat loss would be minor and long term due to the species' preference for mature stands containing snags and downed wood that take many years to regenerate. Spruce fir forest habitat may be lost (1-2%; see Section 4.9 – Vegetation) on the Cedar City, Powell, or Escalante Ranger Districts as a result of oil and gas activities. Impacts would be minor due to the small amount of habitat that could be disturbed relative to what is available on the Dixie National Forest.

SENSITIVE PLANTS

Under SLT, oil and gas activities that occurred in sensitive plant occurrence areas would disturb sensitive plants unless the 200-meter allowance prevented occupation of these areas. Under SLT, operations could be physically moved 200 meters (656 feet). However, a loss of sensitive plant populations or suitable habitat (see *Measurement Indicator #1*) would still be likely under these allowances. Direct impacts to sensitive plants would be long term and moderate because entire populations could be affected if a large number of individual plants cannot be avoided under SLT.

- *Measurement Indicator #1* ACRES OF HABITAT DISTURBANCE RELATIVE TO AVAILABLE HABITAT

Impacts from a loss of suitable habitat would be long term and moderate, as for direct impacts to populations, especially in the case of plants growing on unstable substrates that cannot be reclaimed. Bristlecone pine/rock garden areas are one example of a habitat that is not easily reclaimed. Direct disturbance (loss) of bristlecone pine areas would constitute long term and moderate impacts to sensitive plants that grow in these areas, including Navajo Lake milkvetch, Cedar Breaks biscuitroot, Podunk groundsel, and rock tansy. Bristlecone pine trees are a central part of rock garden communities and take 50 years to mature before reproducing. For this reason, disturbing these long-lived species sets back the succession process in the

community for at least this period of time or indefinitely, if trees do not reestablish. Trees may not reestablish because in addition to slow growth, bristlecone pine trees exhibit poor competitive abilities (Schoettle 2004).

- *Measurement Indicator #2* FRAGMENTATION OF HABITAT

Oil and gas disturbances within habitat for sensitive plants would lead to increased isolation of sensitive plant populations and for some species, may further reduce the likelihood of genetic diversity being introduced into populations that contain few individuals. Small population sizes increase the likelihood of local extinction and ultimately reduce the number of populations within a species and the likelihood that the species can persist under changing conditions. Fragmentation that leads to further isolation of sensitive plant populations would have long term and moderate impacts on sensitive plants.

MIS SPECIES

- *Measurement Indicator #1* ACRES OF HABITAT DISTURBANCE RELATIVE TO AVAILABLE HABITAT

Under SLT, oil and gas activities would result in habitat losses for MIS. Within most major vegetation communities on the Dixie National Forest, oil and gas activities would not disturb more than five percent of the habitat, assuming all exploration and a production field occurred within one habitat type (and within one ranger district; Table 4.9.3 – Percentage habitat disturbance table in Section 4.9, Vegetation). As a result, habitat loss would be minor and short to long term, depending on the activity (exploration = short term; production = long term) and vegetation type (grasses and some shrubs = short term; forests = long term), for terrestrial MIS that depend on major vegetation types, including mule deer, elk, turkey, goshawk, and flicker. Exceptions may include mature forest areas that are more limited than forested vegetation types as a whole, and take longer to replace; old growth habitat losses would be moderate and long term. Regarding habitat losses for aquatic species, aquatic habitat impacts are described in detail in Sections 4.5 (Fisheries) and 4.7 (Water and Watershed Resources). Oil and gas activities that occurred near or within aquatic habitats under SLT may decrease habitat and the effectiveness of habitat because the allowances to protect waters under SLT are relatively limited. Impacts to aquatic MIS from oil and gas activities under SLT would have the potential to be long term and minor to major (see Section 4.5 for more extended justification).

- *Measurement Indicator #2* FRAGMENTATION OF HABITAT

Disturbance of MIS habitats would generally reduce the effectiveness of remaining undisturbed MIS habitats because remaining habitats may not provide the same quality of resource base, including prey species and forage, and may not provide the same level of isolation from human disturbances. Fragmentation impacts in MIS habitats would be long term and minor to moderate depending on the species and amount of continuous undisturbed habitat.

- *Measurement Indicator #5* INCREASES IN INVASIVE PLANTS

In some riparian areas, tamarisk, whitetop, and Russian olive are replacing native riparian vegetation such as willows and cottonwoods. Invasive grasses and species such as rabbitbrush also replace native vegetation and create fewer shaded areas and less stable banks. As a result, higher water temperatures and higher rates of sedimentation characterize the habitat, both of which degrade aquatic habitats and specifically make habitat less suitable for sensitive trout species that require cold, clear water to spawn. Impacts from the spread of invasive species would be long term and minor to major, depending on the fish species, number of

individuals that are not able to tolerate a slightly higher water temperature and reduced shade levels, and are forced to seek out more suitable habitat. If a substantial number of individuals expended energy to seek out alternate habitat then the reproductive rate of the population could be affected and impacts would be moderate to major.

- *Measurement Indicator #9* COMPLIANCE WITH MIS GUIDELINES (USFS 1986)

The Guidelines for MIS (Management Area 4B – Wildlife and Fish Resource Management; USFS 1986:4-84) and the likelihood of compliance with the Guideline under SLT are summarized in Table 4.6-8.

Table 4.6-8 Fish and Resource Management Guidelines for MIS (USFS 1986, including various amendments) and Compliance Under SLT

Guideline	Terrestrial species: big game, goshawk, wild turkey, and flicker	Aquatic species: trout and macroinvertebrates
Maintain habitat capability at a level at least 80% of potential capability for all emphasized species.	MAY NOT COMPLY Production field development under SLT within mature aspen or mature conifer communities may not comply with the Guideline (all terrestrial species).	MAY NOT COMPLY Oil and gas activities under SLT have the potential to degrade aquatic habitat (see TR 4.0, 7.0, and 8.0) thus any large-scale disturbances within 300 feet of streams may not comply with the Guideline.
Maintain habitat needed to support the coordinated population goals	WOULD COMPLY Population goals are being met for MIS on the Dixie National Forest; terrestrial species have generally increased in the past few years due to increased precipitation. Levels of mortality that would affect population numbers are not expected. However, due to highly variable population numbers, population goals could fluctuate and not comply.	MAY NOT COMPLY MIS fisheries and macroinvertebrates are stable but currently below population goals due to recent fires that have degraded habitat. Any further impacts to streams from oil and gas activities may not comply with the Guideline.
Maintain hiding cover (75% of all road edges) that hides 90% of an adult deer or elk from 200 feet away.	WOULD COMPLY Oil and gas activities are unlikely to remove a substantial amount of vegetation along existing roads, thus 75% of hiding cover would likely be maintained.	Not applicable
In forested habitats, maintain 50% minimum hiding cover for deer and elk that is well distributed over the unit, and maintain 30% thermal cover in the unit.	WOULD COMPLY Oil and gas activities would not disturb a substantial portion of cover in any one area. At the ranger district level, these proportions of hiding and thermal cover would be maintained even if the maximum amount of disturbance from a production field occurred.	Not applicable

4.6.5 Impacts by Alternative

The degree to which the connected action impacts (Section 4.6.4) would differ by alternative is discussed in this section. Each alternative involves a unique set of leasing options for each resource component, which would restrict the locations and the nature of oil and gas activities that are allowed wherever these resources occur.

Table 4.6-9 shows the acres of each resource component for recreation under each leasing option, by alternative. Table 4.6-9 incorporates the amount of overlap with more restrictive leasing options (assigned to other resources) in addition to the leasing option assigned directly to each resource component. Alternatives D1, D2, E1, and E2 represent the dual analysis of Alternatives D and E. D1 and E1 represent the acres available with NSO in all IRAs. D2 and E2 represent the acres with leasing allowed in IRAs under a less restrictive leasing option. A more detailed table that separates the acreage by resource component and ranger district will be available in Appendix B.

In this section, impacts are generally discussed at the Forest-wide level and not by ranger district. This is done to avoid repetition and facilitate the comparison of impacts across alternatives. However, any pronounced differences in the impacts to a resource component between ranger districts are highlighted (see Table 4.6-9).

Impacts by *Measurement Indicators* are summarized in Table 4.6-10 (*Measurement Indicators #1 - #5 and #7*) and Tables 4.6-11 and 4.6-12 (*Measurement Indicator #6)*. General differences between alternatives regarding special status species are outlined in the text below. *Measurement indicator #8* is not discussed in this section or in Table 4.6-10 because the impacts in terms of the fisheries classification system would be the same under all alternatives. Impacts with regard to this *Measurement Indicator* would be negligible. *Measurement indicator #9* is discussed in the previous section and only applies to MIS species.

Table 4.6-9 Acreage of Resource Components under each Leasing Option, by Alternative

Resource Component	Leasing option[3]	Alternative[1, 2]						
		A	B	C	D1	D2	E1	E2
California condor rim habitat (30% in IRAs)	NA	66,475	66,475	66,475	66,475	66,475	66,475	66,475
	NL	374,799	256,588	2,574				
	NSO		105,886	324,722	141,670	16,283	132,638	
	TL				233,731 2/1-8/31	356,148 2/1-8/31		
	CSU		12,324	47,701				
	SLT			6			242,161	374,799
Desert tortoise habitat (73% in IRAs)	NA							
	NL	1,774	1,521					
	NSO		254	1,774	1,290	144	1,281	
	TL				485 2/16-11/30	1,631 2/16-11/30		
	CSU							
	SLT						493	1,774
Designated critical desert tortoise habitat (99% in IRAs)	NA							
	NL	79						
	NSO		79	79	79	79	79	
	TL							
	CSU							
	SLT							79

Resource Component	Leasing option[3]	Alternative[1, 2]						
		A	B	C	D1	D2	E1	E2
Utah prairie dog colonies (2% in IRAs)	NA							
	NL	49,628	36,803					
	NSO		12,825	49,628	49,628	49,628	753	
	TL							
	CSU							
	SLT						48,875	49,628
Designated critical Mexican spotted owl habitat (66% in IRAs)	NA							
	NL	18,048	18,048					
	NSO			16,653	12,014	929	11,923	
	TL							
	CSU			1,394	5,861	16,947		
	SLT				172	172	6,125	18,048
Potential (unverified) Mexican spotted owl habitat (8% in IRAs)	NA	23,815	23,815	23,815	23,815	23,815	23,815	23,815
	NL	23,723	13,460	919				
	NSO		10,244	21,862	4,974	2,192	3,834	
	TL							
	CSU		6	943	18,750	21,532		
	SLT						19,890	23,723
Mexican spotted owl PAC (99% in IRAs)	NA							
	NL	732	732					
	NSO			732	731	72	730	
	TL							
	CSU				2	660		
	SLT						2	732
Fisheries habitat	NA	628	1,076[4]	628	628	628	628	628
	NL	4,606	7,547[4]	420				
	NSO			4,186	1,722	450	1,404	
	TL							
	CSU				2,885	4,156		
	SLT						3,202	4,606
Pygmy rabbit habitat	NA	177	177	177	177	177	177	177
	NL	50,573	35,794	308				
	NSO		14,779	34,723	13,735	8,822	5,474	
	TL							
	CSU			15,543	36,838	41,752		
	SLT						45,099	50,573
Sensitive bat habitat	NA	1,065	1,065	1,065	1,065	1,065	1,065	1,065
	NL	1,398	1,143	57				
	NSO		242	1,324	1,243	989	739	
	TL							
	CSU			4	142	396		
	SLT						646	1,398
Goshawk nest areas[5]	NA	1,052	1,052	1,052	207	207	1,052	1,052
	NL	60,781	41,519	85				
	NSO		19,259	60,696	5,379	2,170	11,664	
	TL							
	CSU				13,693	16,902		
	SLT						49,117	60,781

Resource Component	Leasing option[3]	Alternative[1, 2]						
		A	B	C	D1	D2	E1	E2
Goshawk PFA	NA	1,717	1,717	1,717	1,717	1,717	1,717	1,717
	NL	82,691	57,807	40				
	NSO		23,700	74,074	26,418	9,706	18,435	
	TL							
	CSU		1,112	8,577	56,264	72,976		
	SLT				9	9	64,256	82,691
Sage grouse leks	NA							
	NL	8,383	8,383					
	NSO			8,383	8,383	8,383	1,529	
	TL							
	CSU							
	SLT						6,854	8,383
Sage grouse brood rearing and lekking habitat	NA							
	NL	55,029	55,029					
	NSO			40,570	22,957	20,848	2,109	
	TL				32,072 5/1-7/1	34,181 5/1-7/1		
	CSU			14,459				
	SLT						52,920	55,029
Peregrine falcon nest areas	NA	613	613	613	613	613	613	613
	NL	4,026	2,209	2				
	NSO		1,817	4,024	822	302	527	
	TL							
	CSU				3,204	3,724		
	SLT						3,499	4,026
Peregrine falcon rim habitat	NA	66,475	66,475	66,475	66,475	66,475	66,475	66,475
	NL	375,005	256,588	2,574				
	NSO		105,886	324,722	141,700	16,283	132,638	
	TL				233,305 2/1-8/31	358,723 2/1-8/31		
	CSU		12,324	47,701				
	SLT			6			242,161	375,005
Bald eagle winter concentration areas	NA							
	NL	11,400	7,859					
	NSO		3,405	11,400	5,091	3,873	1,226	
	TL							
	CSU				6,309	7,527		
	SLT						10,173	11,400
Flammulated owl habitat	NA	43,306	43,306	43,306	43,306	43,306	43,306	43,306
	NL	377,359	244,188	2,380				
	NSO		133,034	288,264	86,415	38,716	55,037	
	TL							
	CSU			86,716	290,946	338,645		
	SLT						322,322	377,359
Sensitive plant species habitat and occurrences	NA	14,711	14,711	14,711	14,711	14,711	14,711	14,711
	NL	110,293	70,669	2,018				
	NSO		39,624	90,184	40,478	18,050	25,138	
	TL							
	CSU			18,094	68,315	90,742		
	SLT				1,504	1,504	85,159	110,293

Resource Component	Leasing option[3]	Alternative[1, 2]						
		A	B	C	D1	D2	E1	E2
Big game winter range	NA	552	552	552	552	552	552	552
	NL	169,915	169,915	90				
	NSO			134,766	66,245	16,930	49,776	
	TL				103,671 12/1-4/15	152,986 12/1-4/15		
	CSU			35,060				
	SLT						120,139	169,915
Big game summer range	NA	874	874	874	874	874	874	874
	NL	402,343	402,343	3,397				
	NSO			339,745	198,330	36,653	171,169	
	TL			59,202 5/15-7/5	204,015 5/15-7/5	365,692 5/15-7/5		
	CSU							
	SLT						231,174	402,343

[1] Small discrepancies in the acreage presented for each alternative are due to the fact that the GIS database has limitations when applied over an extremely large area that result in an inability to calculate acreages that match exactly between alternatives. A more detailed table that separates the acreage by resource component and ranger district will be available in Appendix B.
[2] Alternatives D1, D2, E1, and E2 represent the dual analysis of Alternatives D and E. D1 and E1 represent the acres available with NSO in all IRAs. D2 and E2 represent the acres with leasing allowed in IRAs under a less restrictive leasing option.
[3] Areas not legally available (NA) for leasing (see Section 1.5.2) are included in the Table to provide context to the analysis.
[4] Includes a 500-foot buffer under Alternative B; all other buffers for fisheries habitat are 300 feet.
[5] Alternative D for goshawk nests is smaller buffer area and therefore less total acreage.

4.6.5.1 Alternative A

There would be no oil and gas activities on the Dixie National Forest within areas not currently leased. Alternative A would continue present management activities as pertaining to oil and gas leasing. The Forest Supervisor under this alternative would not make any new leasing decisions and no new oil and gas leasing would be allowed on the Dixie National Forest. Current operations, including the Upper Valley oil field on the Escalante Ranger District (19 wells, including nine water-injector wells) would continue (USFS 2006g). In total, there are 13,454 acres of existing leases on the Dixie National Forest. Existing leases will expire and the potential number of wells that could be drilled on the Dixie National Forest would decrease over time. Under Alternative A, adverse impacts to special status species and habitats would be negligible.

4.6.5.2 Alternative B

Chapter 2 of the EIS describes how many acres of the Dixie National Forest would fall under each leasing option under Alternative B (Table 2.5-2) and where those acres are located (Figure 2.5-2 (a-d)). Approximately 65 percent of the Dixie National Forest would not be available for lease under Alternative B; of the leasable lands, 20 percent would be NSO and 5 percent would be CSU. As under all alternatives, 5 percent of the Dixie National Forest is legally unavailable for leasing (NA).

All TEC species and habitat would be covered by NSO or NL leasing options under Alternative B, with the exception of California condor rim habitat (3% CSU). There may be fragmentation impacts in rim habitat for California condor and peregrine falcon, as well as within goshawk PFAs under Alternative B. Noise impacts to condor from seismic activities could be minor; habitat losses would be negligible. Noise impacts from seismic activities would be negligible or minor for desert tortoises and Utah prairie dogs and could be moderate in Mexican spotted owl "potential" habitat. Habitat impacts to desert tortoise would be negligible in Critical Habitat (NL),

but may occur in non-Critical Habitat. Impacts from an invasive plant invasion into desert tortoise habitat or prairie dog colony areas would be long term and could be major. Habitat impacts to Utah prairie dogs could be minor under Alternative B because 25 percent of the colony buffer area could be disturbed. Impacts to Endangered fish under Alternative B would be negligible because all streams on the forest would be NL.

Impacts to Sensitive species and MIS under Alternative B could occur from seismic activities, as most resource components are covered at least partially by NSO leasing options. Many resource components are covered completely by NL for other resources under Alternative B, including trout habitat, sage grouse leks, sage grouse brooding habitat, and big game ranges. No impacts would occur to those resource components under Alternative B. Sensitive raptors may be disturbed by seismic noise and impacts could be moderate. Pygmy rabbit and sensitive bat habitat would also have a slight potential for impacts due to the risk of invasive plant proliferation or noise.

Under Alternative B, connected actions would have No Effect on Virgin River chub, woundfin, and yellow-billed cuckoos. Due to potential noise impacts, habitat losses, or weed invasions related to seismic activities, connected actions May Affect but would Not Likely Adversely Affect Mexican spotted owls, California condors (in the Pine Valley Ranger District), Utah prairie dogs, and desert tortoises (Table 4.6-11). There would be "No Impact" to sensitive fishes or sage grouse. For all other Sensitive species, oil and gas activities may affect individuals but would not affect population persistence ("May Impact;" *Measurement Indicator #6*; Table 4.6-12). Although direct disturbance of sensitive raptor nests or sensitive bat roosts, for example, are not likely under Alternative B, foraging and other suitable habitat (that which is mapped in the analysis and that which is not) could be disturbed by oil and gas developments. For most Sensitive species, therefore, oil and gas activities "May Impact" individuals.

4.6.5.3 Alternative C

Alternative C has less restrictive leasing options than Alternative B and more restrictive options than Alternative D. Under Alternative C, IRAs would fall under a NSO leasing option regardless of whether the 2001 Roadless Area Conservation Rule is in place or not. Chapter 2 of this EIS describes how many acres of the Dixie National Forest would fall under each leasing option under Alternative C (Table 2.5-3) and where those acres are located (Figure 2.5-3 (a-d)). Under Alternative C, 73 percent of the Dixie National Forest would be NSO. Five percent would be NA. In addition, linear features (e.g., roads, pipelines) would be allowed as perpendicular stream crossings under NSO.

Impacts to California condors would be as described under Alternative B. No nesting condors would be displaced due to leasing options (CSU). Noise impacts to spotted owls could be short term and moderate in PACs or Critical Habitat due to NSO (seismic). Impacts to desert tortoises (not Critical Habitat) and Utah prairie dogs could be major under Alternative C due to NSO (seismic), as under Alternative B. Unlike Alternative B, disturbances from seismic (NSO) could have a measurable impact on Mexican spotted owls in PACs or Critical Habitat. Impacts to Virgin River chub and woundfin would be negligible because NSO in streams, even allowing crossings, is not likely to lead to the type of hazardous substances spill that could affect fish miles downstream of the forest.

Alternative C with NSO in IRAs would have more adverse impacts to sensitive species than under Alternative B. Under Alternative C, there would be potentially moderate or major impacts to Mexican spotted owl (habitat fragmentation), pygmy rabbit (habitat fragmentation), big game

(habitat fragmentation and increased road density), sage grouse leks (habitat loss and risk of invasive plant infestation), and sensitive plants (habitat fragmentation). Under Alternative C, connected actions would have No Effect on Virgin River chub or woundfin. Due to potential disturbances of habitat or noise that may occur under CSU or TL leasing options, connected actions May Affect but would Not Likely Adversely Affect California condors (Pine Valley Ranger District), desert tortoises, Utah prairie dogs, Mexican spotted owls, and yellow-billed cuckoos. Connected actions are Not Likely to Jeopardize the continued existence of the experimental population of California condors (Table 4.6-11). "May Impact" would apply to all Sensitive species (*Measurement Indicator #6*; Table 4.6-12).

4.6.5.4 Alternative D1 (NSO in IRAs)

Alternative D has less restrictive leasing options than Alternative C and more restrictive options than Alternative E. Chapter 2 of this EIS describes how many acres of the Dixie National Forest would fall under each leasing option under Alternative D (Table 2.5-4) and where those acres are located (Figures 2.5-4 (a-d)). Under Alternative D1 (NSO in IRAs), 33 percent of the Dixie National Forest would be NSO. Five percent would be NA.

Impacts to TEC species would be similar under Alternative D1 to those under Alternative C, with the exception of habitat fragmentation impacts to desert tortoise (impacts would be more adverse under Alternative D1). Impacts to some sensitive species from habitat losses or fragmentation would be more adverse under Alternative D1 than under Alternative C. These sensitive species include pygmy rabbit, sensitive bats, and sensitive plant species.

Due to the large proportion of habitat within IRAs, impacts to desert tortoise and Mexican spotted owl would be measurably lower under Alternative D1 than under Alternative D2 (CSU in IRAs). Impacts to other special status species under Alternative D1 would not be measurably different than under Alternative D2 (below) in intensity or duration. Sensitive bat habitat and big game winter range are mostly within IRAs; however, potential impacts under both Alternative D1 and Alternative D2 would be minor and would not differ.

4.6.5.5 Alternative D2 (CSU in IRAs)

Under Alternative D2 (CSU in IRAs), 8 percent of the Dixie National Forest would be NSO. Five percent would be NA.

In general, a substantial portion of TEC species habitat would carry CSU (Mexican spotted owls) or TL (California condors, desert tortoise) leasing options that are designed to avoid direct "take" but could still lead to habitat losses, fragmentation, impacts from noise, or weed invasions under this alternative. Impacts for all TEC species would be less adverse than under Alternative E, but moderate or major impacts to some species are possible. These species include desert tortoise (habitat disturbance is possible outside the TL and invasive species impacts could be major, as under Alternative B), Utah prairie dog (invasive species impacts could be major, as under Alternative B), and Mexican spotted owl (habitat disturbance is possible under CSU if owls are not present). Impacts to other TEC species would be minor under this alternative.

Alternative D2 could have impacts on most Sensitive species and MIS. Although CSU or TLs would be in place, the oil and gas activities would still occur and would cause some impacts. Several resource components with moderate or major associated impacts under SLT, including most Sensitive species, would likely have fewer associated impacts under Alternative D2, including Endangered fish species, Utah prairie dog, MIS and sensitive trout, pygmy rabbit, and sage grouse.

Under Alternative D2, connected actions May Affect but would Not Likely Adversely Affect all TEC species (with the exception of Endangered fishes) due to potential disturbances of habitat (all species), potential noise disturbances (desert tortoises, Utah prairie dogs, California condors in the Pine Valley Ranger District and Mexican spotted owls), fragmentation (desert tortoise), or potential weed invasions (desert tortoise, Utah prairie dogs). Connected actions are Not Likely to Jeopardize the continued existence of the experimental population of California condors (Table 4.6-11). "May Impact" would apply to all Sensitive species (*Measurement Indicator #6*; Table 4.6-12).

4.6.5.6 Alternative E1 (NSO in IRAs)

Alternative E has the least restrictive leasing options. Chapter 2 of this EIS describes how many acres of the Dixie National Forest would fall under each leasing option under Alternative E1 with NSO in IRAs (Table 2.5-5) and where those acres are located (Figures 2.5-5 (a-d)). Thirty three percent of the Dixie National Forest is within IRAs and would be NSO. Five percent of the Forest would be NA.

The intensity and duration of impacts to most TEC species would be the same as described under SLT with the exception of desert tortoises and Mexican spotted owls. Critical habitats for desert tortoises and spotted owls overlap with IRAs, which are NSO under this alternative. For desert tortoises, habitat impacts, fragmentation, and extended noise would not occur in Critical Habitat under this alternative (99% occurs in IRAs), and would be far less likely within suitable habitat (73% occurs within IRAs). For Mexican spotted owls, habitat impacts would not occur in PACs (100% occurs within IRAs) and would be far less likely within critical habitat (66% occurs within IRAs). Regarding Utah prairie dog, major impacts are possible under this alternative with regard to habitat loss, noise, and invasive plant infestations. Sensitive species and MIS with enough overlap to reduce the intensity of impacts due to NSO in IRAs include big game (29% of winter range is within IRAs; 40% of summer range is in IRAs), peregrine falcon (35% of rim habitat is within IRAs), and sensitive bats (50% of available habitat is within IRAs). In this analysis, impacts are measurably lower for sensitive bats (see Table 4.6-10). Determinations in Table 4.6-12 are the same between Alternative E1 (NSO in IRAs) and Alternative E2 (SLT in IRAs).

Under Alternative E1, determinations under connected actions would be the same as under Alternative E2 (below), with the exception of desert tortoises and Mexican spotted owls. Connected actions May Affect but would Not Likely Adversely Affect desert tortoises and Mexican spotted owls under this alternative because a substantial portion of habitat falls within IRAs, which are NSO. Habitat loss and fragmentation or noise would be less likely to occur under this alternative, relative to SLT, and impacts to these species would be less likely to be adverse.

4.6.5.7 Alternative E2 (SLT in IRAs)

Impacts to TEC species would be the same as described under SLT. Under Alternative E2 with SLT in IRAs, leasing would be allowed on 95 percent of the Forest.

Under Alternative E2, connected actions May Affect but would Not Likely Adversely Affect California condors in the Pine Valley Ranger District, yellow-billed cuckoos, and Endangered fish, due either to a lack of suitable habitat (cuckoos), low probability of occurrence (condors), or low probability of a catastrophic water pollution event (Virgin River chub and woundfin). Connected actions May Affect and Would Likely Adversely Affect other TEC species, including desert tortoises, Utah prairie dogs, and Mexican spotted owls. Adverse effects would be likely

due to disturbance in critical habitat, fragmentation, noise, or weed invasion under SLT (desert tortoises), potential direct disturbance or noise in the vicinity of colonies or suitable habitat under SLT (Utah prairie dogs), and potential disturbance of critical or potential habitat due to a direct loss or noise impacts (Mexican spotted owls). Connected actions are Not Likely to Jeopardize the continued existence of the experimental population of California condors any other TEC species for which there are likely to be adverse effects (MA-LAA; Table 4.6-11). Impacts to Sensitive species and MIS would be the same as described under SLT. Regarding determinations, actions "May Impact" would apply to all species except sensitive fish and sensitive plants ("Will Impact;" *Measurement Indicator #6*; Table 4.6-12).

Table 4.6-10 Impacts with Respect to Measurement Indicators #1 - #5, and #7

Resource			ALT A	ALT B	ALT C	ALT D1	ALT D2	ALT E1	ALT E2
TEC									
Endangered fish[1]		*MI #1*	neg	negligible LT	negligible LT	negligible LT	negligible LT	minor-mod LT	minor-mod LT
California condor		*MI #1*	neg	negligible ST	negligible ST	neg-minor ST	neg-minor ST	neg-minor ST	neg-minor ST
		MI #2	neg	neg-minor LT	neg-minor LT	minor LT	minor LT	minor LT	minor LT
		MI #3	neg	neg-minor ST	neg-minor ST	minor ST	minor ST	minor-mod ST	minor-mod ST
Desert tortoise[1]		*MI #1*	neg	neg-minor ST-LT	minor-mod ST-LT	minor-moderate ST-LT	moderate ST-LT	minor-mod ST-LT	moderate ST-LT
		MI #2	neg	negligible LT	negligible LT	mod-major LT	major LT	mod-major LT	major LT
		MI #3	neg	neg-minor ST	neg-minor ST	minor ST	minor ST	minor ST	minor ST
		MI #5	neg	minor-major LT	minor-major LT	minor-major LT	major LT	minor-major LT	major LT
Utah prairie dog[3]		*MI #1*	neg	neg-minor ST	minor ST	minor ST	minor ST	mod-major LT	mod-major LT
		MI #2	neg	negligible LT	negligible LT	negligible LT	negligible LT	minor-mod LT	moderate LT
		MI #3	neg	minor ST	minor ST	minor ST	minor ST	mod-major ST-LT	mod-major ST-LT
		MI #5	neg	minor-major LT	minor-major LT	minor-major LT	minor-major LT	minor-major LT	minor-major LT
Mexican spotted owl	Critical Habiat[4]	*MI #1*	neg	negligible LT	minor LT	minor LT	moderate LT	minor-mod LT	mod-major LT
		MI #3	neg	negligible ST	minor -mod ST	minor -mod ST	moderate ST	moderate ST	mod-major LT
	"Potential" habitat	*MI #1*	neg	negligible ST	minor ST	minor ST	minor ST	minor ST	minor ST
		MI #3	neg	neg-minor ST	minor-mod ST	minor -mod ST	moderate ST	moderate ST	moderate ST

Resource			ALT A	ALT B	ALT C	ALT D1	ALT D2	ALT E1	ALT E2
	PAC[4]	*MI #1*	neg	negligible ST	neg-minor ST	neg-minor ST	minor-mod LT	neg-minor ST	mod-major LT
		MI #3	neg	negligible ST	minor-mod ST	minor-mod ST	moderate ST	moderate ST	mod-major LT
	All habitats	*MI #2*	neg	negligible LT	moderate LT	moderate LT	moderate LT	moderate LT	moderate LT
Western yellow-billed cuckoo		*MI #1*	neg	negligible LT	minor LT	minor LT	minor LT	minor LT	minor LT
Sensitive /MIS									
MIS and Sensitive trout		*MI #2*	neg	negligible LT	minor-moderate LT	moderate LT	moderate LT	major LT	major LT
		MI #5	neg	negligible LT	moderate LT	moderate LT	moderate LT	moderate LT	moderate LT
Pygmy rabbit		*MI#1*	neg	neg-minor ST	neg-minor ST-LT	mod-major ST-LT	mod-major ST-LT	mod-major ST-LT	mod-major ST-LT
		MI #2	neg	negligible LT	moderate LT	moderate LT	moderate LT	moderate LT	moderate LT
		MI #3	neg	neg-minor ST	minor ST-LT	minor ST-LT	minor ST-LT	mod-major ST-LT	mod-major ST-LT
		MI #5	neg	minor-mod LT	minor-mod LT	minor-mod LT	minor-mod LT	minor-mod LT	minor-mod LT
Sensitive bats[3]		*MI#1*	neg	neg-minor ST	minor ST-LT	minor ST-LT	minor ST-LT	minor-mod ST-LT	mod-major ST-LT
		MI #2	neg	negligible LT	neg-minor LT	moderate LT	moderate LT	moderate LT	moderate LT
		MI #3	neg	neg-minor ST	minor ST	minor ST	minor ST	minor-mod ST-LT	mod-major ST-LT
		MI #5	neg	neg-minor LT	minor LT	minor LT	minor LT	minor LT	minor LT
Big game (MIS)		*MI#1*	neg	negligible ST-LT	negligible-minor ST-LT	minor ST-LT	minor ST-LT	minor ST-LT	minor ST-LT
		MI #2	neg	negligible LT	mod-major LT	major LT	major LT	major LT	major LT
		MI #3	neg	negligible ST	negligible ST	negligible ST	negligible ST	moderate ST	moderate ST

Resource			ALT A	ALT B	ALT C	ALT D1	ALT D2	ALT E1	ALT E2
		MI #4	neg	negligible ST-LT	mod-major[23] ST-LT	mod-major[23] ST-LT	mod-major[23] ST-LT	mod-major[23] ST-LT	mod-major[23] ST-LT
		MI #7	neg	neutral	neutral	neutral	neutral	neutral	neutral
Sensitive raptors		*MI#1*	neg	neg-minor ST	negligible-minor ST-LT	minor-mod ST-LT	minor-mod ST-LT	minor-mod ST-LT	minor-mod ST-LT
		MI #2	neg	minor-mod LT	moderate LT	moderate LT	moderate LT	moderate LT	mod-major LT
		MI #3	neg	minor-mod ST	minor-mod ST	minor-mod ST	minor-mod ST	mod-major ST	mod-major ST
		MI #5	neg	minor LT	minor LT	minor LT	minor LT	minor LT	minor LT
Sage grouse	Brood rearing habitat	*MI#1*	neg	negligible ST-LT	minor-mod ST-LT	minor-mod ST-LT	minor-mod ST-LT	minor-mod ST-LT	minor-mod ST-LT
		MI #2	neg	negligible ST-LT	minor ST-LT	moderate ST-LT	moderate ST-LT	moderate ST-LT	moderate ST-LT
		MI #3	neg	neg-minor ST-LT	neg-minor ST-LT	neg-minor ST-LT	neg-minor ST-LT	moderate ST-LT	moderate ST-LT
	Leks	*MI#1*	neg	negligible ST	mod-major ST	mod-major ST	mod-major ST	major LT	major LT
		MI #3	neg	neg-minor LT	neg-minor LT	neg-minor LT	neg-minor LT	mod-major LT	mod-major LT
	All habitat	*MI #5*	neg	negligible LT	mod-major LT	mod-major LT	mod-major LT	mod-major LT	mod-major LT
Sensitive plants		*MI #1*	neg	neg-minor LT	minor LT	moderate LT	moderate LT	moderate LT	moderate LT
		MI #2	neg	negligible LT	moderate LT	moderate LT	moderate LT	moderate LT	moderate LT
		MI #5	neg	min-mod LT	min-mod LT	min-mod LT	min-mod LT	min-mod LT	min-mod LT

[1] Impacts most likely within Pine Valley Ranger District
[2] Impacts most likely within Cedar City Ranger District
[3] Impacts most likely within Powell Ranger District
[4] Impacts most likely within Escalante Ranger District
Measurement Indicator #6 is summarized in Tables 4.6-11 and 4.6-12. *Measurement Indicator #8* is not presented here because there would be no impacts. *Measurement Indicator #9* is summarized at the end of Section 4.6.4.7.
LT = long term; ST = short term; neg = negligible; mod = moderate.

Table 4.6-11 Effects Determinations (Measurement Indicator #4).

Resource	ALT A	ALT B	ALT C	ALT D1	ALT D2	ALT E1	ALT E2
Virgin River chub	NE	NE	NE	NE	NE	MA-NLAA	MA-NLAA
Woundfin	NE	NE	NE	NE	NE	MA-NLAA	MA-NLAA
California condor	NE	NLJ/ MA-NLAA[1]	NLJ/MA-NLAA[1]	NLJ/MA-NLAA[1]	NLJ/MA-NLAA[1]	NLJ/MA-NLAA[1]	NLJ/MA-NLAA[1]
Mojave desert tortoise	NE	MA-NLAA	MA-NLAA	MA-NLAA	MA-NLAA	MA-NLAA	MA-LAA, NLJ
Utah prairie dog	NE	MA-NLAA	MA-NLAA	MA-NLAA	MA-NLAA	MA-LAA, NLJ	MA-LAA, NLJ
Mexican spotted owl	NE	MA-NLAA	MA-NLAA	MA-NLAA	MA-NLAA	MA-NLAA	MA-LAA, NLJ
Western yellow-billed cuckoo	NE	NE	MA-NLAA	MA-NLAA	MA-NLAA	MA-NLAA	MA-NLAA

NE = No Effect
NLJ = Not Likely to Jeopardize the continued existence.
MA-NLAA = May Affect - Not Likely to Adversely Affect
MA-LAA = May Affect - Likely to Adversely Affect
[1] MA-NLAA determination applies to the Pine Valley Ranger District only; condors in this area are not part of the experimental population.

Table 4.6-12 Determinations of Impacts to Viability from the BE (Measurement Indicator #6).

Resource	ALT A	ALT B	ALT C	ALT D1	ALT D2	ALT E1	ALT E2
Bonneville cutthroat trout	NI	NI	MIIH	MIIH	MIIH	WIFV	WIFV
Colorado cutthroat trout	NI	NI	MIIH	MIIH	MIIH	WIFV	WIFV
Pygmy rabbit	NI	MIIH	MIIH	MIIH	MIIH	MIIH	MIIH
Townsend's big-eared bat	NI	MIIH	MIIH	MIIH	MIIH	MIIH	MIIH
Spotted bat	NI	MIIH	MIIH	MIIH	MIIH	MIIH	MIIH
Bald eagle	NI	MIIH	MIIH	MIIH	MIIH	MIIH	MIIH
Goshawk	NI	MIIH	MIIH	MIIH	MIIH	MIIH	MIIH
Sage grouse	NI	NI	MIIH	MIIH	MIIH	MIIH	MIIH
Peregrine falcon	NI	MIIH	MIIH	MIIH	MIIH	MIIH	MIIH
Three-toed woodpecker	NI	MIIH	MIIH	MIIH	MIIH	MIIH	MIIH
Flammulated owl	NI	MIIH	MIIH	MIIH	MIIH	MIIH	MIIH
Sensitive plants	NI	MIIH	MIIH	MIIH	MIIH	WIFV	WIFV

NI = No Impact
MIIH = May Impact Individuals or Habitat but would not likely contribute to a trend towards Federal listing or cause a loss of viability to the population or species.
WIFV = Will Impact individuals or habitat with a consequence that the action may contribute to a trend towards Federal listing or cause a loss of Viability to the population or species

4.7 Water and Watershed Resources

4.7.1 Introduction

The terms used to describe the context and intensity of effects in this section are discussed in Section 4.1 and Table 4.1-1. Table 4.7-1 provides an example how these terms would apply to Water and Watershed Resources.

Table 4.7-1 Terms used to Describe Effects to Water and Watershed Resources

Attribute of Effect		Description relative to Water and Watershed Resources
Quality	Beneficial	A reduction in the amount of fine sediment delivered to a stream.
	Adverse	An increase in the amount of fine sediment delivered to a stream.
Magnitude (Intensity)	Negligible	An increase in the amount of fine sediment delivered to a stream that is so small it cannot be effectively measured using existing methods.
	Minor	An increase in the amount of fine sediment delivered to a stream that can be effectively measured using existing methods. However, the increase is small relative to current conditions and would not change physical and biological conditions in the stream
	Moderate	An increase in the amount of fine sediment delivered to a stream that can be effectively measured using existing methods. The increase is large enough that it may result in changes to physical and biological conditions in the stream.
	Major	An increase in the amount of fine sediment delivered to a stream that can easily be effectively measured using existing methods and may be visually apparent. The increase is large and would change physical and biological conditions in the stream.
Duration	Temporary	An increase in sediment delivery during construction of a facility (i.e., road, well pad) that does not occur once construction is completed.
	Short-term	An increase in sediment delivery due to exploration activities (i.e., construction of exploratory well pads or access roads). The increase in sediment delivery is limited only to the time needed for exploration and reclamation, 10 years or less.
	Long-term	An increase in sediment delivery due to the construction of production facilities (i.e., a production field and associated roads). The life of the production field and the time needed for reclamation would exceed 10 years.

4.7.2 Measurement Indicators

- *Measurement Indicator #1* NARRATIVE DESCRIPTION OF POTENTIAL SOURCES OF POLLUTANTS, THE TYPES OF POLLUTANTS, AND THE EFFECT TO SURFACE WATERS AND GROUNDWATER
- *Measurement Indicator #2* POTENTIAL TO INCREASE SEDIMENT IN SURFACE STREAMS
- *Measurement Indicator #3* RELATIVE POTENTIAL FOR INCREASING MILES OF ROADS WITHIN MUNICIPAL WATERSHEDS AND LAVA FIELDS OVER SENSITIVE AQUIFERS

- *Measurement Indicator #4* NARRATIVE DESCRIPTION OF POTENTIAL EFFECTS TO SURFACE WATER FLOW AND GROUNDWATER AVAILABILITY
- *Measurement Indicator #5* ACRES OF DISTURBANCE

4.7.3 Impacts Common to All Action Alternatives

Under Alternatives B, C, D, and E it is assumed that activities described under the Reasonably Foreseeable Development Scenario (RFDS) would occur. However, depending on the alternative, activities described under the RFDS would be restricted in some locations. These activities include 60 to 120 acres (depending upon ranger district) of surface disturbance associated with seismic surveys, 83 to 332 acres (depending upon ranger district) of land clearing surface disturbance associated with road and pad building for exploration wells, and 254 acres of land clearing surface disturbance for a production field (per ranger district). The locations of activities are not yet known.

As is discussed in further detail below, water and watershed resources could be affected by any land disturbing activity and/or spills of polluting substances. Increased erosion is one result of land disturbing activity, and if the disturbance occurs in close proximity to a stream or within wetlands, floodplains, or riparian areas, it could result in sediment delivery to streams. Increased erosion and sediment delivery could have effects on water quality and channel stability, which in turn could affect fisheries and downstream users. If spills of polluting substances and chemicals were to reach wetlands, floodplains, riparian areas, or streams, the level of significance of these events would depend on the composition and amount of contaminant and the conditions of the receiving resource.

Of all the activities predicted by the RFDS, seismic surveys present the lowest potential for impacts to water and watershed resources. Impacts associated with seismic surveys result primarily from overland travel by wheeled vehicles, which can leave wheel ruts, compact soils, and crush vegetation. Soil compaction increases runoff rates and erosion. Wheel ruts can further increase erosion by channeling flow. The crushing of vegetation associated with overland travel could reduce this effect because the vegetation would still intercept precipitation and could also provide a protective cover for the soil. Furthermore, *Dixie National Forest Oil and Gas Construction and Operating Standards and Well Site Design Requirements* (Appendix C) specify that operation of mechanical equipment off designated routes should be avoided during periods when soils are susceptible to puddling, rutting, and compaction. Overall, the amount of disturbance should be small enough that given the BMPs, any increases in erosion would be localized and range from negligible to minor and be short term.

The greatest potential for impacts to water and watershed resources comes from roads, which due to topographical constraints may be built in close proximity to streams, often within floodplains or riparian areas. While the specific impacts of roads vary somewhat by resource and are discussed in additional sections below, the primary impacts of roads on water and watershed resources can be generalized to primarily include fragmentation or loss of wildlife habitat, increases in erosion and sediment delivery to streams, and the alteration of hydrology. These impacts result from the fact that runoff rates and erosion are typically increased when vegetation is removed and soil is exposed and compacted. In addition, roads often act as extensions of the stream channel network by capturing and channeling surface water runoff, water that would naturally infiltrate the soil under undisturbed conditions.

The construction of well pads would also require land clearing and the impacts would be similar to those described for roads. However, well pads are not likely to be located as close to water and watershed resources as roads, which reduces the potential for impacts. For roads or well pads that are a part of exploration activities, the impacts would be short term because reclamation activities would return the ground surface and the vegetative cover to a stable condition. Reclamation sufficient to provide erosion protection can be expected to take one to three growing seasons. Prior to reclamation, the level of impacts to water and watershed resources could vary from negligible to major depending upon the site-specific circumstances associated with the location of the facility (i.e., how close to surface water or watershed resources the disturbance is, what the ground slope is where the disturbance occurs, and the erosion characteristics of the disturbance). In the case of a production field, impacts would be of the same type as for exploration, but could be increased in scale because of a greater percentage of land cleared within a given watershed, and long term because the production field operations would last for a greater time.

In exploration and production instances, increases in runoff rates may not result in realized increases in stream runoff, erosion, or sedimentation because of sediment and runoff control BMPs that would retain runoff. To help ensure that this is the case, Appendix C includes a requirement, which dictates site drainage, including berming and ditching criteria. Appendix C also includes a requirement that the operation of mechanical equipment on designated routes should be avoided during periods when routes are susceptible to puddling or rutting unless mitigation (such as drainage and surfacing) is provided.

Oil and gas activity also has the potential to impact water and watershed resources through the inadvertent release of hydrocarbons or chemical pollutants during overland travel or during the construction or use of the cleared land. This may include fluid leaks from vehicles or equipment, fuels or chemicals spilled during exploration or production, or improperly managed storm water runoff that contacts pollutants on drill sites and storage yards, etc. These types of impacts to water and watershed resources would likely be short term, and could be minor to major. This subject, as well as other details for impacts to water resources is discussed in greater detail throughout the following subsections.

Table 4.7-2 lists the leasing options assigned to the watershed resource components under each alternative. Descriptions of leasing options (and associated impacts on water and watershed resources) are described in Section 4.7.4. Each assigned leasing option would either allow or restrict certain oil and gas activities (described under the RFDS) whenever the applicable resource component occurs on the Dixie National Forest.

Table 4.7-2 Leasing Options Assigned Under Each Alternative

Resource Component	Alternative				
	A	B	C	D	E
Lava Fields over Sensitive Aquifers (58,585 acres)	NL	NSO	NSO	NSO	SLT
Streams, Lakes, Springs, Wetlands, Floodplains, and Riparian Areas (including riparian vegetation)[1]	NL	NSO 500 ft buffer NL 300 ft buffer	NSO 300 ft buffer	CSU 300 ft buffer	SLT
Municipal Watershed (53,403 acres)	NL	NL	NSO	CSU	SLT

[1] Includes a 300-foot buffer (410,550 acres), except for Alternative B, which includes a 500-foot buffer (662,835 acres).

As evident throughout the following sections, impact analysis of the RFDS is difficult for water and watershed resources. First, without knowing exactly where a specific action might occur, there is uncertainty saying what the level of impact to water resources might be – it could range from minor to major depending upon many factors such as proximity to water and watershed resources, soil type, geology, season, etc. Second, assuming that all of the environmental protection measures that the Dixie National Forest would have at its disposal (including at the least the *Dixie National Forest Oil and Gas Construction and Operating Standards and Well Site Design Requirements*, Appendix C), even under SLT, are met, as well as all of the other requirements of the various Clean Water Act laws, and assuming that spills or failures of environmental protection measures rarely occur, impacts to water resources could most likely be considered to be negligible or minor; however, there is uncertainty in this prediction. There is at least some indefinable probability that spills or failures in environmental protection measures could occur, with consequent impacts to water resources ranging from negligible to major. The history of oil and gas activities throughout the country indicates that even though improvements have been made in procedures, chemicals used, and environmental protection; unforeseen spills, ruptures, and leaks, can occur. The recent track record of oil and gas companies may be quite good, but it is not perfect – nor can it be expected to be perfect in the future. Last, the level or potential for impacts to water and watershed resources is not so much tied to acreages, but often more tied to proximity of the activities to water sources; while the former is available conceptually in this impact analysis, the latter is not available because specific site locations for future oil and gas activities are not known.

4.7.4 Impacts of Connected Actions by Leasing Option

This section summarizes the leasing options described in Chapter 1 and describes the impacts from connected actions under each leasing option. Leasing options would dictate the conditions under which impacts from connected actions (as described in the RFDS) may occur. Impacts to water and watershed resources considering leasing option overlaps (i.e., overlaps with more restrictive leasing options assigned to other resources) are discussed in Section 4.7.5 (Impacts by Alternative). Under all leasing options and alternatives, oil and gas activity would be subject to the Best Management Practices (BMPs) listed in the *Dixie National Forest Oil and Gas Construction and Operating Standards and Well Site Design Requirements* contained in Appendix C and the *Surface Operating Standards and Guidelines for Oil and Gas Exploration and Development – The Gold Book* (BLM and USFS 2007).

4.7.4.1 Not Legally Available (NA)

There would be no effects to water or watershed resources occurring in areas not legally available for leasing (Section 1.5.2).

4.7.4.2 No Lease (NL)

A NL leasing option does not allow leasing on specified lands for the protection of resources. These lands would not be administratively available for leasing and no direct disturbances associated with oil and gas leasing would occur on lands with an NL leasing option. Under Alternative A, NL is applied to the entire Dixie National Forest. Under Alternative B, NL is also applied to the 300-foot buffer around all waterbodies and to municipal watersheds. Where NL applies to the 300-foot buffer, the intent is to prevent the direct effects associated with ground disturbance from altering watershed resources or delivering pollutants (including sediment) to surface water features and the associated indirect effects on aquatic habitat and human uses. Where NL applies to municipal watersheds, the intent is to provide the maximum level of protection possible to these water sources that are used for community water supplies. This is needed because any sediment production and/or release of potentially polluting materials to municipal water supplies could be considered significant due to the fact that these areas are managed for culinary water production.

Under Alternative A and there would be no direct or indirect effects from oil and gas leasing. For municipal watersheds, NL would eliminate the potential for impacts from leasing activities. For watershed resources and surface water, NL applied to the 300-foot buffer would prevent direct disturbance, but indirect effects could occur as a result of oil and gas activity on adjacent land as described in Section 4.7.4.6. Potential indirect effects include sediment deposition from erosion outside the buffer, hydrocarbon or chemical spills, and the alteration of natural surface water infiltration rates and flow paths. The severity of these effects would depend on the location of these facilities relative to the stream network and other watershed resources. Given the width of the buffer, it is likely that sediment and spilled or leaked materials would settle out prior to reaching a stream. However, a large unattended release would still have the potential to enter a stream, depending upon the circumstance. In general, with proper implementation of BMPs applicable to road and well pad construction, the indirect impacts would likely range from negligible to moderate and be short term for exploration activities and long term for production facilities.

4.7.4.3 No Surface Occupancy (NSO)

There are two separate types of NSO leasing options that would apply to water and watershed resource components. The first type of NSO is discussed in this section and the second type, which allows perpendicular stream crossings, is discussed below under the heading “NSO with Road Crossings.” The first type of NSO would be a general NSO that prohibits occupancy or use of the land for oil and gas related activities (i.e., construction of well pads, central tank batteries, access roads, pipelines, power lines, and other linear structures). However, it would allow for directional drilling into an NSO area from outside its boundaries and would allow for seismic activities. This leasing option is intended to prevent the most likely sources of pollutants and water-related impacts – those related to surface occupancy – from occurring, while still allowing certain uses, which have some, but more minimal potential for impacts. This first type of NSO is applied to lava fields over sensitive aquifers under Alternatives B, C, and D. It is also applied to a 500-foot buffer around streams, lakes, reservoirs, springs, and wetlands under Alternative B and to municipal watersheds under Alternative C. Further, an identical NSO leasing option is applied to IRAs under Alternative B and C and Alternatives D1 and E1.

Impacts under this type of NSO are discussed below (including relevant *Measurement Indicators*).

WATERSHED RESOURCES AND SURFACE WATERS

The 500-foot buffer to which NSO is applied under Alternative B and extends 200 feet beyond the outer edge of the 300-foot buffer, which would be under NL in Alternative B. The only disturbance that could occur within the 200 feet between the outer edge of the 300-foot buffer and the inner edge of the 500-foot buffer would be seismic exploration. The impacts of seismic exploration to streams, wetlands, floodplains, and riparian areas are described in Section 4.7.4.6. They include a small potential for increased erosion and pollutant spills. Spills in this situation could only come from equipment used for the seismic surveys and would be limited to small quantities of fuel, coolant, or lubricants. The impacts of both these disturbances are described in detail in Section 4.7.4.6. These impacts would likely be negligible to minor and short term due to the low amount of disturbance expected and the ability of the resource to recover following minor disturbance. Indirectly, oil and gas activity in adjacent areas could cause erosion in upland areas that may be deposited in wetlands, floodplains, or riparian areas. If the disturbance was large, sediment could reach streams. Other potential indirect impacts may include the alteration of natural infiltration and flow paths, and hydrocarbon or chemical spills. All potential indirect effects are discussed in further detail in Section 4.7.4.6. The severity of these effects would depend on the location and type of disturbance and with proper implementation of BMPs could range from negligible to moderate and be short and long term.

Also, see *Measurement Indicators #1*, *2*, *4*, and *5* below.

GROUNDWATER

NSO applied to lava fields over sensitive aquifers and municipal watersheds would greatly reduce the potential for impacts to these resource components and would only be slightly less protective than a NL leasing option. NSO would not allow road construction and would eliminate much of the potential for spills (as noted and discussed further elsewhere in this section, roads represent one of the greatest potentials for sediment impacts and other water quality impacts due to spills). Further, as other facilities would also be prohibited (i.e., well pads), it would also greatly reduce the potential for most other spills not related to roads to occur or reach these areas.

The intent of applying NSO to lava fields over sensitive aquifers is to prevent the direct effects associated with road building sediments and pollutants that may escape and mix with groundwater, thereby potentially degrading these aquifers over the long term; aquifer cleanup would be difficult and costly. In most cases, sediments, and even small amounts of pollutants, would not present a risk of contamination to groundwater. However, lava fields over sensitive aquifers are unique in that they have extremely high permeability and macro pore spaces. The pore spaces are large enough that any pollutants, including sediment, can rapidly enter the aquifer. Although an oil play is unlikely to occur near lava fields, there is a potential for impacts to groundwater if directional drilling were to occur beneath lava fields over sensitive aquifers. In general, if there is a risk of groundwater contamination, wells would be cased to prevent contamination of groundwater. However, if wells were improperly cased or sealed, leaking of contaminants into the aquifer could occur. The potential for this is very small since proper casing of wells is well regulated. If contamination were to occur, the impacts would be long term and would range from moderate to major. Although some roads currently cross lava field over sensitive aquifers and travel access is allowed, the potential for a spill to occur in large enough proportions from existing approved access is much less than the potential scale of spills from

commercial oil and gas drilling or production activities. Directional drilling would not be likely to impact municipal watersheds. There would be no indirect impacts as discussed in Section 4.7.4.2.

Also, see *Measurement Indicators #1* and *3* below

WATER QUALITY

NSO limits surface disturbance to seismic activity and greatly reduces the potential for direct effects to water quality. Impacts to water quality would be as described above for watershed resources, surface water, and groundwater.

WATER USES

The types of potential impacts to water uses would be similar as described for SLT in Section 4.7.4.6. However, given the protections provided by NSO, as described above, both the probability and magnitude of the effects would be less under NSO than SLT. The magnitude of impacts would follow the magnitude of impacts outlined above for surface water and ground water and, in general, would be negligible to minor and short and long term. If impacts to groundwater occurred, they would likely be of a greater magnitude, as described above.

Measurement Indicators

- *Measurement Indicator #1* NARRATIVE DESCRIPTION OF POTENTIAL SOURCES OF POLLUTANTS, THE TYPES OF POLLUTANTS, AND THE EFFECT TO SURFACE WATERS AND GROUNDWATER

As described in the sections above, seismic exploration has the potential to spill small quantities of fuel, coolant, or lubricants. Improper casing or sealing of wells would have the same impact as described for this measurement indicator in Section 4.7.4.6.

- *Measurement Indicator #2* POTENTIAL TO INCREASE SEDIMENT IN SURFACE STREAMS

The potential for an increase in sediment delivery to streams is greater than for the NA or NL leasing options because seismic exploration would be allowed. However, the potential for increased sediment delivery to surface streams from seismic exploration is minimal due to the small amount of disturbance. Indirectly, oil and gas activity on land adjacent to areas under NSO could contribute sediment as described for SLT (Section 4.7.4.6)

- *Measurement Indicator #3* RELATIVE POTENTIAL FOR INCREASING MILES OF ROADS WITHIN MUNICIPAL WATERSHEDS AND LAVA FIELDS OVER SENSITIVE AQUIFERS

Roads would not be allowed in these areas under NSO.

- *Measurement Indicator #4* NARRATIVE DESCRIPTION OF POTENTIAL EFFECTS TO SURFACE WATER FLOW AND GROUNDWATER AVAILABILITY

The alteration of flow into wetlands from disturbance in upland areas could decrease groundwater recharge and decrease the capability of wetlands to moderate stream fluctuations.

- *Measurement Indicator #5* ACRES OF DISTURBANCE

The only type of direct disturbance that could occur under this type of NSO is seismic activity. As a result, up to 60 acres of seismic exploration could occur on the Pine Valley Ranger District and 120 acres on the Cedar City, Powell, and Escalante Ranger Districts.

NSO WITH ROAD CROSSINGS (ALTERNATIVE C ONLY)

The second type of NSO leasing option would apply to the 300-foot buffer in Alternative C. This NSO leasing option would prohibit occupancy or use of the land for facilities such as well pads and central tank batteries, but would allow roads, pipelines, and similar linear features for short distances perpendicular to streams. This would allow, for example, a culvert to be installed to cross a stream. However, roads and linear features could not be constructed along, or parallel, to streams or any other waterbody within the 300-foot buffer. This reduces, but does not eliminate, the amount of disturbed area that could be in close proximity to a stream. While this application of NSO would be less protective for streams than the type of NSO discussed above, it was developed in recognition of the need for road crossings within a landscape that is dissected by streams. When areas with the different NSO leasing options overlap, the more restrictive NSO would apply (NSO without road crossings). Under this type of NSO, direct disturbance that could occur would include seismic exploration as described above and road-stream crossings. Road-stream crossings could have impacts to stream channels as described in Section 4.7.4.6 including the introduction of sediment, increased bank erosion, and alteration of local hydrological conditions. Impacts of stream crossings would range from minor to moderate and could be short and long term. Indirect effects would be the same as described for SLT in Section 4.7.4.6.and would range from negligible to moderate and be short to long term depending on the location and type of disturbance.

Measurement Indicators

The types of impacts for the measurement indicators would be the same under this type of NSO as described above for the first type of NSO. However, the probability for spills (*Measurement Indicator #1*) and increased sediment introduction (*Measurement Indicator #2*) is increased due to the increased proximity of roads to watershed resources and surface water. Also, the amount of disturbance would be increased as described for *Measurement Indicator #5* below.

- *Measurement Indicator #5* ACRES OF DISTURBANCE

Up to 60 acres of seismic exploration could occur on the Pine Valley Ranger District and 120 acres on the Cedar City, Powell, and Escalante Ranger Districts. In addition, approximately 0.5 acres (600 linear feet) of roads could be constructed at each stream crossing. As the number of possible stream crossings is unknown, a conservative estimate is to assume that disturbance could be up to the maximum estimated for road construction on each ranger district. This would be up to 53.5 acres for the Pine Valley Ranger District, 160.5 acres for the Cedar City Ranger District, and 214.0 acres for both the Powell and Escalante Ranger Districts. As a result, total acres disturbed would be 113.5 acres for the Pine Valley Ranger District, 280.5 acres for the Cedar City Ranger District, and 334.0 acres for the Powell and Escalante Ranger Districts.

4.7.4.4 Timing Limitation (TL)

A TL leasing option is not applied directly to any of the water or watershed resource components.

4.7.4.5 Controlled Surface Use (CSU)

CSU provides for controlled but generally allowed surface use on all or portions of a lease. Operations would be held to special operational constraints that may otherwise exceed the mitigation provided by SLT, regulations, and operating orders. Under Alternative D, a CSU leasing option would be applied within municipal watersheds and to the 300-foot buffer around waterbodies located outside of a municipal watershed. The CSU applied to the 300-foot buffer would allow surface use or occupancy that does not involve blading or other mechanical disturbance of the soil surface. Platforms or other stabilizing structures would need to be use if facilities such as well pad or portions of roads needed to extend into these areas. The exception would be for perpendicular stream crossing as explained above for NSO with Road Crossings. The intent of this CSU is to allow operators some flexibility in the location of facilities, which preventing the impacts to water and watershed resources associated with surface disturbance and erosion. Given the level of restrictions, this CSU would provide similar protection to water and watershed resources as NSO. However, as facilities may be placed in increased proximity to water, there would be an increase potential for spills. As described in Section 4.7.4.6, the impacts of a spill would range from negligible to major, and generally be long term.

A separate CSU leasing option would be applied to municipal watersheds under Alternative D. The CSU would allow surface use and occupancy, with the caveat the proposed activities would be delayed until the Dixie National Forest finds the lessee has sustained its burden of proof and that the proposed activities do not create a foreseeable and substantial risk of pollution to the municipal watershed. This CSU is intended to decrease the risk of pollution described in Section 4.7.4.6 by adding additional oversight. As risks are inherent to all types of oil and gas activity, some potential still exists. However, it is anticipated that the additional oversight should decrease the impacts described in Section 4.7.4.6 to negligible to moderate. Impacts could be short or long term.

Measurement Indicators

The types of impacts for the measurement indicators would be the same under these CSU leasing options as described for NSO. However, the probability for spills (*Measurement Indicator #1*) is increased due to the increased proximity of oil and gas facilities to watershed resources and surface water. Also, the amount of disturbance in municipal watersheds would be increased as described for *Measurement Indicator #5* below.

- *Measurement Indicator #5* ACRES OF DISTURBANCE

The maximum amount of disturbance that could occur within municipal watershed would be the same as describe for SLT in Section 4.7.4.6 (up to 396.9 acres on the Pine Valley Ranger District, 622.9 acres on the Cedar City Ranger District, and 705.9 acres on the Powell and Escalante Ranger Districts).

4.7.4.6 Standard Lease Terms (SLT)

Impacts in this section are discussed assuming no restrictions or leasing options other than those listed on BLM Lease Form 3100-11 (SLT) and the environmental protection measures that would be implemented by other laws and regulations as described in Section 1.8.5.2. Under SLT, anywhere within the leasehold is available for placement of a road and drill site. However, at a minimum, SLT would allow operations to be moved up to 200 meters (656 feet) and be delayed for up to 60 days if the authorizing officer deems it necessary to protect a resource.

Under Alternative E, SLT would be applied on all water and watershed resources components (lava fields over sensitive aquifers, the 300-foot buffer around all waterbodies, and municipal watersheds), including within IRAs if the 2001 Roadless Area Conservation Rule is not in effect (Alternative E2).

While SLT does not apply specific protection to any of the water or watershed resource components, the ability to move operations by up to 200 meters (656 feet) and compliance with other environmental protection laws and regulations would provide a level of protection. For surface waters and watershed resources, if all facilities and operations, including roads, were moved the maximum distance (200 meters, 656 feet) from these resources, the protection would be similar to that under NSO. However, aside from compliance with laws and regulations, SLT does not mandate the movement of operations and it is possible that impacts could occur, most likely be due to an accident or unanticipated event. As a result, SLT is generally less protective than NSO or NL.

As a minimum, all leases are governed by SLT and the impacts described in this section represent the maximum amount of disturbance that could occur as a result of oil and gas activities (Table 4.7-3)

WATERSHED RESOURCES AND SURFACE WATER

Wetlands: Under SLT, direct impacts to wetlands could occur as a result of seismic exploration, construction, and reconstruction of roads, construction of exploratory well pads and associated facilities, and construction of production wells with their associated facilities. Seismic exploration has the least potential for impacts, but if conducted within wetland areas could result in soil compaction and vegetation removal. Due to the low gradient nature of most wetland areas, these impacts may not increase erosion but could temporarily raise turbidity levels (if surface water is present) and reduce wildlife habitat. Further, under all activities (i.e., seismic exploration, exploratory drilling, and production) the possibility for pollutant spills exists if operations were conducted within or in direct proximity to a wetland. Spills could directly kill wetland vegetation and aquatic organisms, which would decrease the wetlands ability to buffer water flow and reduce the uptake of organic nutrients.

The construction of well pads and access roads in wetland areas would result in the removal of wetland vegetation and the filling of wetlands with soil necessary for the construction of these facilities. Section 404 of the Clean Water Act would require a permit from the US Army Corp of Engineers for the discharge of fill material into a wetland. If a permit were granted, the conversion of wetlands to upland habitat would reduce habitat and/or forage for wildlife, reduce the ability of wetlands to trap sediments and pollutants, and alter hydrology. Changes in hydrology would primarily consist of the decreased ability of wetlands to capture high flows and store the water for slow release. As a result, streams may receive higher flows or higher flow velocities, which could lead to increased stream erosion and changes to stream channel morphology. Under SLT, these impacts could range from minor to major. However, many of the impacts could be avoided by the ability to move operations by up to 200 meters (656 feet), Section 404 of the Clean Water Act, and adherence to BMPs. The duration would be short term for impacts due to seismic exploration and possible spills, and long term for any filling of wetlands.

Table 4.7-3 Maximum Projected Road Construction and Total Disturbance that could occur under SLT, by Ranger District

Ranger District	Activity	Roads (miles)[1]		Total[1,2,3] Disturbance (Acres)
		New Roads	Reconstructed Roads	
Pine Valley	Seismic Exploration (100 miles)			60.0
	Exploratory Wells (5 wells)	3.3	19.6	83.0
	Production Wells (19 wells)	10.0		253.9
Cedar City	Seismic Exploration (200 miles)			120.0
	Exploratory Wells (15 wells)	9.9	58.8	249.0
	Production Wells (19 wells)	10.0		253.9
Powell	Seismic Exploration (200 miles)			120.0
	Exploratory Wells (20 wells)	13.2	78.4	332.0
	Production Wells (19 wells)	10.0		253.9
Escalante	Seismic Exploration (200 miles)			120.0
	Exploratory Wells (20 wells)	13.2	78.4	332.0
	Production Wells (19 wells)	10.0		253.9
[2]Forest Total	Seismic Exploration			420.0
	Exploratory Wells	39.6	235.2	996.0
	Production Wells	10.0		253.9

[1] Miles and acres of roads are a part of the estimated total disturbance, which also includes well pads, production facilities, power lines, pipelines, and truck loading areas (BLM 2007a).
[2] For the purpose of this analysis it is assumed that a single production field could be located on any of the ranger districts; however, only a single production field is predicted for the entire forest. As a result the total disturbance for production wells is the same for each ranger district and the Forest total.
[3] Assumes the greatest amount of disturbance predicted in a ranger district occurred.

Due to the protections inherent within SLT, indirect impacts to wetlands are more likely to occur than direct effects. Oil and gas exploration and development on lands adjacent to wetlands would generally involve some degree of surface disturbance and vegetation removal, both of which can lead to increased erosion. This can result in an increase in the amount of sediment delivered to wetlands. While wetlands function to capture sediment and pollutants, excessive amounts of sediment would fill in wetland areas and lead to similar impacts as described above for the direct fill of wetlands. Further, pollutant spills on upland areas may reach wetlands and have similar impacts as already described. Surface disturbance, particularly roads, can also alter the natural drainage pattern of upland areas, which can result in either increased or decreased surface water runoff to wetlands. Decreases in the amount of water delivered would dry up wetlands, which would kill wetland vegetation and alter groundwater infiltration patterns. Increased flow would scour wetlands of sediments, delivering these sediments to adjacent waterbodies. The severity of these effects would depend on the location and type of disturbance; however, application of the BMPs for road construction and drainage and for the control of pollutants and sediment on well pads should limit any affects to areas in the immediate vicinity of the disturbance. As a result, the effects would most likely be negligible to minor, but could range as high as moderate if located directly adjacent to wetlands. Effects would be mostly short term. Adverse impacts to hydrology, such as stream erosion, would be difficult to restore and could result in more long-term impacts.

Stream Channels: Oil and gas activities are not likely to occur in live waters and most direct impacts to stream channels are unlikely. Direct impacts may occur, however, from road crossings of streams. Road crossings usually require the installation of a culvert or bridge. Forest Service Handbook (FSH) 7709.56b (Section 1.41, Subpart 10d) specifies that bridges and major culverts should be designed to accommodate the 50-year and 100-year floods.

Minor culverts should be designed to accommodate the 25-year and 50-year floods. Although these design constraints should prevent large changes to stream hydrology and/or morphology, it is possible that culverts and bridges would create local flow constrictions and increase local flow velocities under extreme flow conditions. This would result in scouring of the streambed downstream of the bridge or culvert and may increase streambank erosion. Further, although the BMPs in Appendix C specify that sediment control measures would be used when constructing stream crossings, some temporary increase in bank erosion and sediment delivery to streams is still expected to occur during culvert or bridge installation. Given the design criteria and BMPs described, these types of direct effects should be constrained to the immediate vicinity of the stream crossing and would generally be negligible to minor. They would be short term for exploration roads and long term for roads associated with a production field.

Indirect effects to stream channels could also occur as a result of upland erosion or the construction of roads in wetlands, floodplains, and riparian areas. The quantity of eroded material that makes its way to a stream are wholly dependent upon site-specific factors including: soil characteristics, ground slope, distance between the disturbance and the stream, and condition of the wetland, floodplain, or riparian areas, among others. For example, in certain areas, site conditions might tend toward producing minor surface erosion from sheet flow, which typically would produce small-sized sediment particles. If this were combined with either a long, low-gradient distance (or a shorter distance with a wetland or riparian area between the source and the stream), these particles would likely be deposited before reaching the channel. In other areas, site conditions could produce gullies or mass earth movements with a direct connection to a stream system, thus adding large amounts of sediment with varying particle sizes to a stream. Generally speaking, activities on steeper slopes would be more likely to erode and transport sediment to a stream, and would take longer to reclaim, all combining to have a greater potential impact to surface water resources.

The type of construction activity also dictates the potential for erosion. Well pads are typically bermed and would be sloped toward a reserve pit located near the cut/slope, trapping most surface water runoff and sediment on site. However, erosion could still occur on the fill slopes below the drill pad. In forested areas, roads have been shown to be the largest contributors of sediment to the aquatic system (Kreutzweiser and Capell 2001). Several factors affect the amount of sediment that can come from roads including, slope, road surface area, drainage structures installed, the type of surfacing, the amount of cut and fill required, and the amount of traffic (Sheridan and Noske 2007). Sheridan and Noske (2007) found that sediment production was highest for unsurfaced roads with moderate amounts of traffic and for surfaced roads (gravel) with high traffic levels. Due to their temporary nature, roads associated with exploratory wells would not likely be surfaced and could be local contributors of sediment depending upon the other factors. Surfaced roads associated with a production field would likely be contributors of sediment due to large amounts of traffic resulting from trucking the oil to market as predicted by the RFDS. Further, roads have been shown to act as extensions of the stream channel network by capturing and channeling surface water runoff, water that would naturally infiltrate the soil under undisturbed conditions. The result is that forest roads, especially when built in close proximity to streams channels, can increase the magnitude and frequency of peak flows (Jones et al. 2000). Both of these processes (increased sediment delivery and increased flood frequency) can affect stream channel morphology. Increased sedimentation can lead to channel aggradations, whereas increased flows can result in stream channel incision.

One measure by which roads and their potential to cause sediment-related water quality impacts can be assessed is road density. For wildlife uses on the Dixie National Forest, a

density of 2 miles of road per square mile is considered dense and problematic. Using a similar measure to qualitatively assess road-related impacts to water resources, it can be said that a developed well field may likely exceed that density, and thus be more likely to cross some threshold of sediment potential than an exploration program under SLT, whereby exploration is more likely to be spread out. The location of the road (or any other disturbance) also affects its potential to contribute to sediment production and increased runoff. Construction activities in areas with steep slopes and less permeable soils often result in increased runoff. On a local level, and/or where the impacted acreage represents a higher percentage of the watershed area, the increased runoff volumes could trigger gully development and/or accelerated stream bank erosion in receiving streams. It could also exacerbate instability in previously existing deteriorated or vulnerable streams. Construction activities in other areas (those with flatter gradients, more permeable soils, or lower natural drainage density, for example) might only negligibly increase local runoff.

As the location of disturbance is impossible to predict, the impacts could range from negligible to major depending upon the amount and location relative to the affected stream channel, the type of road design, and the amount of traffic on the road. Effects could be short to long term depending upon the length of time the road is in service.

Floodplains: Oil and gas activity would directly impact floodplains primarily by removing vegetation and reducing the connectivity between streams and floodplains. The removal and/or degradation of floodplain vegetation could result at any phase of development, including seismic exploration. The removal of vegetation would reduce the ability of floodplains to slow water velocities during high flow events, reduce bank stability, increase erodibility of floodplains soils, and destroy structure that provides habitat for aquatic organisms during periods of inundation. Impacts to stream-floodplain connectivity would occur as a result of any development in the floodplain area; however, as described above, roads on National Forest System lands often run parallel to streams and have the greatest potential for impacts (Trombulak and Frissell 2000). These roads are usually constructed above the normal high-water mark and may be lined by riprap on the streambank side to prevent erosion. These roads essentially serve as dikes and may not allow streams to overflow onto parts of their floodplains. A reduction in stream-floodplain connectivity would increase flow velocities, decrease the availability of rearing and foraging habitat important to fish and other aquatic organisms, and reduce the amount of organic matter delivered to streams. An increase in flow velocities can result in increased stream erosion and subsequent changes in stream channel morphology, including bank erosion, channel widening, channel incision, and sedimentation.

Under SLT, a total of up to 32.9 miles of roads are possible adjacent to streams on the Pine Valley Ranger District, 78.7 miles on the Cedar City Ranger District, and 101.6 miles on the Powell and Escalante Ranger Districts. While this represents less than one percent of stream miles on the respective ranger districts, the local direct impacts to stream channels and floodplains could range from minor to moderate. Most impacts could be avoided if operations were moved up to the maximum amount possible (200 meters, 656 feet) and constructed in compliance with the laws and regulations mentioned. In addition, many floodplain areas may be considered jurisdictional wetlands and avoidance, minimization, or mitigation of impacts to these areas would be required by Section 404 of the Clean Water Act. Indirect impacts to floodplains would primarily be short term and negligible to minor and would consist primarily of impacts to vegetation as a result of sediment delivery to floodplain areas.

Riparian Areas: Similar to other resources discussed in this section, the greatest potential for impacts is from roads. The removal of riparian vegetation for road construction would reduce

wildlife habitat important to a variety of terrestrial animals, particularly bird species. In aquatic ecosystems, removal of riparian vegetation can decrease cover for fish and other aquatic organisms, reduce inputs of organic matter and woody debris, and decrease shade levels (Trombulak and Frissell 2000). As riparian areas purify water, trap sediments, buffer stream flows, and stabilize streambanks, the impacts of a reduction in riparian vegetation cover or condition can translate to streams in a similar way as described above for wetlands. These impacts can include increased flooding, increased stream erosion, and decreased base flows. As mentioned for stream channels, increased flow can lead to channel incision, which can lower local water tables and reduce the water available to riparian vegetation. The result is a negative feedback loop, where impacts to riparian areas can result in impacts to stream channels, which in turn can further impact riparian areas. Given the amount of disturbance that could occur within riparian areas under SLT, including roads (Table 4.7-3, *Measurement Indicator #5*), impacts would range from negligible to minor for seismic activity and minor to moderate for roads and well pads. Impacts would be both long and short term as changes in hydrology and stream channel conditions would be difficult to reverse in the short term.

Some amount of sediment from oil and gas activity in upland areas, particularly from roads, is likely to be delivered to riparian areas. However, given the modest amount of disturbance predicted for exploratory wells and adherence to the BMPs, the amount of sediment delivered to riparian areas would likely have negligible effects on riparian vegetation. More intense impacts could result from the roads and well pads associated with a production field but would likely still only range from negligible to minor. Other possible indirect effects may include some degradation of vegetation due to fugitive dust from adjacent facilities, but these would also be negligible and temporary.

Also, see *Measurement Indicators #4* and *5* at the end of this section.

GROUNDWATER

While direct ground-disturbing activities are not normally considered to have the potential to affect groundwater quality by introduction of sediments, there are some unique areas on the Dixie National Forest in which this could occur. These areas are where lava flows outcrop. These outcrops are highly permeable and essentially provide a direct pathway between the surface and groundwater. Road construction or pad development in these locations would likely require importing fill material, which could erode and be conveyed into the subsurface of the lava flows adversely affecting the permeability and geochemistry of the flow paths in the basalt lava rock. This impact would be site-specific, minor, and long-term, depending upon the exact circumstance. In some areas of the Cedar Ranger District, these lava fields overlie sensitive aquifers and these areas have been singled out as a resource component.

In addition to adverse water quality impacts related to sediment, contamination of groundwater could potentially occur due to inadvertent releases of pollutants from activities such as:

- Spilling fuels, lubricants, or liquid hydrocarbon product from mobile equipment;
- Spilling or releasing drilling fluids, including chemical products used during drilling or stimulation of production zones;
- Improperly casing or plugging wells; and
- Mishandling produced water.

Impacts of these activities are discussed below (under Other Water Quality Impacts) in association with surface water quality.

WATER QUALITY

Sediment-Related Water Quality Impacts: As already described above for watershed resources and stream channels in particular, oil and gas activity under SLT has the potential to increase erosion and surface water runoff. Some of the eroded material has the potential to enter streams, particularly if disturbance occurs within wetlands, floodplains, or riparian areas. This may result in adverse impacts to water quality, including raised sediment concentrations and increases in turbidity. Fugitive dust from vehicles, roads, and other bare soil areas can also be deposited on stream or lake surfaces, thus adding fine particles that could become suspended in the water column. This could increase turbidity. Introduction of sediments into a stream can also have side effects, including raising water temperature and increasing salt load, among others.

Once sediment has reached a stream, the distance and timing of its downstream progression is highly dependent upon factors such as particle size, flow patterns, stream velocity, bed substrate, and channel morphology, among others. For example, fine sediments derived from shales and clays are likely to remain suspended in all but the slowest-moving water, temporarily causing increased turbidity and sediment concentration, but not necessarily destabilizing the stream channel, which could lead to longer term adverse water quality impacts. Particle sizes added en masse to a stream might initially be deposited rather than transported, with finer sizes being gradually winnowed away over time, or the deposit might move downstream as a slug of sediment as a result of a single large storm event. A stream with a high percentage of pools might serve as a reservoir for sediments, temporarily mitigating the water quality impact, but over the long term altering the channel morphology. While there is a reasonable potential that fine sediment will be added from fugitive dust, this impact is not likely to be substantial, even where the sources are near to the water resource. As these few examples show, the variations in sediment transport are endless and thus difficult to predict, especially for general types of disturbances in unknown locations.

As a result, it is only possible to estimate adverse sediment-related water quality impacts from connected actions in a general manner. Although they would most likely be temporary or short term in duration, their magnitude could range from negligible to major, depending upon the location of the activity and the effectiveness of environmental protection measures. The environmental protection measures that would apply to the various types of activities have been designed to reduce the potential for adverse sediment-related water quality impacts. Section 2.6 describes these to include the *Surface Operating Standards and Guidelines for Oil and Gas Exploration and Development – The Gold Book* (BLM and USFS 2007), the *Forest Service Region 4 Oil and Gas Roading Guidelines*, and *Dixie National Forest Oil and Gas Construction and Operating Standards and Well Site Design Requirements* (Appendix C). For example, Operating Standards No. 4, 13, and 20 (Appendix C) require operators to implement erosion control measures. In general, the actual acreage of disturbance associated with any given well pad is relatively small, compared to the natural setting, and acreage associated with linear features such as roads and pipelines would be dispersed. This would also tend to reduce the potential for adverse sediment-related water quality impacts. Assuming that these environmental protection measures are properly implemented, that disturbance is distributed over multiple watersheds or sub-watersheds, and that project-specific NEPA analysis is completed, adverse sediment-related water quality impacts would likely be negligible or minor

for the majority of leases, at least as a result of the normal course of events. If the above assumptions are not met, impacts could be greater as previously described.

Also see *Measurement Indicators #1*, *2*, and *4* below.

Other Water Quality Impacts: In addition to adverse water quality impacts related to sediment, contamination of surface water or groundwater could potentially occur due to inadvertent releases of pollutants from activities such as:

- Spilling fuels, lubricants, or liquid hydrocarbon product from mobile equipment;
- Spilling or releasing drilling fluids, including chemical products used during drilling or stimulation of production zones;
- Improperly casing or plugging wells; and
- Mishandling produced water.

Fuels and lubricants would be used in all aspects of exploration and production. They are used in vehicles of all types and in equipment such as pumps, drill rigs, compressors, and the like. Further, a developed oil field would produce liquid oil, transporting it by pipeline and storing it temporarily at the well field, and conveying it by trucks from the production field out of the Dixie National Forest to market. While these hydrocarbons would not intentionally be released in such a way as to enter streams or groundwater, accidental releases could occur. The releases could be from field maintenance of vehicles or equipment, on-site fueling, transfer to and from storage facilities, and vehicle or equipment accidents. Secondary containment at tank batteries reduces the impact of the release. Depending upon the quantity of the release and its proximity to a stream, failure of secondary containment could adversely impact surface water quality. The degree of impact to surface water could vary from negligible to major, but in most cases it would be short term. If the release were to occur over a lava field overlying groundwater, in particular a lava field overlying a sensitive aquifer, it could adversely impact groundwater quality. While the degree of impact would vary depending upon the quantity released, the impact could be long term if not immediately mitigated.

Drilling fluids, including chemical additives, which can contain toxic substances, would be used during exploration well drilling. During production field development these fluids would be used both for drilling production wells and a produced water disposal (injection) well. Normally, these fluids would be contained in lined reserve pits on site and properly disposed off site after drilling is complete. Appendix C includes several criteria for reserve pits to ensure that they function properly. However, their inadvertent failure and release of fluids, or an operator's failure to follow protocol for off-site disposal, could result in short-term surface water quality impacts, the degree of which would depend upon the quantity released and the proximity of the release to a stream. The inadvertent release of these fluids on a lava field could have a longer-term impact on groundwater if it could not be immediately mitigated. Similarly, transporting any of these chemicals to the drill sites could result in accidental releases, which could impact either surface water or groundwater, again depending upon quantity and proximity, potentially affecting any of the three resource components to a degree ranging from negligible to major.

While drilling and completion activities must use casing and dry hole plugging designs that are intended to protect groundwater resources, their unexpected failure could lead to potential impacts to groundwater quality. This could also occur due to failure to isolate usable groundwater from other water-bearing zones with naturally poor quality water, potentially degrading a higher quality groundwater by introducing lower quality water. Such problems

would be difficult to discover, particularly in plugged and abandoned wells or in production wells where there are no operational symptoms of the problem. This type of impact, if it occurred, would likely be long term and range from moderate to major.

Water is produced as a natural byproduct of both exploration and production wells, but mostly during production. Due to the geologic occurrences that are the focus of oil and gas drilling, this produced water often contains high concentrations of Total Dissolved Solids (TDS). Because of its quality, the produced water typically cannot be discharged to surface waters, particularly within the Colorado River Basin where the Colorado River Salinity Control Forum has placed salt load limits on any water discharges. Thus, the produced water is normally temporarily held in storage tanks at the production facilities and then either disposed on site through a permitted underground injection well to a deep formation, or is trucked off site for disposal. Off-site disposal of produced water can also involve temporary storage in tanks and re-injection in a permitted well but can also take place in permitted, lined evaporation ponds. This EIS has assumed that one injection well and no large evaporation ponds would be utilized. Routine handling of produced water would not result in impact. Any release of production water would be accidental, however it could impact water quality depending upon the quantity released and its proximity to surface waters. Again, this type of direct impact could range from negligible to major, and would most likely be temporary for streams.

There is also the concern that the reinjected produced water could migrate into groundwater associated with other formations and degrade its quality. While the configuration of hydrogeologic characteristics may differ, a study done by the USGS (Steiger 2007) found no evidence that this has occurred in the Altamont-Bluebell oil and gas field in the Uintah Basin.

The environmental protection measures that would apply to the various types of activities have been designed to reduce the potential for adverse water quality impacts. Section 2.6 describes these to include: the *Surface Operating Standards and Guidelines for Oil and Gas Exploration and Development – The Gold Book* (BLM and USFS 2007), the *Forest Service Region 4 Oil and Gas Roading Guidelines,* and the *Dixie National Forest Oil and Gas Construction and Operating Standards and Well Site Design Requirements* (Appendix C). Assuming that these environmental protection measures are properly implemented, adverse water quality impacts would likely be short term and negligible to minor for the majority of leases, at least as a result of the normal course of events. If the above assumptions are not met, impacts could be greater.

As noted above, recent history indicates that the track record of the oil and gas industry is good, but not perfect, and it cannot be expected to be perfect. For the purposes of this document, it can reasonable be assumed that under SLT, at least one if not more, of the following could occur

- A hydrochloric acid spill as a result of hauling or use as a fracturing fluid;
- A hydrocarbon spill, due to a truck overturn or a line rupture, or similar event;
- A magnesium chloride (or other dust suppressant) release due to either a truck or tank spill or to over-application during dust control;
- Overflow of a reserve pit containing produced water; and/or
- A leak or other failure of an improperly placed, designed, or maintained reserve pit liner, resulting in a release of drilling fluids.

If one or more of these events, or similar events, occurred, it may or may not result in an impact to water resources depending upon the volume, location, proximity to waters, etc. However, it can be stated that the likelihood is greater under SLT than other leasing options with more restrictive leasing options.

Also see *Measurement Indicator # 1* below.

WATER USES

Introduction of sediment, fuels, lubricants, product oil, drilling fluids, or produced water to surface and/or groundwater systems that alter water quality, as described above, could also affect down gradient water users. The primary human users of Dixie National Forest water resources are downstream irrigators, and culinary users both on-Forest and downstream. Livestock, wildlife, and aquatic life also depend on Dixie National Forest surface water. Such water uses are often driven by the natural water quality and the reliability of the source. Water quality in the State of Utah is protected based upon its defined Beneficial Use classification, and in turn, this classification provides an indication of the types of uses a given stream segment may have (Utah Annotated Code R317-2-13).

For example, some streams on the Dixie National Forest are Beneficial Use Class 4, which means that they are protected for agricultural uses including irrigation of crops and stock watering. Class 4 streams have a TDS water quality standard for irrigation of 1,200 mg/L (ppm). If an accidental release of briny production water were to enter this stream, it would represent a violation of the water quality standard and could also temporarily affect an irrigator's ability to use this water source. If sediment-induced water quality impacts were to occur on this stream, there would not be a standards violation (there are no applicable sediment standards for Class 4 waters). While introduced sediment would not be a standards violation, there still may be impacts to an irrigator, such as a physical impact to a diversion structure as a result of sediment cause channel instability.

Some streams on the Dixie National Forest are Beneficial Use Class 3, which means that they are protected for fish and other aquatic life. For Class 3 streams, there are high state water quality standards for heavy metals. Some of the heavy metals for which water quality standards exist could be introduced into streams due to advertent chemical spills. This might only have short-term impact on water quality, but could have a longer-term impact on aquatic life if concentrations were high long enough to adversely impact aquatic species populations. Sediment impacts, which are not limited by water quality standards, could have long- or short-term impacts on aquatic life and upon humans who use those streams for fishing.

Degradation of municipal or culinary water supplies could occur if their source water were impacted. Beneficial Use Class 1 streams are those that are protected for such domestic purposes; however, within the Dixie National Forest, all such streams are in subclass 1C, which presumes that prior treatment is needed. There are numerous municipal watersheds throughout the Dixie National Forest. Since potential usage impacts to those features due to water quality impacts is not common to all action alternatives, the discussion on that subject occurs in Section 4.7.5.

In regard to groundwater supplies, there are not many currently used wells on the Dixie National Forest. However, there is at least some potential that fresh water aquifers could be affected by drilling, if proper procedures were not followed or if accidents occur. These effects could be due to: cross-contamination between aquifers, altered flow patterns as a result of withdrawal and

reinjection of water into the wells, and contamination from drilling fluids and other materials. Exploration activities would be less likely to result in this occurrence than production wells because they would be plugged sooner. Further, as noted above, a USGS study (Steiger 2007) found no evidence that migration of reinjected produced water has contaminated other aquifers in the Altamont-Bluebell oil and gas field in the Uintah Basin.

For the same reasons that there is uncertainty in determining location and level of impact to water quality in general, impacts to any given water use or users are also uncertain at this level of analysis. The environmental protection measures that would apply to the various types of activities have been designed to reduce the potential for adverse water quality impacts, and would thus reduce the potential for impact to water users. However, the site-specific NEPA analysis that would occur for any given future exploration or development proposal would fully analyze this potential effect.

Also see *Measurement Indicators #1* and *2* below.

IMPACTS TO WATER QUANTITY

During exploration and production, water is primarily used to facilitate drilling and control dust. Water for either of these uses cannot be withdrawn from a nearby stream or from a groundwater source without approval of the State Engineers Office. Exploration activities generally require a limited amount of water for a limited time period and the operator purchases water from an existing, legitimate water right holder. Water could be purchased from an off-site source such as a city well, or from a water right holder who temporarily defers their use of the stream for irrigation or stock watering. Therefore, there would be no net change in diversion of water from surface water or groundwater sources due to exploration water needs.

Larger quantities of water are needed during well field development than during exploration, due to a larger number of wells and a greater road network. For these longer-term road uses, a measure such as magnesium chloride application to roads for dust control is often used to reduce the need for frequent water application. It is likely that well field development and production activities would similarly purchase water from existing water holders, as described above for exploration. There is essentially no surface water and very little groundwater available for appropriation in any of the basins within the Dixie National Forest, so operators would likely purchase water that has already been appropriated, thus it is assumed that there would be no net change in diversion of water from surface water or groundwater sources.

During production, water is often removed from the wells in conjunction with the oil and/or gas (more so with gas than oil). Such produced water would be re-injected on site into the same formation from which it was obtained, or would be trucked off site for disposal by injection or evaporation. Produced water is typically poor quality and obtained from great depth; thus it is not generally considered to be usable groundwater or to support wetlands, stream base flow, aquatic wildlife, or human uses.

All uses of water during exploration, field development, or production must comply with rules established under Utah Water Rights Law (Title 73, Chapter 3, Appropriation). Produced water would be managed in compliance with rules established under the Utah Water Quality Act (Title 19, Chapter 5) so as not to infringe upon other water users' abilities to use water to which they have a right. Therefore, the effects to the quantity of water resources, including quantities associated with the three identified components, would be expected to be negligible.

Also see *Measurement Indicator #4* below.

Measurement Indicators

- *Measurement Indicator #1* NARRATIVE DESCRIPTION OF POTENTIAL SOURCES OF POLLUTANTS, THE TYPES OF POLLUTANTS, AND THE EFFECT TO SURFACE WATERS AND GROUNDWATER

The potential sources of pollutants, the types of pollutants, and the general effects to surface waters and groundwater are described above. As noted, whether these pollutants adversely affect water quality and by how much and for how long is uncertain because specific activity locations are not known and these impacts would vary by site location and conditions. Thus, future project-specific NEPA analyses would need to be relied upon for further analysis of this measurement indicator. However, the impacts would be negligible to minor as long as the existing environmental protection measures are properly implemented and no accidents occur.

- *Measurement Indicator #2* POTENTIAL TO INCREASE SEDIMENT IN SURFACE STREAMS

As noted above under SLT, there is an increased potential for increased sediment delivery to surface streams. The means by which this could occur was also described. Whether this increase would actually occur, its magnitude, and its duration would depend upon many factors and in part requires knowing the site-specific locations of the activities. Thus, the project-specific NEPA analyses would need to be relied upon for further analysis of this measurement indicator. However, the impacts could be kept as negligible to minor as long as environmental protection measures are properly implemented.

- *Measurement Indicator #3* RELATIVE POTENTIAL FOR INCREASING MILES OF ROADS WITHIN MUNICIPAL WATERSHEDS AND LAVA FIELDS OVER SENSITIVE AQUIFERS

Under SLT, road construction would be allowed in municipal watershed and lava fields over sensitive aquifers. As a result, total miles of new roads predicted by the RFDS (Table 4.7-3) to occur on any ranger district (13.3 miles of new road on the Pine Valley Ranger District, 19.9 miles on the Cedar City Ranger District, and 23.2 miles on both the Powell and Cedar City Ranger Districts) could occur within a municipal watershed. Lava fields over a sensitive aquifer only occur on the Cedar City Ranger District and the total amount of new roads that could occur would be 19.9 miles..

- *Measurement Indicator #4* NARRATIVE DESCRIPTION OF POTENTIAL EFFECTS TO SURFACE WATER FLOW AND GROUNDWATER AVAILABILITY

The filling of wetlands, whether via direct fill or indirect sedimentation, and an increase in the amount of roads would decrease the capability of watershed resources to moderate stream fluctuations. The result would likely be increased flow volumes and velocities during high flow events and decreased base flows during periods of low flow. In addition, the filling of wetlands and/or alteration of flow into wetlands could decrease groundwater recharge. The construction or roads within floodplain and riparian areas would also increase stream flow velocities by altering the ability of a stream to overflow its banks. Further, the construction of culverts and bridges at stream crossings by roads could create localized areas of high flows and scour.

- *Measurement Indicator #5* ACRES OF DISTURBANCE

The total disturbance that could occur relative to the different phases of oil and gas activity is listed by ranger district in Table 4.7-3. Disturbance of up to 396.9 acres could occur on the Pine Valley Ranger District, 622.9 acres on the Cedar City Ranger District, and 705.9 acres on the Powell and Escalante Ranger Districts.

4.7.5 Impacts by Alternative

The degree to which the impacts of connected actions (Section 4.7.4) would differ by alternative is discussed in this section. Alternatives involve leasing options, which would restrict the locations and the nature of oil and gas impacts. Because different resource components overlap, leasing options assigned to each resource component would also overlap and the most restrictive leasing option would take precedence (refer to Section 2.3.1). The water and watershed resource components are defined in Chapter 3

Table 4.7-4 shows the acres of wetland, floodplain, and riparian area resource components under each leasing option by alternative. Table 4.7-4 incorporates the amount of overlap with more restrictive leasing options (assigned to other resources) in addition to the leasing option assigned directly to each resource component. Alternatives D1, D2, E1, and E2 represent the dual analysis of Alternatives D and E. D1 and E1 represent the acres available with NSO in all IRAs. D2 and E2 represent the acres with leasing allowed in IRAs under a less restrictive leasing option. The following resource components fall within IRAs: lava fields over sensitive aquifers (32 percent); stream, lakes, springs, wetlands, floodplains, and riparian areas (35 percent); and municipal watersheds (23 percent).

In this section, impacts are generally discussed at the Forest-wide level and not by ranger district. This is done to avoid repetition and facilitate the comparison of impacts across alternatives. However, any pronounced differences in the impacts to a resource component between ranger districts will be highlighted and discussed.

Table 4.7-4 Acreage of Resource Components under each Leasing Option by Alternative

Resource Component	Leasing Option[3]	Alternative[1,2]						
		A	B	C[4]	D2	D2	E1	E2
Lava Fields over Sensitive Aquifers	NA							
	NL	58,585	41,990	225				
	NSO		16,596	58,565	58,790	58,790	18,821	
	CSU							
	SLT						39,969	58,790
Streams, Lakes, Springs, Wetlands, Floodplains, and Riparian Areas (including riparian vegetation)[5]	NA	22,939	37,325	22,939	22,940	22,940	22,939	22,939
	NL	387,879	543,172	5,614				
	NSO		82,338	382,265[3]	167,404	27,370	142,117	
	CSU				220,477	360,510		
	SLT						245,762	387,879
Municipal Watersheds	NA		7,587	7,587	7,587	7,587	7,587	7,587
	NL	53,403	45,816	5,449				

Resource Component	Leasing Option[3]	Alternative[1,2]						
		A	B	C[4]	D2	D2	E1	E2
	NSO			40,366	23,548	5,940	12,480	
	CSU				22,268	39,876		
	SLT						33,337	45,816

[1] Small discrepancies in the acreage presented for each alternative are due to the fact that the GIS database has limitations when applied over an extremely large area that result in an inability to calculate acreages that match exactly between alternatives. A more detailed table that separates the acreage by resource component and ranger district will be available in Appendix B.
[2] Alternatives D1, D2, E1, and E2 represent the dual analysis of Alternatives D and E. D1 and E1 represent the acres available with NSO in all IRAs. D2 and E2 represent the acres with leasing allowed in IRAs under a less restrictive leasing option.
[3] Areas not legally available (NA) for leasing (see Section 1.5.2) are included in the Table to provide context to the analysis.
[4] NSO for Alternative B is different than for Alternative C and is described in Section 4.7.4.3
[5] Includes a 300-foot buffer (410,550 acres), except for Alternative B, which includes a 500-foot buffer (662,835 acres). As a result, acreage for Alternative B in the table is large than under the other alternatives.

4.7.5.1 Alternative A

There would be no oil and gas activities on the Dixie National Forest within areas not currently leased. Alternative A would continue present management activities as pertaining to oil and gas leasing. The Forest Supervisor under this alternative would not make any new leasing decisions and no new oil and gas leasing would be allowed on the Dixie National Forest. Current operations, including the Upper Valley oil field on the Escalante Ranger District (19 wells, including nine water-injector wells) would continue (USFS 2006g). In total, there are 13,454 acres of existing leases on the Dixie National Forest. Existing leases will expire and the potential number of wells that could be drilled on the Dixie National Forest would decrease over time. As no new leases would be made available, there would be no direct or indirect impacts to water and watershed resources. There would be no change in the measurement indicators.

4.7.5.2 Alternative B

Alternative B would apply a NSO leasing option to lava fields over sensitive aquifers, a NL option to municipal watersheds, and a NL option to the 300-foot buffer around all waterbodies. It would also apply a NSO leasing option to a 500-foot buffer around these areas. Considering leasing option overlaps, approximately 28 percent (16,596 acres) of lava field over sensitive aquifers would be under NSO and approximately 72 percent (41,990 acres) would be under NL. Approximately six percent (37,325 acres) of the 300-foot buffer are occurs in areas not legally available (NA) for leasing, approximately 82 percent (543,172 acres) would be under NL, and approximately 12 percent (82,338 acres) would have a NSO leasing option. For municipal watersheds, approximately 14 percent (7,587 acres) would be under NA and 86 percent (45,816 acres) would be under NL (Table 4.7-4).

Under this alternative, disturbance (*Measurement Indicator #5*) could only occur in the 200-foot distance between the outer edge of the 300-foot buffer and the outer edge of the 500-foot buffer and in lave fields over sensitive aquifers Disturbance in these areas would be limited to seismic activity by NSO. As a result, up to 60 acres of seismic exploration could occur on the Pine Valley Ranger District and 120 acres on the Cedar City, Powell, and Escalante Ranger Districts. This represents less than one percent of the total acreage available on the individual ranger districts. There would no surface disturbance to municipal watersheds and essentially no potential for the types of effects described in Section 4.7.4.6. Further, there would be no potential for increasing miles of roads within municipal watersheds and lava fields over sensitive

aquifers (*Measurement Indicator #3*). Impacts to the 28 percent of lava field over sensitive aquifers available under NSO would be the same as described for NSO in Section 4.7.4.3.

For watershed resources and surface waters, the NSO leasing option applied under this alternative would not allow roads within the buffers, including perpendicular stream crossings. There would be no disturbance within the 300-foot buffer and only seismic exploration within the additional 200-foot area associated with the 500-foot buffer. As most wetlands, floodplains, and riparian areas are expected to be contained within the 300-foot buffer, there would be no direct impacts to wetlands, stream channels, floodplains, or riparian areas. Indirect effects to these resources could occur as a result of oil and gas activity on adjacent land as described in Section 4.7.4.6 and would include primarily the delivery of sediment (*Measurement Indicator #2*) and contaminants (*Measurement Indicator #1*) to these areas, as well as possible changes in drainage patterns (*Measurement Indicator #4*). Given the additional buffer distance (200 feet beyond the edge of the 300-foot buffer), most erosion, sediment transport, and hazardous material spills should settle out prior to entering the 300-foot buffer.

However, despite this and the BMPs described, changes to drainage patterns as a result of activity in upland areas may not be entirely buffered by the additional 200 feet and could still affect watershed resources. It is most likely that the changes would not be of a magnitude sufficient to cause more than minor impacts, with duration depending upon the type of activity.

In addition, there is some potential for the general effects described in Section 4.7.4.6 to occur to water and watershed resources outside of the defined components. Those three components represent aspects of water resources that are keyed upon in this EIS, but in fact, water and watershed resources occur across the Forest. For surface water resources, upland watershed areas, ephemeral channels, or headwater catchment areas are not included in the streams resource component, but could be impacted by the types of general effects described above. In part, because this restricts the potential areas wherein oil and gas exploration can occur, it might have the consequence of forcing disturbances to be located within a smaller area and perhaps result in a greater likelihood that a higher proportion of a small subwatershed could be disturbed, even if the identified water and watershed resource components were not directly subject to the activity. For example, while exploration activity in general might not be likely to greatly increase road density over some threshold value (such as the two miles/square mile), if enough land is excluded from exploration, the remaining available land might result in a concentration of activity and thus by default increase road density in that area. Groundwater occurs in other areas than just the identified lava fields over sensitive aquifer component, and would have at least some potential for impact, depending upon specific circumstances.

However, the environmental protection measures that would apply to the various types of activities would reduce the likelihood of impacts, assuming that they are properly implemented. That, combined with the leasing options that would be in place under this alternative, the likelihood of occurrence would be even further reduced because the areas over which the impact could occur would be limited. For example, the types of specific events listed in Section 4.7.4.6 as being assumed that could occur under SLT (hydrochloric acid spills, hydrocarbon spills, magnesium chloride releases, reserve pit overflows, failure of reserve pit liner), are less likely to occur under this alternative and much less likely to affect water resources, should they occur.

4.7.5.3 Alternative C

Alternative C would apply a NSO leasing option to all water and watershed resources. Considering leasing option overlaps, all lava fields over sensitive aquifers (which occur only on the Cedar Ranger District) would be under a restrictive leasing option, with most areas under NSO (99.6 percent, 58,565 acres) and 0.4 percent (225 acres) under NL. Regarding municipal watersheds, 76 percent (40,336 acres) would be NSO, 14 percent (7,588 acres) would be NA, and 10 percent (5,449 acres) would be NL. Approximately six percent (22,939 acres) of the 300-foot buffer areas would be within areas not legally available for leasing (NA) and approximately 5,614 acres (one percent) would be within areas with a NL option. The remaining 93 percent (382,265 acres) would be available under NSO. However, two NSO leasing options would apply. Approximately 69 percent (284,220 acres) would be under a general NSO leasing option that would not allow use or occupancy, with the exception of seismic exploration. Approximately 24 percent (98,045 acres) would be under the NSO developed to allow for perpendicular stream crossings.

As a result of the different NSO leasing options under Alternative C, direct impacts to watershed resources and surface water would be limited to seismic exploration over 69 percent of the 300-foot buffer, with a small amount of road, culvert, and bridge construction allowed in 24 percent of the 300-foot buffer. Leasing and associated impacts could not occur on seven percent (six percent NA and one percent NL). The impacts of seismic exploration would be as described for SLT in Section 4.7.4.6. Road-stream crossings would also have impacts as described in Section 4.7.4.6 including the introduction of sediment, increased bank erosion, and alteration of local hydrological conditions; however, most of these would be avoided by following existing requirements contained in Appendix C and BLM and USFS (2007). Also, impacts of road stream crossings would be less severe than described in Section 4.7.4.6, as only small amounts of these water and watershed resources would be affected at each crossing (there would be approximately 600 linear feet of road within the buffer at each crossing, or about 0.5 acres). As a result, impacts would range from negligible to moderate and would be short to long term. Indirect effects would be the same as described for SLT in Section 4.7.4.6. The majority of lava fields over sensitive aquifers and municipal watersheds would be available under NSO and the impacts to these resources would be the same as described for NSO in Section 4.7.4.3. There would be no potential for increasing miles of roads within municipal watersheds and lava fields over sensitive aquifers (*Measurement Indicator #3*).

Direct disturbance under this alternative (*Measurement Indicator #5*) would be primarily seismic exploration, with up to 60 acres on the Pine Valley Ranger District and 120 acres on the Cedar City, Powell, and Escalante Ranger Districts. In addition, approximately 0.5 acres (600 linear feet) of roads would be constructed at each stream crossing. As the number of possible stream crossings is unknown, a conservative estimate is to assume that disturbance could be up to the maximum estimated for road construction on each ranger district. This would be up to 53.5 acres for the Pine Valley Ranger District, 160.5 acres for Cedar City, and 214.0 acres for the Powell and Escalante Ranger Districts. As a result, total acres disturbed would be 113.5 acres for the Pine Valley Ranger District, 280.5 acres for the Cedar City Ranger District, and 334.0 acres for the Powell and Escalante Ranger Districts. This represents less than one percent of the total acreage of the different resource components on the individual ranger districts.

Indirect effects may also occur as a result of oil and gas activity in upland areas. The types and magnitude of indirect effects would generally be the same as for Alternative B; however, the potential for these effects to occur is increased relative to Alternative B due to the lack of an additional buffer. Also, as described under Alternative B, there would be the potential to impact

water resources other than those associated with the three identified resource components. However, the types of specific events listed in Section 4.7.4.6 as being assumed that one or more could occur under SLT (hydrochloric acid spills, hydrocarbon spills, magnesium chloride releases, reserve pit overflows, failure of reserve pit liner), are less likely to occur under this alternative and substantially less likely to affect water resources, should they occur. In general, this alternative would have an increased potential for effect to water and watershed resources relative to Alternative B, but the potential for direct effects would be reduced compared to Alternatives D and E.

4.7.5.4 Alternative D1 (NSO in IRAs)

Under Alternative D1 (NSO in IRAs), NSO would apply to 100 percent of lava fields over sensitive aquifers and CSU would apply to the other water and watershed resource components. Approximately 42 percent (22,268 acres) of municipal watersheds would be CSU, approximately 44 percent (23,548 acres) would have an NSO leasing option, and the remainder (14 percent, 7,587 acres) would be NA. Approximately six percent (22,940 acres) of the 300-foot buffered areas would be within wilderness and not legally available (NA) for leasing, 41 percent (167,404 acres) would be under NSO, 54 percent (220,477 acres) would be under CSU.

When compared with Alternative C, assignment of leasing options under this alternative is almost the same in regard to lava fields over sensitive aquifers, except that all acres would be available only under NSO, rather than the 0.4 percent that would be NL under Alternative C. There is no potential for increasing miles of roads within lava fields over sensitive aquifers (*Measurement Indicator #3*).

As described in Section 4.7.4.5, the CSU applied to the 300-foot buffer around all waterbodies is similar to the NSO applied under Alternative C (NSO with Stream Crossings). As a result, the impacts to watershed resources and surface waters (including *Measurement Indicators # 1, 2, 4*, and *5*) would be the same as described for Alternative C. For municipal watersheds, the disturbance allowed would essentially be the same as SLT (*Measurement Indicators #3* and *5*). However, the level of impacts expected to occur from the types of impacts to water quality described in Section 4.7.4.6 would be reduces due to increased oversight and regulation. As a result, impacts due to short-term sediment impacts and temporary impacts from accidental releases of fuels or chemical spills would be negligible to moderate, and short-term (as compared to negligible to major under SLT). However, given the amount of disturbance allowed under CSU, there would still be a greater potential to impact municipal watersheds than under Alternative B and C.

4.7.5.5 Alternative D2 (CSU in IRAs)

Under Alternative D2 (CSU in IRAs), 100 percent of lava fields over sensitive aquifers would be under a NSO leasing option. Approximately 14 percent (7,587 acres) of municipal watershed would be under NA, 75 percent (39,876 acres) would be CSU, and 11 percent (5,940 acres) would have an NSO leasing option. Approximately six percent (22,940 acres) of the buffered areas would be within wilderness and not available for leasing, seven percent (27,370 acres) would be under NSO, and 87 percent (360,510 acres) would be under CSU.

The same types of impacts as described for Alternative D1 would have the potential to occur under this alternative and the impacts (including *Measurement Indicators*)would be the same as described for Alternative D1. The difference between Alternative D2 and Alternative D1 is simply a matter of the amount of acres of streams, lakes, springs, wetlands, floodplains, riparian areas, and municipal watersheds where surface occupancy would be allowed. Under this

alternative, a greater number of acres would have a CSU leasing option and thus would be more prone to impact than equivalent areas where NSO would apply.

4.7.5.6 Alternative E1 (NSO in IRAs)

Under this alternative, all of the identified resource components would be available for lease under SLT, with the exception of those that are NA, or are within IRAs, which would be available under the NSO leasing option. Approximately 32 percent (18,821 acres) of lava field over sensitive aquifers would be within IRAs and under NSO. The remainder (68 percent, 39,969 acres) would be available under SLT. For municipal watersheds, 14 percent (7,587 acres) would be NA, 23 percent (12,480 acres) would be within IRAs and under NSO, and 63 percent (33,337 acres) would be available under SLT. Approximately six percent (22,939 acres) of the buffered areas would be within wilderness and not legally available (NA) for leasing and 34 percent (142,117 acres) would be under NSO. The remaining 60 percent (245,762 acres) would be available under SLT.

As large portions of each resource component are available under SLT, the impacts would generally be the same as described for SLT in Section 4.7.4.6. However, an average of 35 percent of all water and watershed resource components would be under NA or protected by NSO, and the potential for impacts would be reduced relative to having the entire area available under SLT. Disturbance (*Measurement Indicator #5*) would be the same as described for SLT in Section 4.7.4.6 and shown in Table 4.7-3.

4.7.5.7 Alternative E2 (SLT in IRAs)

Under this alternative, the identified resource components would all be available for lease under SLT, except where they are NA (the same percentages as under Alternatives C, D, and Alternative E1). This means that all of the potential impacts discussed under 4.7.4.6 would have the potential to occur on all of the lava fields over sensitive aquifers, 94 percent of water resource components within the 300-foot buffer, and 86 percent of municipal watersheds. Both direct and indirect impacts as well as disturbance (*Measurement Indicator #5*) would be the same as described for SLT in Section 4.7.4.6. All told, this alternative would have the greatest potential to impact water and watershed resources.

4.8 Soils and Geologic Hazards

4.8.1 Introduction

The terms used to describe the context and intensity of effects in this section are discussed in Section 4.1 and Table 4.1-1. Table 4.8-1 provides an example how these terms would apply to soils and geologic hazards.

Table 4.8-1 Terms used to Describe Effects to Soils and Geologic Hazards

Attribute of Effect		Description relative to Soils and Geologic Hazards
Quality	Beneficial	Soil structure, texture, and fertility are fortified over time, leading to decreased rates of soil erosion and increased plant productivity.
	Adverse	Soil structure, texture, and fertility are lost over time, leading to increased rates of soil erosion and decreased plant productivity.
Magnitude (Intensity)	Negligible	Any change to soil structure, texture, or fertility is so small it cannot be measured effectively using existing methods.
	Minor	Changes to soil structure, texture, or fertility are large enough to be measured using existing methods. However, these changes are small and do not change physical or biological conditions on the affected area or surrounding lands.
	Moderate	Changes to soil structure, texture, or fertility are large enough to be measured using existing methods. Changes may result in increased erosion or sedimentation above background levels, and/or decreased plant cover and production on the affected area or surrounding lands. The land still supports vegetation and soil productivity is maintained at a base level.
	Major	Changes to soil structure, texture, or fertility are large enough to be measured using existing methods. Changes include increased erosion or sedimentation above background levels, and/or decreased plant cover and production on the affected area or surrounding lands that result in long-term and visible change to the soil and vegetative resource on the affected area and nearby soils.
Duration	Temporary	A decrease in vegetation and other soil cover and an increase in sediment delivery during construction of a facility (i.e., road, well pad) that is resolved once construction is completed.
	Short-term	A decrease in vegetation and other soil cover and an increase in sediment delivery due to exploration activities (i.e., construction of exploratory well pads or access roads). These changes are limited to the time needed for exploration and reclamation, 10 years or less.
	Long-term	A decrease in vegetation and other soil cover and an increase in sediment delivery due to the construction of production facilities (i.e., a production field and associated roads). The life of the production field and the time needed for reclamation would exceed 10 years.

4.8.2 Measurement Indicators

- *Measurement Indicator #1* ACRES OF DISTURBANCE
- *Measurement Indicator #2* NARRATIVE DESCRIPTION OF POTENTIAL EFFECTS TO SOIL PRODUCTIVITY
- *Measurement Indicator #3* POTENTIAL SOIL LOSS
- *Measurement Indicator #4* MILES OF ROAD AND AREA OF DISTURBANCE (ACRES) ON SENSITIVE LANDFORMS
- *Measurement Indicator #5* POTENTIAL FOR CREATING HAZARDOUS CONDITIONS
- *Measurement Indicator #6* PERCENTAGE OF DISTURBANCE ON SENSITIVE SOIL TYPES

4.8.3 Impacts Common to All Action Alternatives

Under Alternatives B, C, D, and E, it is assumed that activities described in the RFDS would occur. Activities described under the RFDS include 60 to 120 acres (depending upon ranger district) of overland travel associated with seismic surveys, 80 to 330 acres (depending upon ranger district) of land clearing surface disturbance associated with road and pad building for exploration wells, and 254 acres of land clearing surface disturbance for a production field (per ranger district). The locations of these activities are not yet known.

Seismic exploration effects were noted in a BLM compliance review of a recent 2-D seismic survey conducted in northeastern Utah between 6,000 and 8,000 feet elevation. Truck-mounted drills, buggy-mounted drills, OHVs, and heliportable drills were used. Effects of heliportable drills were limited to footprints by workers in the 3-foot diameter drill area with some subsurface drill cuttings left on the surface. Impacts from truck- and buggy-mounted drill rigs were more noticeable and included up to six passes by some form of vehicle. Effects included localized compaction, decreased infiltration, corresponding increased surface run-off, and decreased ability for seedling establishment and root growth (BLM 2002).

For the Dixie National Forest, seismic work occurring on steep slopes could result in compaction of soil where wheeled vehicles pass. This could lead to the formation of rills and new flow patterns, which, over time, could develop into gullies. Where stream channels were crossed, imprints could be left on channel banks, which would be susceptible to increased erosion or head-cutting. Any vehicle path could lead to the establishment of new four-wheel drive or OHV trails. However, in the Utah study, all types of drills and transportation devices were determined to cause “little soil disturbance,” which would be “normal in appearance after the next spring’s rains” (BLM 2002). With this report in mind, it is likely that effects of seismic surveying on soil resources would be adverse, negligible to minor in intensity, and short term in duration.

Exploratory well development would likely cause the following impacts to soils in all locations:

- An increase in erosion of soil materials from roads and drill pads onto native lands due to run-off events, wind, and traffic. Erosion would be more likely to occur on cut slopes, fill slopes, and/or developments located on steep slopes or areas with high erosion potential. Using BMPs *and Dixie National Forest Operating Standards and Well Site Design Requirements* (see Appendix C), these impacts would most likely be adverse, negligible to minor, and short term in duration.
- An increase in sediment deposition on lands next to roads and drill pads, or in streams near these areas, due to the erosion noted above. Using BMPs, these impacts would most likely be adverse, negligible to minor in intensity, and short term in duration.
- Pollution to soil resources due to hydrocarbon, drilling mud, or other chemical spills occurring on drill pads, some of which may require treatment at a land farm. Using BMPs, these impacts would most likely be adverse, negligible to moderate in intensity, and would generally be short term in duration. However, if a reportable spill were to occur, effects could be adverse, major, and long term.
- Development of any oil and gas related infrastructure on rockfall/unstable areas could result in more frequent landslides and rockfall. This would be hazardous to people, wildlife, livestock, vegetation, and other resources that could be hit and injured, killed, or buried by falling rock. If proper siting of well pads and roads occurred, most incidents would be adverse, negligible to minor in intensity, and short term in duration. Proper siting of well pads and roads would reduce the likelihood of such incidents.

Full-field development would likely include the same effects as described for exploration above.

Table 4.8-2 lists the leasing option assigned to each sensitive soil/geologic hazard by alternative. Descriptions of leasing options (and associated impacts on soils) are described in Section 4.8.4. Each assigned leasing option would either allow or restrict certain oil and gas activities (described under the RFDS) wherever the applicable resource component occurs on the Dixie National Forest.

Table 4.8-2 Leasing Options Assigned to Areas with Sensitive Soil/Geologic Hazards under each Alternative

Resource Component	Alternative				
	A	B	C	D	E
Active rockfall and landslide areas	NL	NSO	NSO	NSO	SLT
Slopes > 35 percent	NL	NSO	NSO	CSU	SLT
Areas of high erosion potential	NL	NSO	NSO	CSU	SLT
Marginally unstable slopes	NL	CSU	CSU	SLT	SLT
Cave resources	NL	CSU	CSU	CSU	SLT

4.8.4 Impacts of Connected Actions by Leasing Option

Leasing options would dictate the conditions under which impacts from connected actions (described under the RFDS) may occur. Impacts from connected actions under each leasing option are discussed in this section. Impacts to soil resources, considering leasing option overlaps (i.e., overlaps with more restrictive leasing options assigned to other resources) are discussed in Section 4.8.5 (Impacts by Alternative). Under all leasing options and alternatives, oil and gas activity would be subject to the Best Management Practices (BMPs) listed in the *Dixie National Forest Oil and Gas Construction and Operating Standards and Well Site Design Requirements* (Appendix C) and the *Surface Operating Standards and Guidelines for Oil and Gas Exploration and Development – The Gold Book* (BLM and USFS 2007).

4.8.4.1 Not Legally Available (NA)

NA applies to lands that are not legally available for leasing, including Brian Head Ski Permit Area, wilderness areas, and areas surrounding the Box-Death Hollow Wilderness Area that were withdrawn from leasing by the Utah Wilderness Act of 1984. No oil and gas leasing would occur in these areas and no disturbance to soils in these areas would occur.

4.8.4.2 No Lease (NL)

NL applies to lands where no new leases would be authorized. These lands would not be administratively available for leasing and no disturbance to soils or geologic hazards would occur under NL. Under Alternative A, NL would apply to all soils and geologic resource components listed in Table 4.8-2. No oil and gas leasing would occur in these areas; thus no disturbance to soils would occur in these areas.

4.8.4.3 No Surface Occupancy (NSO)

With the exception of seismic activities, NSO would prohibit occupancy or use of the land for oil and gas activities (e.g., construction of well pads, central tank batteries, access roads, pipelines, power lines, and other linear structures). Under Alternatives B and C, NSO would apply to rockfall/unstable areas, steep slopes, and areas of high erosion potential. Under Alternative D,

NSO would apply only in rockfall/unstable areas. Under Alternative C, linear features (e.g., roads, pipelines) would be allowed perpendicular to streams.

Measurement Indicators

- *Measurement Indicator #1* ACRES OF DISTURBANCE

Under NSO, seismic activities could occur and could affect 60 to 120 acres. These disturbances could be located in rockfall/unstable areas, steep slopes, or areas with high erosion potential. Potential effects would vary depending on the soil affected and are described more fully under the measurement indicators below. Compared to the total acreage of sensitive soils, these effects would be negligible and short term in duration.

- *Measurement Indicator #2* POTENTIAL EFFECTS TO SOIL PRODUCTIVITY

Under NSO, seismic exploration activities could occur and could be located in rockfall/unstable areas, on steep slopes, and on areas with high erosion potential. Potential effects include a loss of soil productivity due to breaking down of the soil structure on travelways of seismic trucks and buggies, especially in areas with minimal vegetation coverage. Some downhill or downstream sedimentation would be expected if disturbed soil was eroded. If seismic work is conducted using trucks on roads, and helicopters and/or specially designed buggies, impacts to sensitive soils/geologic hazards would be negligible and short term in duration. I

- *Measurement Indicator #3* POTENTIAL SOIL LOSS

Under NSO, seismic exploration activities could occur and could be located in rockfall/unstable areas, on steep slopes, and on areas with high erosion potential. Potential effects include erosion of soil due to wind and water, particularly if seismic lines went straight up and down hills.

Soil loss would be minimal on areas with high rockfall potential since these areas have little soil and are often barren of vegetation (e.g., boulder field, lava flow field). Effects of soil loss due to seismic activity in rockfall areas and cave resources would be negligible and short term.

Soil loss would tend to be more severe on steep slopes/unstable areas especially if landslides are caused by activities (slopes mostly greater than 35 percent) because there is often a substantial soil resource in these areas that is being pulled downward by the force of gravity and may be poorly adhered to the underlying parent material. Activities that involve steep cuts and fills (roads and pads) could change slope support dynamics and result in greater soil water retention, which could cause the soils to move or fail. Areas with thicker vegetation cover are often less likely to erode because of the anchoring effects of root systems and plant transpiration which removes water from the soils. Effects of soil loss due to seismic activity on steep slopes could cause adverse, minor impacts of long-term duration.

Soil loss on highly erosive soils would be most severe due to the inherent erodibility of these soils. Effects of soil loss due to seismic activity on highly erosive soils could cause adverse, minor impacts of long-term duration.

- *Measurement Indicator # 4* MILES OF ROAD AND AREA OF DISTURBANCE ON SENSITIVE LANDFORMS

Under NSO, no roads would be constructed. However, as explained in Section 2.2.3, approximately 100 miles of seismic lines could occur on the Pine Valley Ranger District, and

200 miles could occur on each of the other ranger districts in the next 15 years, with approximately 50 to 100 linear miles per ranger district per year. This is equivalent to 60 to120 acres of total disturbance per ranger district over 15 years. Physical impacts of seismic surveying on sensitive soils/geologic hazards are described in Section 4.8.3. The effect of running 100 to 200 miles, or 60 to120 acres, of seismic line across rockfall areas, areas with slopes over 35 percent, and/or areas high erosion potential in each ranger district would be an adverse, negligible to minor impact of short-term duration.

- *Measurement Indicator # 5* POTENTIAL FOR CREATING HAZARDOUS CONDITIONS

Under NSO, seismic activities taking place in rockfall/unstable areas, steep slopes, or areas with high erosion potential could create hazardous conditions if drill sites and travelways were not selected to avoid potential rockfall areas, or areas or conditions prone to cause landslide. Rockfall may occur any time, but is more frequent during freeze-thaw periods. Landslides tend to occur during very wet periods, on very steep, unconsolidated slopes, or on cut banks adjoining drainages. Because of the nature of these landscapes, areas affected by rockfall or landslides would be altered permanently, effects of seismic activities conducted in hazardous areas could be adverse and minor to moderate in intensity depending on the size of any resulting landslide or rockfall area, and long term in duration.

- *Measurement Indicator # 6* PERCENTAGE OF DISTURBANCE ON SENSITIVE SOIL/GEOLOGIC HAZARDS

Percent disturbance on sensitive soils/geologic hazards would be up to 0.8 percent of the total if all disturbance through production wells occurred on sensitive soils/geologic hazards, which is highly unlikely. For all sensitive soils/geologic hazards, this would be a negligible, short-term impact.

4.8.4.4 Timing Limitation (TL)

No Timing Limitation stipulations were developed for protection of Soils and Geologic Hazards.

4.8.4.5 Controlled Surface Use (CSU)

The CSU leasing option allows surface use on all or portions of a lease with special operational constraints that may otherwise exceed the mitigation provided by SLT, regulations, and operating orders. A CSU leasing option would not prevent disturbance to sensitive soils/geologic hazards. A CSU leasing option would apply to marginally unstable slopes under Alternatives B and C and to slopes over 35 percent and areas of high erosion potential under Alternative D. Impacts to soils resources under CSU with regard to applicable measurement indicators are described below.

- *Measurement Indicator #1* ACRES OF DISTURBANCE

Under CSU, marginally unstable slopes and cave resources would be open to exploration and production under Alternatives B and C. Steep slopes and areas of high erosion potential would be open to these disturbances under Alternative D. Effects from seismic activities would be the same as those listed in Section 4.8.3 and for NSO (Section 4.8.4.3), which were identified as negligible and short term in duration.

Under CSU, up to 330 acres of disturbance for exploration and 254 acres of disturbance for full-field development could occur on marginally unstable slopes and cave resource areas under

Alternatives B or C, and to steep slopes and areas of high erosion potential under Alternative D. This is the same amount of possible disturbance as under SLT (Section 4.8.4.6). However, impacts to sensitive soils would not be as likely because the CSU stipulation states that wells will be sited to avoid these areas. Considering likely avoidance in addition to the small relative amount of sensitive soil disturbance that is possible if all activities did occur in these areas (Table 4.8-3), impacts would be negligible.

- *Measurement Indicator #2* POTENTIAL EFFECTS TO SOIL PRODUCTIVITY

Under CSU, marginally unstable slopes and cave resources would be open to seismic exploration under Alternatives B and C. Steep slopes and areas of high erosion potential would be open to seismic exploration under Alternative D. Between 60 and 120 acres would be disturbed by seismic exploration. Effects would be similar to those listed under Section 4.8.3, Impacts Common to all Action Alternatives. Compared to the total acreage of these sensitive soils (Table 3.8-1), these effects would be negligible and short term in duration.

Under CSU, exploration or full-field development on marginally unstable slopes or cave resources areas under Alternatives B or C, or slopes over 35 percent or areas with high erosion potential under Alternative D, could result in lost soil productivity if soil resources were polluted due to hydrocarbon, drilling mud, or other chemical spills on drill pads. Under the CSU, these impacts would be the same as SLT (Section 4.8.4.6): most likely adverse, minor in intensity, and of short-term duration. However, if a spill were large enough to be reportable, effects could be adverse, major, and long term, as under SLT (Section 4.8.4.6).

- *Measurement Indicator # 3* POTENTIAL SOIL LOSS

Under CSU, marginally unstable slopes and cave resources would be open to seismic exploration under Alternatives B and C. Steep slopes and areas of high erosion potential would be open to seismic exploration under Alternative D. Effects would be similar to those listed under Section 4.8.3 and for NSO (Section 4.8.4.3). Compared to the total acreage of these sensitive soils (Table 3.8-1), these effects would be negligible and short term in duration.

Under CSU, exploration or full-field development could result in soil loss on marginally unstable slopes or cave resource areas under Alternatives B and C, or steep slopes or areas with high erosion potential under Alternative D if erosion from roads and drilling pads were not controlled adequately, as under SLT (Section 4.8.4.6).

Erosion would be most likely to occur if the surface of roads and drill pads were not adequately watered or was fine-textured. Erosion is also more likely to occur on cut slopes, fill slopes, and/or travelways. Erosion can increase sediment load in streams located near existing and newly developed roads and drill pads. The erosional force of water is more pronounced on steep slopes. Soil takes many years to re-develop once it is lost. Under the CSU, however, impacts from soil loss on erodible soils, marginally unstable slopes, and steep slopes should be adverse and minor, but long term in duration.

- *Measurement Indicator # 4* MILES OF ROAD AND AREA OF DISTURBANCE ON SENSITIVE LANDFORMS

Under CSU, seismic disturbance could take place. Effects would be similar to those listed under Section 4.8.3 and for NSO (Section 4.8.4.3), which were identified as negligible and short term in duration.

As under SLT (Section 4.8.4.6), if all roads were constructed in sensitive soil areas, the proportion of road mileage on sensitive soils/geologic hazard areas would increase by 26 percent. Under Alternative B & C, this disturbance could occur on marginally unstable slopes or cave resource areas. Under Alternative D, this could occur on steep slopes or areas with high erosion potential and cave resources. Assuming that roads are constructed to standards outlined in BLM and USFS (2007) and the *Dixie National Forest Oil and Gas Construction and Operating Standards and Well Site Design Requirements* (Appendix C), effects of this increased road mileage on sensitive soils/geologic hazards would be an adverse, moderate impact of long-term duration. These would be the same impacts as under SLT because the CSU has no specific stipulations regarding road building over sensitive soils.

- *Measurement Indicator # 5* POTENTIAL FOR CREATING HAZARDOUS CONDITIONS

Effects of seismic activities conducted in hazardous areas would be adverse and minor to moderate in intensity depending on the size of any resulting landslide or rockfall area, and long term in duration as analyzed in section 4.8.3 and 4.8.4.3 for NSO.

Under CSU, exploration drilling or full-field development could create unstable conditions on marginally unstable slopes under Alternatives B and C, and steep slopes or highly erosive areas under Alternative D if oil and gas facilities are not properly planned and constructed. However, CSU stipulations contain provisions for avoiding such conditions and as a result adverse impacts would be less likely under the CSU than under SLT (Section 4.8.4.6). Effects of unstable conditions on marginally unstable slopes under Alternatives B and C, or steep slopes and areas of high erosion potential under Alternative D, if not properly controlled, would be adverse, minor to moderate, and long term in duration.

Impacts to caves are also likely to be less adverse than under SLT due to CSU stipulations designed to protect lava tube cave resources. Long-term impacts to cave could be moderate under CSU.

- *Measurement Indicator # 6* PERCENTAGE OF DISTURBANCE ON SENSITIVE SOIL/GEOLOGIC HAZARDS

Percent disturbance on sensitive soils could be to 0.8 percent if all disturbances through production wells occurred on sensitive soils/geologic hazards, which is highly unlikely. Depending on the type of disturbance, duration could be short or long term. Thus, for all sensitive soils/geologic hazards, this would be a negligible, short-term impact.

4.8.4.6 Standard Lease Terms (SLT)

Impacts in this section are discussed assuming no restrictions or leasing options other than those listed on BLM Lease Form 3100-11 (SLT) and the environmental protection measures that would be implemented by other laws and regulations as described in Section 1.8.5.2. As a minimum, all leases are governed by SLT and the impacts described in this section represent the maximum amount of disturbance that could occur as a result of oil and gas activities.

Under Alternative E, SLT would apply directly to all identified soil and geologic hazard areas, including within IRAs if the 2001 Roadless Area Conservation Rule was not in effect.

Measurement Indicators

- *Measurement Indicator #1* ACRES OF DISTURBANCE

Under SLT, all acres of sensitive soils and geologic resources would be open to seismic survey. Between 60 and 120 acres could be affected. Effects would be the same as those listed under Section 4.8.3, which were identified as negligible (with regard to the entire area of sensitive soils) and short term in duration.

Under SLT, between 397 and 706 acres of disturbance could occur on each ranger district, or up to 1,672 acres on the Dixie National Forest as a whole, over the next 15 years. The locations of future oil and gas activity disturbance are unknown at this point. However, if full development were to occur as described in the RFDS (Section 2.2.1), and if all disturbances took place on sensitive soils/geologic hazards, less than one percent of these sensitive areas would be disturbed in each ranger district. The Pine Valley Ranger District would have the least disturbance and the Powell and Escalante Ranger Districts would have the most (see Table 4.8-3 below). These effects would be negligible. Duration would be short term if disturbance was related to exploratory activities and long term if associated with production activities.

Table 4.8-3 Maximum Acres of Disturbance to Sensitive Soils/Geologic Hazards and the Percent of Total Acreage

Ranger District	Acres			Percent of Acres in District	
	Seismic Disturbance	Full field development (includes seismic disturbance)	Sensitive Soils/Geologic Hazards in District[2]	Seismic Disturbance	Full Field Developme nt
Pine Valley[1]	60	397	144,023	0.04%	0.28%
Cedar City[1]	120	623	79,217	0.15%	0.79%
Escalante[1]	120	706	112,191	0.11%	0.63%
Powell[1]	120	706	126,415	0.09%	0.56%

[1] Assumes the greatest amount of disturbance predicted in a ranger district occurred within each area. Cave resources are not included in the acreage estimates.
[2] There are more than 706 acres of each of the sensitive soils/geologic hazards on each ranger district, except Pine Valley, which has no acres of unstable soils. The figures in this table represent potential development acreage on each type of sensitive soil. The sensitive soil acreage is not split out within a ranger district, as it would be redundant.

- *Measurement Indicator #2* POTENTIAL EFFECTS TO SOIL PRODUCTIVITY

Under SLT, all acres of sensitive soils/geologic hazards would be open to seismic surveys. Up to about 120 acres could be affected. Effects would be similar to those listed under Section 4.8.3 and for NSO (Section 4.8.4.3), which were identified as negligible and short term in duration.

Soil productivity and slope stability is generally adversely affected by oil and gas development due to compaction or disturbance by salvaging of soils on road and pad locations. Compaction inhibits water movement and root penetration within the soil matrix, and results in less water infiltration and higher overland flow. Soil physical structure is lost when soil is excavated and stockpiled for future use during reclamation of disturbed areas. Some silty or gypsum-rich soils become powdery when excavated, creating poor contact between soil and seed or soil and root, which results in poor plant growth. Powdery soil is also prone to wind and water erosion, which

results in nutrient-rich topsoil loss. Effects of compaction or excavation on soil resources would be adverse, minor to moderate, and long term in duration.

- *Measurement Indicator # 3* POTENTIAL SOIL LOSS

Under SLT, all acres of sensitive soils/geologic hazards would be open to seismic survey. Up to about 120 acres could be affected. Effects would be similar to those listed under Section 4.8.3 and for NSO (Section 4.8.4.3), which were identified as negligible and short term in duration.

Under SLT, high-erosion areas, steep slopes, and marginally unstable areas could be exposed to severe soil loss if proper road and pad siting were not completed, and/or if proper design features specific to the proposed development site were not employed. Areas of high erosion potential, steep slopes, and marginally unstable areas, would not be adequately protected using standard BMPs designed to prevent erosion and sedimentation. Effects of soil loss to areas of high erosion potential, steep slopes, and marginally unstable areas would be adverse, minor to major, and long term in duration.

Under SLT, exploratory or full-field development in rockfall areas or cave resources would have little effect on soil loss as there is very little soil in either of these areas. Effects would be adverse, negligible, and short term.

- *Measurement Indicator # 4* MILES OF ROAD AND AREA OF DISTURBANCE ON SENSITIVE LANDFORMS

Under SLT, all acres of sensitive soils/geologic resources would be open to seismic survey, exploration, and full field development. Up to 293 miles of road disturbance could occur on the Dixie National Forest due to exploration activities, with a total of 996 acres (including roads and all other disturbance) disturbed for this purpose. One production field on the Forest would result in approximately 15 miles of new road and 254 acres of disturbance (it is assumed the production well could occur on any ranger district and so is included in the potential disturbance for each district). Total gross Forest-wide disturbance associated with oil and gas activity through construction of a production well would be approximately 1,673 acres. All but 220 acres of this (the production field disturbance) would be reclaimed. There are 3,031 miles of authorized Forest roads on the Dixie National Forest (see Section 3.10). Approximately 1,188 miles of these are in areas that present risks to soil resources (USFS 2003c). Exploration and production activities would increase overall Forest road mileage by 308 miles of new and reconstructed roads (10 percent). Although unlikely, if all roads were constructed in sensitive soil areas, the proportion of road mileage on sensitive soils/geologic hazard areas would increase by 26 percent.

- *Measurement Indicator # 5* POTENTIAL FOR CREATING HAZARDOUS CONDITIONS

Under SLT, all acres of sensitive soils/geologic hazards would be open to seismic survey. Up to about 120 acres could be affected. Effects would be the same as those described Section 4.8.3 and Section 4.8.4.5, which were identified as adverse, minor to major, and short-term in duration. Depending on the underlying geology, significant effort may be required to “anchor” facilities to the hill, or allow subsurface water to safely flow under, over, or around a road or drill pad. Under some conditions, it may be necessary to provide both surface and subsurface drainage, such as horizontal drains, drainage trenches, French drains, gabions, or drainage blankets to prevent groundwater from entering embankments, which can lead to moisture saturation and subsequent slope failure.

Hazardous effects to cave resources from oil and gas activities have been given more attention recently because of increased development in karst and lava tube areas. BLM (2006c) provides information on potential and inherent impacts of oil and gas development on caves and cave resources. These include:

- Areas with sensitive bat colonies or other animals could collapse, be buried, or destroyed for the very long term if no specific leasing options or limitations are in place to protect these resources. Such effects would be adverse, major, and of long term duration.
- Most caves are not completely mapped. Exploratory drilling activities may "punch through" an unknown subterranean passage and fill or partially fill a cave cavity with drilling mud, water, hydrocarbons, and/or drill cuttings.
- Unknown voids located close to the surface can collapse when heavy trucks or drilling equipment drives or parks over the void. This occurred at the Exxon Fed. #4 location in New Mexico. The ceiling of the cavern stooped to the surface producing a 15-foot diameter hole under the drilling rig. This could result in injury or death to humans or animals, damage or destroy personal property, and/or could damage or destroy sensitive cave ecosystems (James Goodbar, BLM, personal communication). These effects would be adverse, moderate to major in intensity, and long term in duration because of the difficulty of accessing cave reaches to mitigate effects.
- If any part of a well casing fails during drilling or testing, brine, gas, hydrogen sulfide gas, or drilling fluid could enter the cave system. Some caves are water sources for culinary water or stream water supplies. All springs on Forest Service land are considered Class 1 waters in Utah. Pollution of cave waters could pollute Class 1 and culinary water supplies for the short term or indefinitely (BLM 2006c).
- During completion of a well, the casing is set to the desired depth and a mixture of cement and additives are pumped down the casing and back up outside to form a protective sheath of cement between the casing and well bore. If voids have been encountered, the cement mixture would enter the void and remain there permanently. This volume could amount to several hundred to several thousand cubic feet of cement, the total volume of the annulus (BLM 2006c). Effects would be adverse, minor to major in intensity depending on the material and volume lost to the cave system, and long term in duration because of the difficulty of accessing cave reaches to mitigate effects.
- The opening of new entrances to the earth's surface could influence or alter normal cave temperatures and change the flow of air, water, and humidity through the cave, thus changing the cave's microclimate. This change in the constant microclimate could affect cave flora, fauna, and development and growth of cave formations (i.e., speleogens and speleothems). Some cave formations could be destroyed by changes in air pressure (BLM 2006c).
- The use of lined mud pits (versus self-contained mud pits) could cause contamination of cave environments by leaching of chemicals into the ground and groundwater systems after pits are broken and allowed to dry. Soluble chemical constituents in the mud could percolate down through natural fractures in the rock, carried by the rainwater, and enter caves and cave water systems. It is this same percolation of rainwater that provides water for the development of speleothems. Leaching of chemicals could also occur due to leaking flow lines, gas dehydrators, and tanks. The chemicals and other constituents could change the chemical composition of the minerals forming speleothems and

adversely alter the cave atmosphere. This chemically-altered atmosphere could cause the deterioration of existing speleothems and/or prevent their natural growth (BLM 2006c).

- The presence of hydrogen sulfide and methane gas, even in small amounts, could change the delicate balance of the cave atmosphere, causing the rapid deterioration of cave formations and the disruption or death of cave life. These gasses could also explode, causing damage to existing formations from the shockwave (BLM 2006b). Effects would be adverse, negligible to major in intensity, depending on the concentration of gasses (effects may be unknown for many years), and long term in duration because of the difficulty of accessing cave reaches to mitigate effects.
- After a well was depleted, plugged, and abandoned, impacts to cave values could still occur. The steel casing could deteriorate over time because of interactions of the casing with hydrogen sulfide gas and weak acids in percolating water, causing leaks and the problems noted in the bullet above (BLM 2006c).
- Although unlikely, in a worst-case situation during the drilling, completion, or production of a well, natural gas could settle in the bottom of sinkholes and migrate into caves or fractures leading to caves and contaminate them. If natural gas were to flow through an open hole or through casing/cement that either failed or was inadvertently perforated, the gas would follow passages or other routes – some known, some unknown – such as small fractures or faults, and eventually contaminate a cave or cave system. The risk to humans and all other cave fauna from the migration of hydrogen sulfide and/or methane gas could be substantial. Explosions could result when the gas and oxygen in the cave mix and are ignited by carbide lights often used by cavers. The replacement of oxygen by the other gases endangers humans and other fauna by asphyxiation (BLM 2006c).

Because of the difficulty of accessing cave reaches to mitigate impacts, effects of these changes to cave resources would be adverse, negligible to major in intensity, depending on the extent of contamination (effects may be unknown for many years), and long term in duration.

Under SLT, all acres of sensitive soils/geologic hazards would be open to exploration and full-field development. Potential effects of this development on sensitive soils/geologic hazards would vary, depending on the specific location of development. Impacts would be adverse, long term in duration, and could range from minor to major, and would be similar to those outlined in Section 4.8.3 and *Measurement Indicator #3*, above. Effects of hazardous conditions on sensitive soils/geologic hazards, if not properly controlled, would be adverse, minor to major, and long term in duration.

- *Measurement Indicator # 6* PERCENTAGE OF DISTURBANCE ON SENSITIVE SOIL/GEOLOGIC HAZARDS

Percent disturbance on sensitive soils could range from 0.0 percent if no sensitive soils/geologic hazards were disturbed, to 0.8 percent if all disturbance through production wells occurred on sensitive soils/geologic hazards, which is highly unlikely. Depending on the type of disturbance, duration could be short or long term. Thus, for all sensitive soils/geologic hazards, this would be a negligible, short-term impact.

4.8.5 Impacts by Alternative

The degree to which the connected action impacts would differ by alternative are discussed in this section. Each alternative involves a unique set of leasing options for each resource component, which would restrict the locations and the nature of oil and gas activities that are allowed wherever these resources occur.

Table 4.8-4 shows the acres of each resource component for soils/geologic hazards under each leasing option, by alternative. Table 4.8-4 incorporates the amount of overlap with more restrictive leasing options (assigned to other resources) in addition to the leasing option assigned directly to each resource component. Alternatives D1, D2, E1, and E2 represent the dual analysis of Alternatives D and E. D1 and E1 represent the acres available with NSO in all IRAs. D2 and E2 represent the acres with leasing allowed in IRAs under a less restrictive leasing option. A more detailed table that separates the acreage by resource component and ranger district is available in Appendix B. The percent of the resource components discussed (with the exception of cave resources, which have not been quantified) in this section that fall within IRAs is as follows: Pine Valley Ranger District (56 percent), Cedar City Ranger District (2 percent), Powell Ranger District (39 percent), and Escalante Ranger District (44 percent).

In this section, impacts are generally discussed at the Forest-wide level and not by ranger district. This is done to avoid repetition and facilitate the comparison of impacts across alternatives. However, any pronounced differences in the impacts to a resource component between ranger districts are highlighted.

Impacts by alternative are summarized in Table 4.8-4 below and differences between alternatives regarding soil resources are outlined in the text below. *Measurement Indicator #1* is not discussed in this section or in Table 4.8-4 because the impacts in terms of acres disturbed would be the same under all alternatives that allow leasing. The percentage of sensitive soils disturbed by development (*Measurement Indicator #6*) is relatively small for each alternative (0.0 to 0.8 percent). Relative to these measurement indicators, impacts would be negligible and short to long term. Under Alternative A, no new leasing would be allowed and impacts relative to *Measurement Indicators #1* and *#6* would be negligible.

Table 4.8-4 Acreage of Resource Components under each Leasing Option, by Alternative

Resource Component[3]	Leasing Option[4]	Alternative[1,2]						
		A	B	C	D1	D2	E1	E2
Active rockfall and landslide areas Rockfall/ unstable	NA	8,740	8,740	8,740	8,740	8,740	8,740	8,740
	NL	8,413	6,667	343				
	NSO		1,775	8,070	8,413	8,413	4,942	
	CSU							
	SLT						3,471	8,413
Slopes >35%	NA	62,579	62,579	62,579	62,579	62,579	62,579	62,579
	NL	319,905	245,132	6,531				
	NSO		74,755	313,374	178,827	17,576	171,803	
	CSU				141,079	302,330		
	SLT						148,102	319,908
Areas of High Erosion Potential	NA	9,734	9,734	9,734	9,734	9,734	9,734	9,734
	NL	86,230	61,003	2,020				
	NSO		25,217	84,210	42,180	6,202	40,101	
	CSU				44,050	80,028		
	SLT						46,129	86,230
Marginally Unstable Soils	NA	771	771	771	771	771	771	771
	NL	43,217	33,203	<1	<1	<1		
	NSO		9,435	40,686	21,086	2,300	19,972	
	CSU		574	2,531	22,080	40,866		
	SLT				50	50	25,245	43,217

[1] Small discrepancies in the acreage presented for each alternative are due to the fact that the GIS database has limitations when applied over an extremely large area that result in an inability to calculate acreages that match exactly between alternatives. A more detailed table that separates the acreage by resource component and ranger district will be available in Appendix B.
[2] Alternatives D1, D2, E1, and E2 represent the dual analysis of Alternatives D and E. D1 and E1 represent the acres available with NSO in all IRAs. D2 and E2 represent the acres with leasing allowed in IRAs under a less restrictive leasing option.
[3] Note that there is some overlap of resource components (e.g. soils can be both steep and rocky). Thus, the total acreage by resource component is more than the total acres of sensitive soils by approximately 11 percent.
[4] Areas not legally available (NA) for leasing (see Section 1.5.2) are included in the Table to provide context to the analysis.

4.8.5.1 Alternative A

There would be no oil and gas activities on the Dixie National Forest within areas not currently leased. Alternative A would continue present management activities as pertaining to oil and gas leasing. The Forest Supervisor under this alternative would not make any new leasing decisions and no new oil and gas leasing would be allowed on the Dixie National Forest. Current operations, including the Upper Valley oil field on the Escalante Ranger District (19 wells, including nine water-injector wells) would continue (USFS 2006g). In total, there are 13,454 acres of existing leases on the Dixie National Forest. Existing leases not in production will expire and the potential number of wells that could be drilled on the Dixie National Forest would decrease over time. Under Alternative A, impacts to sensitive soil and geologic hazards from oil and gas leasing would be negligible because no new leases would be approved.

4.8.5.2 Alternative B

Section 2.5.2 describes how many acres of the Dixie National Forest would fall under each leasing option under Alternative B (*Measurement Indicator #1*; see Table 2.5-2). Under all

alternatives, 5 percent of the Forest is not legally available for leasing (NA) and approximately 69 percent would not be leased (NL) under Alternative B. Of the remainder, 20 percent would be NSO and 6 percent would be CSU. Due to overlapping leasing options with other resource values, leasing options under Alternative B include NA and NL, as well as NSO in rockfall/unstable areas, steep slopes, and in areas with high erosion potential. Marginally unstable slopes include NA, NL, and NSO as well as some CSU. The area and locations of cave resources is unknown at this time, but would be covered by CSU if a more restrictive leasing option did not overlap.

Effects under Alternative B would be the same as described under Sections 4.8.4.3 (for rockfall/unstable areas, steep slopes, and areas of high erosion potential) and 4.8.4.5 (marginally unstable slopes and cave resources). For rockfall/unstable areas, steep slopes, and areas of erosion potential, the main possibility of impacts under Alternative B (NSO for these resources) is with regard to *Measurement Indicator #5* (hazardous conditions) due to the possibility (although remote) of a catastrophic event resulting from seismic activities on these areas. Impacts to unstable slopes could be minor with an additional regard to soil productivity (*Measurement Indicator #2*) and hazardous conditions (*Measurement Indicator #5*), and moderate with regard to disturbance of sensitive landforms (*Measurement Indicator #4*), because any oil and gas activity may be allowed in these areas under Alternative B (CSU for this resource)..

Impacts to cave resources would be similar under Alternatives B, C, D, and E, due to the possibility (although highly improbable) of a catastrophic event (see *Measurement Indicators #2* and *#5*), although unlikely, that could have moderate or major impacts regardless of leasing options. Impacts with regard to *Measurement Indicator #4* (acres disturbance on sensitive landforms) would be moderate under Alternatives B, C, D, and E (refer to Section 4.8.4.5).

4.8.5.3 Alternative C

Section 2.5.2 describes how many acres of the Dixie National Forest would fall under each leasing option under Alternative C with NSO in IRAs. All sensitive soils/geologic hazard areas outside IRAs are covered either by areas of NA, NL, or by CSU. Some areas of CSU have an additional TL for wildlife protection: this designation does not change the effects of oil and gas exploration or development.

Impacts to cave resources under Alternative C would be as described under Alternative B. Impacts to rockfall/unstable areas, steep slopes, and areas of erosion potential would be very similar to Alternative B because leasing options are the same between alternatives. Impacts to unstable slopes would also be similar but slightly more adverse under Alternative C, relative to Alternative B, because more acres would fall under the CSU leasing option where all oil and gas activities would be allowed. For unstable slopes, moderate impacts would be possible under Alternative C with regard to soil productivity (*Measurement Indicator #2*) and hazardous conditions (*Measurement Indicator #5*), unlike Alternative B.

4.8.5.4 Alternative D1 (NSO in IRAs)

For sensitive soils/geologic hazards, Alternative D1 (NSO in IRAs) is more restrictive than Alternative D2 (CSU in IRAs). However, this alternative applies a CSU leasing option to slopes greater than 35 percent and areas of high erosion potential and, therefore, is technically less restrictive than Alternatives A, B, and C. NSO applies to all rockfall/unstable areas under this alternative and because of leasing option overlaps, steep slopes would also be under NSO (despite having a CSU leasing option applied). Leasing options under this alternative include

NSO in all IRAs, rockfall/unstable areas, and steep slopes because of overlapping resource components. Areas with high erosion potential, and cave resource areas are open to leasing with the CSU option unless they are located within an IRA.

Effects of Alternative D1 would be limited to seismic activities, and would be the same as described under Section 4.8.4.3 (for all sensitive soils), and Section 4.8.4.5 (for areas of high erosion potential, marginally unstable slopes, cave resources). Impacts to cave resources would be as described under Alternative B. Impacts to rockfall areas and unstable slopes would be as described under Alternative C because leasing options between alternatives are similar. Impacts to steep slopes and areas of erosion potential would be more adverse under Alternative D, relative to Alternative C, because leasing options for these resources would be CSU, thus allowing all oil and gas activities to potentially take place in these areas. Impacts to areas of high erosion potential could be major with regard to soil productivity (*Measurement Indicator #2*) and moderate with regard to sensitive landforms (*Measurement Indicator #4*), which are substantially more adverse than Alternative C. Impacts to steep slopes with regard to soil productivity (*Measurement Indicator #2*) could potentially be major in areas covered by CSU.

4.8.5.5 Alternative D2 (CSU in IRAs)

Under Alternative D2 (CSU in IRAs), eight percent of the Dixie National Forest would be NSO, 34 percent would be CSU, 46 percent would be TL, and five percent would be NA. This alternative would include, in addition to a CSU leasing option in IRAs, NSO leasing options in those areas where leasing can still occur, but other, more restrictive resources values overlap. Chapter 2 of this EIS describes how many acres of the Dixie National Forest would fall under each leasing option under Alternative D2 and where those acres are located. Impacts to all soil resources under this alternative would be similar to those described under Alternative D1.

4.8.5.6 Alternative E1 (NSO in IRAs)

Under Alternative E1, all areas of sensitive soils/geologic hazards are open to leasing under SLT except for those sensitive soils/geologic areas located within IRAs, which are covered by NSO. Relative to other alternatives, impacts under Alternative E1 would be most severe with regard to rockfall/unstable areas because they are protected by NSO under other alternatives, and not protected (they would be under SLT) under Alternative E1 (and E2). This would allow any oil and gas activity to take place on a rockfall/unstable area with only the minimum requirements in place for resource protection that are contained in all leases. Impacts could be major if a catastrophic event occurred on these areas, although such events are unlikely (see Section 4.8.4.6). Impacts to other soil resources could potentially be major also, but impacts are not dissimilar to those described under Alternative D, under which most resources are protected by CSU leasing options under which most oil and gas activities would still be allowed.

4.8.5.7 Alternative E2 (SLT in IRAs)

Alternative E2 (SLT in IRAs) would allow leasing under the SLT leasing option on all lands, regardless of their designation as having sensitive soils, geologic hazards, or other resource values such as designated wilderness or sensitive plant populations. The potential impacts of this option are discussed for SLT in Section 4.8.4.6.

Table 4.8-5 Impacts with respect to Measurement Indicators #2 through #5

Resource	*Measurement Indicator (MI)*	ALT B	ALT C	ALT D1	ALT D2	ALT E1	ALT E2
Active Rockfall and Landslide Areas	*MI #2*	Neg ST	Neg ST	Neg ST	Neg ST	Minor-Major[b] ST-LT	Minor-Major[b] ST-LT
	MI #3	Neg ST	Neg ST	Neg ST	Neg ST	Neg ST	Neg ST
	MI #4	Neg ST	Neg-min ST	Neg-min ST	Neg-min ST	Moderate LT	Moderate LT
	MI #5	Minor-moderate LT	Minor-moderate LT	Minor-moderate LT	Minor-moderate LT	Minor-major LT	Minor-major LT
	MI # 6	Neg ST[c]	Neg ST[c]	Neg ST[c]	Neg ST[c]	Neg ST[c]	Neg ST[c]
Slopes >35%	*MI #2*	Neg ST	Neg ST	Minor-Major[b] ST-LT	Minor-Major[b] ST-LT	Minor-Major[b] ST-LT	Minor-Major[b] ST-LT
	MI #3	Neg ST	Minor ST	Minor ST	Minor ST	Minor ST	Minor ST
	MI #4	Neg ST	Neg ST	Neg ST	Neg ST	Moderate LT	Moderate LT
	MI #5	Minor-moderate LT	Minor-moderate LT	Minor-moderate LT	Minor-moderate LT	Minor-major LT	Minor-major LT
	MI # 6	Neg ST[c]	Neg ST[c]	Neg ST[c]	Neg ST[c]	Neg ST[c]	Neg ST[c]
Areas of High Erosion Potential	*MI #2*	Neg ST	Neg ST	Minor-Major[b] ST-LT	Minor-Major[b] ST-LT	Minor-Major[b] ST-LT	Minor-Major[b] ST-LT
	MI #3	Minor LT	Minor LT	Minor ST	Minor ST	Minor ST	Minor ST
	MI #4	Neg ST	Neg ST	Moderate LT	Moderate LT	Moderate LT	Moderate LT
	MI #5	Minor-moderate LT	Minor-moderate LT	Minor-major LT	Minor-major LT	Minor-major LT	Minor-major LT
	MI # 6	Neg ST[c]	Neg ST[c]	Neg ST[c]	Neg ST[c]	Neg ST[c]	Neg ST[c]
Marginally Unstable Slopes	*MI #2*	Minor[b] ST-LT	Minor-Mod[b] ST-LT	Minor-Major[b] ST-LT	Minor-Major[b] ST-LT	Minor-Major[b] ST-LT	Minor-Major[b] ST-LT
	MI #3	Neg ST	Neg-min ST	Minor ST	Minor ST	Minor ST	Minor ST

Resource	*Measurement Indicator (MI)*	ALT B	ALT C	ALT D1	ALT D2	ALT E1	ALT E2
	MI #4	Moderate LT	Moderate LT	Moderate LT	Moderate LT	Moderate LT	Moderate LT
	MI #5	Minor LT	Minor-mod LT	Minor-mod LT	Minor-mod LT	Minor-major LT	Minor-major LT
	MI # 6	Neg ST[c]	Neg ST[c]	Neg ST[c]	Neg ST[c]	Neg ST[c]	Neg ST[c]
Cave Resources[a]	*MI #2*	Minor-Major [a] ST-LT	Minor-Major [a] ST-LT	Minor-Major [a] ST-LT	Minor-Major [a] ST-LT	Minor-Major [a] ST-LT	Minor-Major [a] ST-LT
	MI #3	Neg ST	Neg ST	Neg ST	Neg ST	Neg ST	Neg ST
	MI #4	Moderate LT	Moderate LT	Moderate LT	Moderate LT	Moderate LT	Moderate LT
	MI #5	Minor-mod LT	Minor- mod LT	Minor- mod LT	Minor- mod LT	Minor-major LT	Minor-major LT
	MI # 6	Neg ST[c]	Neg ST[c]	Neg ST[c]	Neg ST[c]	Neg ST[c]	Neg ST[c]

LT = long term; ST = short term; neg = negligible; mod = moderate
a Impacts to cave resources could be major if a road, production well or field was located over a cave void or passage.
b Impacts would generally be minor and short-term. However, if a reportable hydrocarbon spill occurred, impacts could be major and long-term.
c Impacts would be negligible but could persist for a long term depending on the type of activity occurring (exploration vs. development).

4.9 Vegetation

4.9.1 Introduction

The terms used to describe the context and intensity of effects in this section are discussed in Section 4.1 and Table 4.1-1. Table 4.9-1 provides an example how these terms would apply to vegetation.

Table 4.9-1 Terms used to Describe Effects to Vegetation

Attribute of Effect		Description relative to Vegetation
Quality	Beneficial	An increase in the amount or quality of a native vegetation community.
	Adverse	A decrease in the amount or quality of a native vegetation community.
Magnitude (Intensity)	Negligible	A modification in the amount or quality of a native vegetation community that is not perceptible on a Forest-wide scale. *Example: Loss of <5% of a major vegetation community.*
	Minor	A modification in the amount or quality of a native vegetation community that would only affect individual plants and not affect the overall character of the community. *Example: Loss of part (e.g., 10-15%) of a short-lived and major vegetation community that is locally abundant and could be restored.*
	Moderate	A modification in the amount or quality of a native vegetation community that would affect the overall character of the community. *Example: Uncontrolled increase in invasive plants within a community that would modify the relative abundance of species over time.* *Example: Modification of a special or unique vegetation area that degrades its 'special' or 'unique' characteristics.* *Example: Loss of mature forest that may or may not be restored to its original condition.*
	Major	A modification in the amount or quality of a vegetation community that would completely change the overall character of the community. *Example: Complete removal of native forest or long-lived shrub community without re-vegetation (i.e., conversion).* *Example: Irretrievable loss of a special or unique vegetation area, or a major vegetation community that is limited in the area.*
Duration	Temporary	A vegetation modification that only occurs during construction of a facility (i.e., road, well pad). Original condition is immediately restored once construction is completed. *Example: Seismic activities that occupy an area without disturbing the vegetation.*
	Short-term	A vegetation modification that occurs during exploration activities (i.e., construction of exploratory well pads or access roads) or only affects short-lived species such as grasses or shrubs. The vegetation modification lasts 10 years or less. Original condition would likely be restored within this time frame. *Example: Removal or modification of grass or shrub community that is eventually re-vegetated.*
	Long-term	A vegetation modification that occurs during extended exploration activities or during production activities, or affects long-lived species such as forest or long-lived shrubs (e.g., some sagebrush). The vegetation modification lasts more than 10 years and original condition may or may not be restored. *Example: Removal or modification of forest community.*

4.9.2 Measurement Indicators

- *Measurement Indicator #1* ACRES OF DISTURBANCE
- *Measurement Indicator #2* LOCATION OF SURFACE DISTURBANCE
- *Measurement Indicator #3* COMPLIANCE WITH ESTABLISHMENT RECORDS (RESEARCH NATURAL AREAS)
- *Measurement Indicator #4* NARRATIVE DESCRIPTION OF THE EFFECTS AND DURATION OF EFFECTS THAT WOULD OCCUR TO THE LIMITING ATTRIBUTES OF THE AREAS, WHICH LED TO DESIGNATION (SPECIAL AREAS/RESEARCH NATURAL AREAS)
- *Measurement Indicator #5* COMPLIANCE WITH MANAGEMENT OBJECTIVES (SPECIAL AREAS/RESEARCH NATURAL AREAS)
- *Measurement Indicator #6* INCREASES IN INVASIVE PLANTS

4.9.3 Impacts Common to All Action Alternatives

Under Alternatives B, C, D, and E it is assumed that activities described under the RFDS would occur. These activities include 60 to 120 acres (per ranger district) of overland travel associated with seismic surveys, 83 to 332 acres (per ranger district) of land clearing surface disturbance associated with road and pad building for exploration wells, and 254 acres of land clearing surface disturbance for a production field. The locations of activities are not yet known. The main impact to vegetation associated with land clearing is complete vegetation removal. Vegetation would be removed within the footprints of the well pads, associated facilities, and roads, for as long as the activities were conducted plus the time needed for reclamation and successful reestablishment of vegetation. Impacts of vegetation removal are a loss of vegetation in at least the short term (for grasses, forbs, and most shrubs) and in many cases the long term (forested and some non-forested areas), a temporary loss of soil stability (see Section 4.8), alteration of vegetation communities after reclamation (species may differ from what was disturbed), and alteration of adjacent (undisturbed) vegetation communities due to changes in relative species abundance. Species used for reclamation would be chosen based on the need to establish vegetation for a variety of uses (e.g., erosion control, wildlife and livestock forage, achieving management objectives for diversity, etc.). Vegetation would be expected to reach the required percentage of ground cover after two to three years, but may or may not eventually reach the same productivity as pre-disturbance conditions.

Seismic exploration effects were noted in a BLM compliance review of a recent 2-D seismic survey conducted in northeastern Utah between 6,000 and 8,000 feet elevation. Truck-mounted drills, buggy-mounted drills, OHVs, and heliportable drills were used. Effects of heliportable drills were limited to footprints by workers in the 3-foot diameter drill area with some subsurface drill cuttings left on the surface. Impacts from truck- and buggy-mounted drill rigs were more noticeable and included up to six passes by some form of vehicle. Effects included localized soil compaction, decreased infiltration, corresponding increased surface run-off, and decreased ability for seedling establishment and root growth (BLM 2002). Any vehicle path could lead to the establishment of new four-wheel drive or OHV trails. However, in the Utah study, all types of drills and transportation devices were determined to cause “little soil disturbance,” which would be “normal in appearance after the next spring’s rains” (BLM 2002). With this report in

mind, it is likely that effects of seismic surveying on soil resources would be adverse, negligible to minor in intensity, and short term in duration.

Impacts associated with overland travel (seismic activities) include the crushing of grasses, forbs, bushes, and other low growing species. Generally, impacts of crushing vegetation are negligible as the roots remain intact and plants would recover or resprout the following year. Biological soil crusts would be disturbed for the long term by overland travel because they take many years to regenerate. Because seismic activities cover long distances (either by ground or helicopter), soils and seed from other sites could be introduced that would alter soil conditions or plant community composition, e.g., by spreading invasive plants (see *Measurement Indicator #6*). The amount of direct removal of or damage to vegetation would be greater for exploration well construction, which would include footprints for roads, well pads, and other structures. Indirect adverse impacts to vegetation may also occur in the vicinity of exploration wells if soils and seed are introduced, via construction vehicles and other traffic, to undisturbed vegetation around the sites. Organic materials from other locations may alter the composition and succession of these vegetation communities following reclamation. Direct adverse impacts from exploration activities that do not result in development would be minor and short term (less than 10 years); direct impacts would typically last five years (1 year drilling, 1 year reclamation, and 3 years for revegetation). In the event that production occurs on a well, adverse impacts from disturbance at that location would be long term and moderate due to the larger amount of vegetation removed or damaged and the extended length of well field operations. On production wells, the portion of each pad not needed for production would be reclaimed and revegetated after the well is drilled. Any indirect adverse impacts to vegetation from the spread of invasive plants would be long term and minor to moderate, depending on the extent.

Table 4.9-2 lists the leasing options assigned to each vegetation resource component under each alternative. Descriptions of leasing options (and associated impacts on vegetation resources) are described in Section 4.9.4. Each assigned leasing option would either allow or restrict certain oil and gas activities (described under the RFDS) wherever the applicable resource component occurs on the Dixie National Forest.

Table 4.9-2 Leasing Options assigned under each Alternative for Vegetation Resources

Resource Component	Alternative				
	A	B	C	D	E
Botanical and Geological Areas (i.e., Red Canyon Botanical Area; 203 acres)	NL	NSO	NSO	NSO	SLT
Side Hollow Ponderosa Pine Provenance Study Area (4.5 acres)	NL	NSO	NSO	NSO	SLT
Research Natural Areas (4,796 acres)	NL	NL	NL	NSO	SLT[1]

[1] SLT in Research Natural Areas would not be in compliance with the 1986 Land and Resource Management Plan, which requires NSO in these areas (see Section 4.18.

4.9.4 Impacts of Connected Actions by Leasing Option

Leasing options would dictate the conditions under which connected actions (described under the RFDS) would be allowed, and under which impacts may occur. Impacts from connected actions under each leasing option are discussed in this section. Impacts to vegetation

resources considering leasing option overlaps (i.e., overlaps with more restrictive leasing options assigned to other resources) are discussed in Section 4.9.5 (Impacts by Alternative).

4.9.4.1 Not Legally Available (NA)

NA applies to lands that are not legally available for leasing, including Brian Head Ski Permit Area, wilderness areas, and areas surrounding the Box-Death Hollow Wilderness Area that were withdrawn from leasing by the Utah Wilderness Act of 1984. No oil and gas leasing would occur in these areas and no disturbance to vegetation resources in these areas would occur. NA does not apply to any of the vegetation resource components under any alternative.

4.9.4.2 No Lease (NL)

NL applies to lands where no new leases would be authorized. These lands would not be administratively available for leasing and no oil and gas leasing or disturbance would occur on lands with a NL leasing option. Under Alternative A, NL would apply to the Red Canyon Botanical Area and Side Hollow Study Area (Special Areas) and all five Research Natural Areas. NL would also apply to all Research Natural Areas under Alternatives B and C. Because no new leases would be authorized on lands within Special Areas or Research Natural Areas under NL, there would be no surface disturbance related to oil and gas activities within these boundaries and no direct or indirect impacts to these resources.

4.9.4.3 No Surface Occupancy (NSO)

With the exception of seismic activities, NSO would prohibit occupancy or use of the land for oil and gas activities (e.g., construction of well pads, central tank batteries, access roads, pipelines, power lines, and other linear structures). Under NSO, adverse impacts to vegetation would be limited to crushing plants, breaking of branches and stems, and a loss of live plant material as a result of seismic activities.

Under Alternatives B, C, and D, NSO would apply to the Red Canyon Botanical Area and Side Hollow Study Area. Under Alternative D, NSO would apply to these resources in addition to all five Research Natural Areas. Impacts to these resource components under NSO with regard to applicable measurement indicators are described below.

Measurement Indicators

- *Measurement Indicator #3* COMPLIANCE WITH ESTABLISHMENT RECORDS

The establishment records for Research Natural Areas generally do not explicitly allow surface disturbing activities unrelated to research or educational uses. Oil and gas reserves located under a Research Natural Area could potentially still be accessed by drilling from outside the boundary of the Research Natural Area. Compliance with prescriptions in the RNA establishment records for oil and gas leasing specifically within RNAs are discussed here. Impacts as a result of connected actions to leasing are discussed under *Measurement Indicator #5* (Compliance with Management Objectives).

Regarding specific prescriptions for oil and gas leasing, establishment records for Research Natural Areas either: 1) do not specify special protection measures for oil and gas activities (Table Cliff); 2) honor oil and gas activities (Browse and Upper Sand Creek), 3) specify that the area be withdrawn from mineral entry (Timbered Cinder Cone), or 4) lease with appropriate protective stipulations (Red Canyon). Seismic activities that are allowed under NSO would comply with the establishment record for each Research Natural Area either: 1) by default,

because no direction is specified (Table Cliff); 2) by prescription, because oil and gas leasing is allowed on existing leases until expiration (Browse and Upper Sand Creek); 3) because seismic activities are not considered mineral entry (Timbered Cinder Cone), or 4) because NSO would provide sufficient protective stipulations to features of the RNA (Red Canyon). Therefore, adverse impacts with regard to *Measurement Indicator #3* within all Research Natural Areas would be negligible under NSO.

- *Measurement Indicator #4* EFFECTS AND DURATION OF EFFECTS IN LIMITING ATTRIBUTES OF SPECIAL AREAS

Under NSO, adverse impacts to sensitive plants (i.e., the limiting attribute) in the Red Canyon Botanical Area could occur as a result of overland travel and foot traffic associated with seismic activities. Individual sensitive plants may be trampled or removed by overland travel or foot traffic. The soil would also be altered during seismic surveys in a way that would make it less likely for sensitive plants to establish in the future. In the Red Canyon Botanical Area, the probability of most sensitive plant species establishing is determined by levels of erosion and soil stability, which are both natural and human-caused. Approximately 50 percent (115 acres) of the area is classified as having a high erosion potential. Seismic activities may involve minor amounts of human-caused erosion to the Claron Formation by foot and buggy traffic or helicopter landings and equipment placement, and the use of trails and roads in the Area to access seismic sites. Human caused erosion may adversely modify growth conditions for sensitive plants by creating compacted or eroded areas that would be less likely to support germination or establishment of these species. These adverse impacts could be long term and major.

Under NSO, adverse impacts to ponderosa pine trees (i.e., a limiting attribute) in the Side Hollow Study Area due to seismic activities would be negligible because individual trees would be avoided. Seismic activities may compromise the scientific integrity of the Side Hollow Study Area (i.e., a limiting attribute) because the process of accessing seismic sites may disturb the soil or vegetation within or adjacent to study plots that are meant to be consistent (and thus comparable) with other areas. Adverse impacts could be major and long term (see *Measurement Indicator #5*).

- *Measurement Indicator #5* COMPLIANCE WITH MANAGEMENT OBJECTIVES

Management objectives for the Red Canyon Botanical Area involve protecting erosive soils and ensuring the persistence of sensitive plants. Soils and sensitive plants could be disturbed directly and indirectly under NSO by seismic activities though trampling and subsequent erosion and disturbed growing conditions (see *Measurement Indicator #4*). Disturbance to soils and sensitive plants within the Red Canyon Botanical Area under NSO would violate management objectives. Adverse impacts could be long term and major.

Management objectives for the Side Hollow Study Area involve protecting ponderosa pine trees and supporting ongoing studies. Studies may be indirectly affected by seismic activities under NSO within the Study Area if soil or other vegetation conditions are altered within study plots by human traffic, buggies, helicopters, or other equipment. Small alterations of soils and vegetation in one area of a study plot may produce detectable impacts by diminishing the comparability of that plot to others, depending on the scale of the study. Adverse impacts from seismic activities under NSO could be major and long term because many studies in the Side Hollow Study Area are more than 10 years old and cannot be replicated.

Management objectives for Research Natural Areas include preserving and maintaining the natural state of these areas; similar to the Side Hollow Study Area, small alterations to vegetation within Research Natural Areas caused by seismic activities would conflict with preservation of the natural vegetation trends essential for research and interpretation. In general, vegetation disturbance unrelated to scientific or educational uses in Research Natural Areas is not allowed. Although seismic activities under NSO would not have noticeable impacts on the vegetation itself, adverse impacts in terms of compliance with management objectives to preserve the area from disturbance would be detectable. Therefore, adverse impacts to Research Natural Areas under NSO could be long term and major due to seismic activities.

- *Measurement Indicator #6* INCREASES IN INVASIVE PLANTS

Compared to other connected actions, invasive plant proliferation would be relatively likely to occur during seismic activities (with buggies), which are permitted under NSO. Transporting the seismic equipment on the ground requires a wide wheelbase, and equipment is heavy enough to produce ruts if the soil is soft. The combination of a large surface area (the wheel) where weed seeds can attach, and the creation of disturbance (ruts) where seeds could establish creates conditions suitable for the proliferation of invasive plants. In addition, seismic assessments require relatively long, linear distances to be covered between points, thus the potential area of exposure is high. Invasive plant infestations would be less of an issue if helicopters were used for seismic surveys. Adverse impacts of an infestation under NSO could be long term and moderate to major, depending on whether or not the infestation is controllable and reversible.

4.9.4.4 Timing Limitation (TL)

A TL leasing option would not apply to vegetation resources directly under any alternative.

4.9.4.5 Controlled Surface Use (CSU)

A CSU leasing option would not apply to vegetation resources directly under any alternative.

4.9.4.6 Standard Lease Terms (SLT)

Impacts in this section are discussed assuming no restrictions or leasing options other than those listed on BLM Lease Form 3100-11 (SLT) and the environmental protection measures that would be implemented by other laws and regulations as described in Section 1.8.5.2. As a minimum, all leases are governed by SLT and the impacts described in this section represent the maximum amount of disturbance that could occur as a result of oil and gas activities.

Under Alternative E, SLT would apply to the Red Canyon Botanical Area and Side Hollow Study Area (Special Areas) and all five Research Natural Areas, including within IRAS if the 2001 Roadless Area Conservation Rule is not in effect.

Measurement Indicators

VEGETATION RESOURCES (ALL)

- *Measurement Indicator #1* ACRES OF DISTURBANCE

The amount of disturbance expected from connected actions is presented as Tables 2.2-1 and 2.2-2. In summary, the RFDS predicts between 397 and 706 acres of disturbance on each ranger district over the next 15 years. The Pine Valley Ranger District would have the least disturbance and the Powell and Escalante Ranger Districts would have the most. The adverse

impacts on vegetation resources in general from disturbed acres would be short term and minor for exploration activities that did not result in production, and long term and moderate for production activities.

- *Measurement Indicator #2* LOCATION OF DISTURBANCE

The intensities of direct impacts (i.e., removal of vegetation) and indirect impacts (i.e., alteration of community) to vegetation are proportional to the ratio between disturbed and undisturbed vegetation of the same type within the Dixie National Forest or within the area under consideration (i.e., in Special Areas or Research Natural Areas). The amount of undisturbed acreage depends on the location of disturbance (i.e., what vegetation type is being disturbed). Within major vegetation communities (see below), adverse impacts would generally be negligible. In unique vegetation areas, Special Areas, or Research Natural Areas (see below), direct and indirect impacts would be more adverse because these areas are smaller (i.e., more would be lost relative to what is available) and the vegetation is less replaceable than for common types, so impacts would be more long term. The relative amount of vegetation removed also depends on the density of vegetation. The adverse impacts of disturbance location are discussed under each vegetation resource component.

MAJOR VEGETATION COMMUNITIES

Disturbance from connected actions could occur in any of the major vegetation communities on the Dixie National Forest. Pinyon juniper, sage steppe, and aspen/conifer are the most common vegetation types on the Dixie National Forest (56% of all vegetation). These areas are the most likely to be disturbed if there is no correlation between vegetation type and probability that an area will be leased. Disturbance in grassland and some shrub communities from oil and gas activities would be short term (less than 10 years), assuming similar vegetation reestablishes. Disturbance in forest communities would be long term because forests take at least 50 to 100 years to reestablish. Sagebrush communities can also take up to 50 years to reach maturity, thus sagebrush disturbances could also be long term. The proportion of grasses and shrubs would increase in the short term after reclamation regardless of the type disturbed. In some cases a site may be disturbed or altered to the point that reestablishment of native vegetation is not possible. These adverse impacts would be long term.

Assuming that all activities (397 to 706 acres of disturbance, depending on the ranger district) occurred within one vegetation type, less than three percent of any type would be disturbed in most cases (Table 10.5-3). Adverse impacts would be short or long term depending on the vegetation. These impacts would be negligible for common vegetation types because less than five percent would be disturbed in most cases, if all activities occurred within one type. Impacts would be of relatively greater intensity within locally rare types, such as desert scrub on the Escalante Ranger District or grass meadow within the Pine Valley Ranger District (see Table 4.9-3). Considering the spatial extent and concentration of oil and gas activities, however, it is not likely that activities would remove the relatively small amount of grass meadow type on the Pine Valley Ranger District (479 acres mapped; maximum predicted disturbance of 397 acres would remove 83%). These occurrences are scattered and most lie within the Pine Mountain Wilderness Area, which is not available for lease (see Figure 4.9-1). Although unlikely, activities could conceivably remove 452 acres of the relatively small amount of desert scrub type (488 acres) within the Escalante Ranger District; this adverse impact would be short term and major for either exploration or exploration and production.

Table 4.9-3 Maximum Percentage of Possible Habitat Disturbance in Major Vegetation Communities Impacted by Oil and Gas Activities

Ranger District (# wells[1])	pinyon juniper[3]	aspen conifer	pine wood	moun-tain brush[3]	sage steppe[3]	spruce fir	grass meadow	desert scrub[3]
Pine Valley[2] (5 + 19)	<1%	1%	10%	<1%	2%	--	83%	4%
Cedar City[2] (15 + 19)	2%	1%	1%	2%	1%	2%	5%	--
Powell[2] (20 + 19)	1%	1%	3%	--	1%	2%	3%	--
Escalante[2] (20 + 19)	1%	1%	1%	13%	1%	1%	6%	93%

[1] (Exploratory wells + production wells); exploratory wells include acres disturbed by seismic exploration.
[2] Assumes the greatest amount of disturbance predicted in a ranger district occurred within each area
[3] Any activities within pinyon juniper, mountain brush, sage steppe, or desert scrub have the potential to adversely impact biological soil crusts.

UNIQUE VEGETATION AREAS

Direct disturbance of physical soil crusts would destabilize the soil temporarily, and after reclamation, soil conditions would be improved because physical soil crusts represent a degraded state. Without reseeding, physical crusts will tend to reform during the first rainstorm after disturbance (USFS 2001) and pre-disturbance conditions would return quickly.

Direct disturbance of biological soil crusts would physically destabilize the soil, reduce soil fertility (by removing photosynthetic and nitrogen-fixing organisms and other nutrients contained in the crust), decrease the ability of the soil to retain water, and increase the potential for noxious weed invasion (NSTC 2001). Recovery of biological crusts may take decades to hundreds of years. Recovery and establishment can be impeded by invasive plants, such as cheatgrass, that invade following disturbance. Biological crusts that are in areas of low rainfall, are on coarse-textured soils with low stability, and are in areas with a large amount of bare ground have the longest recovery times (USFS 2001). Direct disturbance of gypsum soils would reduce the amount of area where biological soil crusts are likely to establish. In some areas, disturbance of gypsum beds (a component of the Claron Formation) would reduce the amount of suitable habitat for sensitive plants (see Section 4.6). However, sensitive plants on the Claron Formation seldom occur in the same areas as biological soil crusts. Adverse impacts to biological soil crusts, if they occurred, would be long term and minor.

SPECIAL AREAS AND RNAS

Each Special Area or Research Natural Area measures less than 2,000 acres. Thus, disturbances associated with multiple exploration wells (16.6 acres each) or a production field (254 acres; Table 2.2-1) would constitute long term and major adverse impacts to vegetation resources considering the amount of this type of vegetation available. Seismic exploration would have major adverse impacts to Special or Research Natural Areas, and the risk of invasive plant infestation would be high. Invasive plant impacts, if they occurred, would be adverse, long term and moderate to major (see *Measurement Indicator #6*).

Disturbance within Research Natural Areas or a Special Area would generally be long term due to the uniqueness of this vegetation. In Special Areas, features are by definition unique and are not easily restored. Regarding Research Natural Areas, although they contain the same major

vegetation types as the rest of the Dixie National Forest, vegetation in these areas is considered to be of the highest quality and is not easily replaceable. Research Natural Areas are designated as good examples of common or important vegetation, thus the "available" exemplary vegetation is restricted to the Research Natural Area itself (see *Measurement Indicator #4*).

Drilling that occurs outside the boundaries of a Research Natural Area or Special Area but that accesses oil or gas beneath the Research Natural Area or Special Area would have no adverse impacts on the vegetation within these areas.

- *Measurement Indicator #3* COMPLIANCE WITH ESTABLISHMENT RECORDS

Establishment Records for Research Natural Areas discuss possible conflicts between the intent in establishing the area as a Research Natural Area and the use of the area for oil and gas leasing. Specific direction is put forth in some cases.

Red Canyon: The Establishment Record specified that appropriate protective stipulations be applied to any future leasing, thus oil and gas leasing and activities under SLT within the Red Canyon Research Natural Area would not comply with the Establishment Record for this area. Oil and gas leasing under SLT would also violate objectives in the Establishment Record to preserve and maintain the 'natural' state of the area (see *Measurement Indicator #5*). Adverse impacts in terms of compliance under SLT would be long term and major.

Timbered Cinder Cone: Timbered Cinder Cone Research Natural Area was to be withdrawn from mineral entry after establishment record approval; however, withdrawal has not been initiated. Regarding connected actions, any oil and gas activities involving drilling in the Research Natural Area would not be in compliance. Oil and gas leasing under SLT would also violate objectives in the Establishment Record to preserve and maintain the 'natural' state of the area (see *Measurement Indicator #5*). Seismic activities are not considered mineral entry and therefore would be in compliance (see NSO). Adverse impacts from drilling activities under SLT would be long term and major.

Table Cliff: No special protection measures were put forth in the establishment record for oil and gas leasing; however, leasing within the Table Cliff Research Natural Area would violate the Establishment Record in its objective to preserve and maintain the 'natural' state of the area (see *Measurement Indicator #5*). Adverse impacts in terms of compliance under SLT would be long term and major.

Browse: Oil and gas existing leases and authorized exploration would be honored within the Browse Research Natural Area, thus any oil and gas leasing that followed current statutes and Standard Lease Terms on a current lease would be in compliance with the Browse Research Natural Area Establishment Record. However, Leasing within the Browse Research Natural Area would violate the Establishment Record in its objective to preserve and maintain the 'natural' state of the area (see *Measurement Indicator #5*). Adverse impacts in terms of compliance under SLT would be long term and major.

Upper Sand Creek: Existing Oil and gas existing leases and authorized exploration were honored within the Upper Sand Creek Research Natural Area, thus any oil and gas leasing that followed current statutes and Standard Lease Terms on a current lease would be in compliance with the Upper Sand Creek Research Natural Area Establishment Record. Any additional leasing is not in compliance with the Establishment Record because all parts of the Upper Sand

Creek Research Natural Area outside the Box-Death Hollow Wilderness Area are within Management Area 8A2, which states that all lands are withdrawn from all forms of appropriation under the mining laws (with the exception of $C0_2$ leasing until the leases expired).

- *Measurement Indicator #4* EFFECTS AND DURATION OF EFFECTS IN LIMITING ATTRIBUTES OF SPECIAL AREAS

Red Canyon Botanical Area: Disturbance from oil and gas activities to the Claron Limestone and associated rare plant species within the Red Canyon Botanical Area would be a major adverse impact to vegetation resources. Adverse impacts would be long term (greater than 10 years) if any exploratory, development, or production activities took place within the Red Canyon Botanical Area. The endemic and rare plant species that grow on the highly erosive soils of the Claron Formation in the area are vulnerable to disturbance because these areas are naturally unstable (see Soils and Geologic Hazards, Section 4.8). Approximately 50 percent (115 acres) of the area is classified as having a high erosion potential. It is therefore likely that if these areas are disturbed by oil and gas activities, restoration would be impossible in many areas and impacts would be long term.

Indirect adverse impacts to the undisturbed individuals of endemic and rare plant populations in the Red Canyon Botanical Area (including four sensitive species; Section 4.6) are possible if segments of rare plant populations are disturbed or removed by oil and gas activities. In general, the loss of individuals within a small population reduces the number of individuals for reproduction and the amount of gene flow within and between populations. These effects would be more adverse if the vegetation disturbed is locally rare (i.e., sensitive plant population). Indirect adverse impacts would be moderate and long term.

Side Hollow Study Area: The Side Hollow Study Area could be avoided under SLT allowances and thus there would be no direct impacts to trees or ongoing studies within the Study Area. A loss of trees or other vegetation outside and in the vicinity of the Study Area may affect conditions in the Side Hollow Study Area, however, such as water and nutrient levels, that could in turn affect the development parameters of Study Area trees. Any trees in the Study Area that were affected by outside conditions would affect the results of studies that require equal competition and would compromise the objectivity of those studies. Adverse indirect impacts to the Side Hollow Study Area under SLT would be long term and moderate.

- *Measurement Indicator #5* COMPLIANCE WITH MANAGEMENT OBJECTIVES

Unique features of Special Areas and the “exemplary” nature of Research Natural Areas need to be protected in order to comply with management objectives.

Oil and gas activities within Red Canyon Botanical Area would be evaluated through a Biological Evaluation process to determine impact to sensitive plants, and any threat to the persistence of sensitive plants would violate management objectives for the Area. Road building within the Area would need to be carefully evaluated to determine impacts to sensitive plants. No specific prescriptions for oil and gas were given at the time of designation. Adverse impacts with regard to compliance with management objectives under SLT would be long term and major, if oil and gas activities posed a threat to the persistence of sensitive plants.

Management objectives within the Side Hollow Study Area involve preserving the ponderosa pine trees and supporting ongoing studies within the boundary. Pine trees within the boundary would be preserved because the area would be avoided under SLT allowances. Any oil and gas activities that did not interfere with tree growth (i.e., change drainage patterns or other

conditions outside the Area) would comply with management objectives for preserving studies. Even small modifications to the soil or plant community conditions in an adjacent location could have an adverse impact on studies in the area that depend on natural conditions to be consistent across study plots (i.e., equal competition). Adverse indirect impacts to conditions in the Side Hollow Study Area from oil and gas activities under SLT could be long term and moderate if adjacent areas were disturbed.

In general, disturbance within Research Natural Areas from oil and gas exploration would compromise management objectives. Management objectives for Research Natural Areas are to preserve and maintain the 'natural' state of an area, and removing any vegetation within such an area would constitute an unnecessary human intrusion and conflict with preservation of the natural vegetation trends essential for research and interpretation. Research Natural Areas are protected at the level of the entire Area and not just the features of that Area. Additional management objectives for Research Natural Areas involve using Areas for educational or research purposes. Regarding oil and gas activities, mineral lease applications are to be reviewed in a timely fashion and NSO leasing options are recommended (USFS 1986:4-155). Adverse impacts from the alteration of vegetation within Research Natural Areas under SLT would be long term and major.

INVASIVE PLANTS

- *Measurement Indicator #6* INCREASES IN INVASIVE PLANTS

Establishment of or increases in invasive plants, including noxious weeds, would cause indirect adverse impacts to native vegetation. Impacts would be more adverse if infestations occurred in a unique vegetation area, Special Area, or Research Natural Area. Invasive plants cause adverse impacts to the vegetation resources by reducing biodiversity, amount of forage, habitat, soil productivity, and the likelihood that a site can be reclaimed to a 'natural' or historic state. The likelihood of invasive plant proliferation would be most likely during seismic activities (with buggies; see discussion under NSO), but could also occur as a result of pad and road construction, pad development, discharge waters, and secondary disturbances (Bergquist et al. 2007). Road construction may pose the most likely mode of invasive plant proliferation outside of seismic activities under SLT, as roads cover longer linear distances than other construction activities and have a constant and direct contact with vehicles that may transport seeds.

Standard operating procedures include measures to prevent invasive plant occurrences from spreading or establishing during operations and after reclamation. These prescriptions are contained in the *BLM Surface Operating Standards and Guidelines for Oil and Gas Exploration and Development*, *Forest Service Region 4 Oil and Gas Roading Guidelines*, *Dixie National Forest Oil and Gas Construction and Operating Standards* (Appendix C), and other regulating documents. Surface operating standards (BLM and USFS 2007) state that revegetation and maintenance activities on all leases (regardless of leasing option) must ensure that a reclaimed site is free of state- and county-listed noxious weeds. Regarding road construction and reclamation, all roads used to access oil and gas locations exist only as long as necessary to complete exploration and production operations, and are reclaimed after use with native topsoil (where available). Reclaimed areas are seeded with native species, as the long-term objective of final reclamation is to set the course for eventual ecosystem restoration of the natural vegetation community. At the time of reclamation, the operator must achieve at least short-term stability, visual, hydrological, and productivity objectives and take the steps necessary to ensure that long-term objectives will be reached via natural processes (BLM and USFS 2007). These objectives include rapidly controlling and eradicating invasive plants, including noxious weeds, early after they appear on site.

If invasive plants were to increase on the Dixie National Forest, adverse impacts would generally be long term and moderate but would depend on the species introduced. An increase in invasive plants could result in relative abundance thresholds being crossed that will be difficult or impossible to recover from; in this case, impacts would be major. Further spread of salt cedar or Russian olive may remove the remaining riparian cottonwood communities; these adverse impacts would be moderate to major and long term. Introduction of knapweeds would change species composition, ecological processes, and native plant reproduction due to allelopathic effects; these impacts would be adverse, long term, and moderate.

4.9.5 Impacts by Alternative

The degree to which the connected action impacts (Section 4.9.4) would differ by alternative is discussed in this section. Each alternative involves a unique set of leasing options for each resource component, which would restrict the locations and the nature of oil and gas activities that are allowed wherever these resources occur.

Table 4.9-4 shows the acres of each resource component for vegetation under each leasing option, by alternative. Table 4.9-4 incorporates the amount of overlap with more restrictive leasing options (assigned to other resources) in addition to the leasing option assigned directly to each vegetation resource component. Alternatives D1, D2, E1, and E2 represent the dual analysis of Alternatives D and E. D1 and E1 represent the acres available with NSO in all IRAs. D2 and E2 represent the acres with leasing allowed in IRAs under a less restrictive leasing option. A more detailed table that separates the acreage by resource component and ranger district will be available in Appendix B. The Side Hollow Study Area and portions of several Research Natural Areas are within IRAs.

Table 4.9-4 Acreage of Resource Components for Vegetation under each Leasing Option, by Alternative

Resource Component	Leasing Option[3]	Alternative[1,2]						
		A	B	C	D1	D2	E1	E2
Red Canyon Botanical Area (0 acres in IRAs)	NA							
	NL	203	79					
	NSO		124	203	203	203		
	CSU							
	SLT						203	203
Side Hollow Ponderosa Pine Provenance Study Area (4.5 acres in IRAs)	NA							
	NL	4.5	4.5					
	NSO			4.5	4.5	4.5	4.5	
	CSU							
	SLT							4.5
Research Natural Areas (3,219 acres in IRAs)	NA	542	542	542	542	542	542	542
	NL	4,253	4,253	4,253				
	NSO				4,253	4,253	3,219	
	CSU							
	SLT						492	4,253

[1] Small discrepancies in the acreage presented for each alternative are due to the fact that the GIS database has limitations when applied over an extremely large area that result in an inability to calculate acreages that match exactly between alternatives. A more detailed table that separates the acreage by resource component and ranger district will be available in Appendix B.
[2] Alternatives D1, D2, E1, and E2 represent the dual analysis of Alternatives D and E. D1 and E1 represent the acres available with NSO in all IRAs. D2 and E2 represent the acres with leasing allowed in IRAs under a less restrictive leasing option.
[3] Areas not legally available (NA) for leasing (see Section 1.5.2) are included in the Table to provide context to the analysis.

In this section, impacts are discussed mainly at the Forest-wide level and not by ranger district. This is done to avoid repetition and facilitate the comparison of impacts across alternatives. Differences among ranger districts are highlighted in this section if there are pronounced differences among ranger districts.

Impacts by *Measurement Indicators* are summarized in Table 4.9-5 and differences between alternatives regarding vegetation resources are outlined in the text below. *Measurement Indicator #1* is not discussed in this section or in Table 4.9-5 because the impacts in terms of acres disturbed would be the same under all alternatives that allow leasing (Alternatives B, C, D, and E; see Section 4.9.4.6). Under Alternative A, no leasing would be allowed and impacts relative to *Measurement Indicator #1* would be negligible.

Under all alternatives, five percent of the Dixie National Forest would be NA, or legally unavailable for lease, including Brian Head Ski Permit Area, wilderness areas, and areas surrounding the Box-Death Hollow Wilderness Area that were withdrawn from leasing by the Utah Wilderness Act of 1984 (see Section 1.5.2).

4.9.5.1 Alternative A

There would be no oil and gas activities on the Dixie National Forest within areas not currently leased. Alternative A would continue present management activities as pertaining to oil and gas leasing. The Forest Supervisor under this alternative would not make any new leasing decisions and no new oil and gas leasing would be allowed on the Dixie National Forest. Current operations, including the Upper Valley oil field on the Escalante Ranger District (19 wells, including nine water-injector wells) would continue (USFS 2006g). In total, there are 13,454 acres of existing leases on the Dixie National Forest. Existing leases will expire and the potential number of wells that could be drilled on the Dixie National Forest would decrease over time. Under Alternative A, adverse impacts to vegetation resources, including major vegetation communities, biological soil crusts and gypsum soils, Special Areas, Research Natural Areas, and invasive plants would be negligible.

4.9.5.2 Alternative B

Chapter 2 of the EIS describes how many acres of the Dixie National Forest would fall under each leasing option under Alternative B (*Measurement Indicator #1*; see Table 2.5-2) and where those acres are located (*Measurement Indicator #2*; Figure 2.5-2 (a-d)). Under all alternatives, five percent of the Dixie National Forest is not legally available for leasing (NA).

Approximately 65 percent of the Dixie National Forest would not be leased (NL) under Alternative B; of the remainder, 20 percent would be NSO and 5 percent would be CSU. All Special Areas and Research Natural Areas would be assigned a leasing option of NSO; however, large parts of these areas would be NL due to overlapping leasing options with other resources. Approximately 39 percent of the Red Canyon Botanical Area, all of the Side Hollow Study Area, and all Research Natural Areas would not be available for lease (NL) under Alternative B.

Under Alternative B, a NL leasing option would preclude surface disturbance to vegetation resources in areas covered by this leasing option. Adverse impacts to Research Natural Areas with regard to location of disturbance (*Measurement Indicator #2*), compliance with Establishment Records (*Measurement Indicator #3*), and compliance with management objectives (*Measurement Indicator #5*) would be negligible because no disturbance would occur in Research Natural Areas. Adverse impacts to Special Areas with regard to *Measurement*

Indicators #2, #5, and effects on limiting attributes (*Measurement Indicator #4*), would be negligible in the Side Hollow Study Area because it is covered by NL under Alternative B. Regarding the Red Canyon Botanical Area, which is 39 percent NL and 61 percent NSO, impacts would likely be negligible (if no activities occurred) but could be long term and minor if seismic activities were allowed.

For vegetation resources without an assigned leasing option (major vegetation types, biological soil crusts, and weed infestations), under Alternative B the least amount of land would be available for leasing relative to other alternatives (i.e., C, D, and E). The density of oil and gas disturbances predicted under the RFDS (397 to 706 acres) could be higher because only 5 percent of the lands on the Dixie National Forest would be available (i.e., CSU) for the same amount of oil and gas exploration and development. However, since five percent of the Dixie National Forest is equal to about 100,000 acres, oil and gas density would likely be about the same as if the entire Forest were available for leasing. The 100,000 acres that are available under Alternative B appear to be a mix of major vegetation types similar to that across the entire Forest. No locally rare vegetation (i.e., desert scrub in the Escalante Ranger District) would be available for lease under Alternative B, thus adverse impacts to major vegetation types would be minor and short term (exploration disturbance) to moderate and long term (production disturbance). Adverse impacts to major vegetation communities from seismic activities alone would be negligible.

Adverse impacts to biological soil crusts and invasive plants would be the same under Alternatives B, C, D (both alternatives), and E (both alternatives) because the same amount of disturbance is predicted. Suitable vegetation areas for soil crusts, including desert scrub, pinyon-juniper, sagebrush, are generally available under all alternatives that allow leasing. Likewise, invasive plants may invade any vegetation type, including all areas open to leasing under Alternative B. With NL leasing options in IRAs, the majority of the Pine Valley Ranger District (where crusts are most likely to occur and the greatest numbers of weed infestations are located) would be NL due to the prevalence of IRAs. However, the risk of weed invasion during seismic activities would still be allowed under NSO, which covers 20 percent of the Forest. Adverse impacts with regard to weeds are similar to (or greater than) that from drilling, road building, or any other connected action. Thus, impacts in terms of crust disturbance and weed invasion would not be measurably lower under NSO leasing options, which characterize most available lands under Alternative B, relative to SLT. Adverse impacts to crusts, if they occurred, would be long term and minor, and would be further prevented from recovering by a spread of invasive plants. Adverse impacts related to invasive plants, if they occurred, would be long term and moderate.

4.9.5.3 Alternative C

Alternative C has less restrictive leasing options than Alternative B and more restrictive options than Alternative D. Chapter 2 of this EIS describes how many acres of the Dixie National Forest would fall under each leasing option under Alternative C (*Measurement Indicator #1*; see Table 2.5-3) and where those acres are located (*Measurement Indicator #2*; Figure 2.5-3 (a-d)).

Under Alternative C, 73 percent of vegetation on the Dixie National Forest would be NSO. Five percent would be NA. All approved leasing within Special Areas and Research Natural Areas would be NSO.

The same amount of disturbances may occur under Alternative C as under Alternatives B, D, and E. Adverse impacts to major vegetation communities would be minor and short term

(exploration) to moderate and long term (production), as described under Alternative B. Under Alternative C, adverse impacts to desert scrub could be major if a production field occurred within this vegetation type on the Escalante Ranger District.

Adverse impacts to biological soil crusts and invasive plants under Alternative C would be the same as under Alternative B because the same amount of disturbance may occur. Regarding Special Areas, 100 percent of the land within these boundaries would be NSO under Alternative C, which is a larger amount of NSO than under Alternative B, under which some areas (i.e., Side Hollow) would not be leased (NL) due to overlaps with other resources. Under Alternative C, seismic activities could occur anywhere within Special Areas due to NSO leasing options throughout. Adverse impacts to Special Areas under Alternative C would be of greater intensity than under Alternative B and are described in 4.9.4.3 (NSO); these impacts could be long term and minor, if they occurred. There would be no adverse impacts to Research Natural Areas under Alternative C due to NL leasing options.

4.9.5.4 Alternative D1 (NSO in IRAs)

Alternative D has less restrictive leasing options than Alternative C and more restrictive options than Alternative E. Chapter 2 of this EIS describes how many acres of the Dixie National Forest would fall under each leasing option under Alternative D1 (NSO in IRAs) (*Measurement Indicator #1*; see Table 2.5-4) and where those acres are located (*Measurement Indicator #2*; Figures 2.5-4 (a-d)).

Under Alternative D1, 33 percent of the Dixie National Forest would be NSO. Five percent would be NA. As under Alternatives B and C, all approved leasing within Special Areas and Research Natural Areas would be NSO.

Adverse impacts to major vegetation communities, biological soil crusts and invasive plants (*Measurement Indicator #6*), would be the same as under Alternatives B and C because the same amount of disturbance may occur in an unknown location. Adverse impacts to Special Areas (*Measurement Indicators #4 and #5*) would be the same as described for Special Areas under Alternative C because the entirety of these areas would be covered by NSO, under which impacts could be long term and minor. Any impact to Research Natural Areas would be major, as described under NSO (*Measurement Indicators #3* and *#5*; Section 4.9.4.3).

4.9.5.5 Alternative D2 (CSU in IRAs)

Under Alternative D2 (CSU in IRAs), 8 percent of the Dixie National Forest would be NSO. Five percent would be NA. As under Alternative D1, all approved leasing within Special Areas and Research Natural Areas would be under NSO, which would allow seismic activities.

Adverse impacts to vegetation resources (*Measurement Indicators #3, #4, #5,* and *#6*), including major vegetation communities, biological soil crusts, and invasive plants, would be the same as under Alternative E2 (SLT in IRAs). This is because a CSU leasing option (covering the majority of the Forest under this alternative) would not prevent disturbance to vegetation resources and the same impacts may occur as under SLT. Adverse impacts to Special Areas and Research Natural Areas would be the same as under Alternative D1 because leasing options on these lands would still be 100 percent NSO.

4.9.5.6 Alternative E1 (NSO in IRAs)

Alternative E has the least restrictive leasing options. All lands on the Dixie National Forest, with the exception of IRAs, would be under SLT. Chapter 2 of this EIS describes how many acres of forest would fall under each leasing option under Alternative E1 (with NSO in IRAs) (*Measurement Indicator #1*; see Table 2.5-5) and where those acres are located (*Measurement Indicator #2*; Figures 2.5-5 (a-d)).

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Under Alternative E1, leasing would be allowed under NSO on 33 percent of the Dixie National Forest and under SLT on the remainder, with five percent NA. All Special Areas and Research Natural Areas would be under SLT, with leasing allowed in the Side Hollow Study Area, Timbered Cinder Cone Research Natural Area, and Red Canyon Research Natural Area only under NSO because of its location in an IRA.

Adverse impacts to major vegetation communities, biological soil crusts, and invasive plants (*Measurement Indicator #6*), would be the same as under Alternatives B, C, and D because the same amount of disturbance may occur in an unknown location.

Relative to Alternative E2 (SLT in IRAs) (Section 4.9.4.6), although some Research Natural Areas would fall in IRAs and thus be covered by NSO stipulations, adverse impacts to Research Natural Areas under this alternative would still be major. Regarding Special Areas within IRAs (i.e., Side Hollow Study Area), adverse impacts, if they occurred, would be long term and minor. Impacts within Red Canyon Botanical Area would be the same as SLT (4.9.4.6) because this area is not covered by IRAs. In terms of compliance with Establishment Records of Research Natural Areas (*Measurement Indicator #3*), adverse impacts from oil and gas disturbance under Alternative E with NSO in IRAs would be long term and minor for only Timbered Cinder Cone; all others would be negligible because Establishment Records would not be violated. In terms of compliance with management objectives (*Measurement Indicator #5*), SLT options under Alternative E would violate management objectives for Research Natural Areas which state that NSO leasing options should apply within these areas (the 1986 Land and Resource Management Plan would also be violated; see Section 4.17. SLT would also open a larger possibility for disturbance within Special Areas that would violate management objectives to preserve unique features of these areas. These adverse impacts, if they occurred under SLT, would be long term and major.

4.9.5.7 Alternative E2 (SLT in IRAs)

Leasing would be allowed anywhere on the Dixie National Forest that is legally available (90 percent of the forest; Table 1.5-1) under SLT. Impacts would be as described in Section 4.9.4.6.

Table 4.9-5 Adverse Impacts with Respect to Measurement Indicators #2 - #6

Resource			ALT A	ALT B	ALT C	ALT D1	ALT D2	ALT E1	ALT E2
Major Vegetation Types		*MI #2*	neg	minor-mod ST-LT	minor-mod[1] ST-LT	minor-mod[1] ST-LT	minor-mod[1] ST-LT	minor-mod[1] ST-LT	minor-mod[1] ST-LT
Biological Crusts		*MI#2*	neg	minor LT **#**	minor LT **#**	minor LT **#**	minor LT **#**	minor LT **#**	minor LT **#**
Special Areas	Red Canyon Botanical Area	*MI#2*	neg	neg – minor LT	minor LT	minor LT	minor LT	major LT	major LT
		MI #4	neg	neg – minor LT	minor LT	minor LT	minor LT	major LT	major LT
		MI #5	neg	neg – minor LT	minor LT	minor LT	minor LT	major LT	major LT
	Side Hollow Ponderosa Pine Study Area	*MI#2*	neg	negligible LT	negligible LT	negligible LT	negligible LT	negligible LT	Major[2] LT
		MI #4	neg	negligible LT	minor LT	minor LT	minor LT	minor LT	Major[2] LT
		MI #5	neg	negligible LT	minor LT	minor LT	minor LT	minor LT	Major[2] LT
Research Natural Areas	Browse	*MI #2*	neg	negligible LT	negligible LT	major LT	major LT	major LT	major LT
		MI#3	neg	negligible	negligible	negligible	negligible	negligible	negligible
		MI #5	neg	negligible LT	negligible LT	major LT	major LT	major LT	major LT
	Red Canyon	*MI #2*	neg	negligible LT	negligible LT	Alt D: same as Browse		Alt E: same as Browse	
		MI#3	neg	negligible	negligible				
		MI #5	neg	negligible LT	negligible LT				
	Table Cliff	*MI #2*	neg	negligible LT	negligible LT	Alt D: same as Browse		Alt E: same as Browse	
		MI#3	neg	negligible	negligible				
		MI #5	neg	negligible LT	negligible LT				

Resource			ALT A	ALT B	ALT C	ALT D1	ALT D2	ALT E1	ALT E2
	Timbered Cinder Cone	*MI #2*	neg	negligible LT	negligible LT	Alt D: same as Browse		Alt E: same as Browse	
		MI#3	neg	negligible LT	negligible LT				
		MI #5	neg	negligible LT	negligible LT				
	Upper Sand Creek	*MI #2*	neg	negligible	negligible	negligible	negligible	negligible	negligible
		MI#3	neg	negligible	negligible	negligible	negligible	negligible	negligible
		MI #5	neg	negligible	negligible	negligible	negligible	negligible	negligible
Invasive Plants		*MI#6*	neg	mod-major LT[3]	mod-major LT[3]	mod-major LT[3]	mod-major LT[3]	mod-major LT[3]	mod-major LT[3]

[1] Impacts within desert scrub in Escalante Ranger District could be major if a production field occurred completely within desert scrub.
[2] Impacts would be long term and major if they occurred; however, due to its small size this area could be avoided.
[3] Impacts most likely within Pine Valley Ranger District.
LT = long term; ST = short term; neg = negligible; mod = moderate.

4.10 Transportation

4.10.1 Introduction

The terms used to describe the context and intensity of effects in this section are discussed in Section 4.1 and Table 4.1-1. Table 4.10-1 provides an example how these terms would apply to the transportation system.

Table 4.10-1 Terms used to Describe Effects to the Transportation System

Attribute of Effect		Description relative to the Transportation System
Quality	Beneficial	An improvement of an existing road, such as adding or improving drainage, grading, or improving surface condition.
	Adverse	A degradation of an existing road as a result of an increase in the number of large vehicles (e.g., semi trucks, etc.), which can increase maintenance costs and create safety concerns.
Magnitude (Intensity)	Negligible	An increase in traffic volume that is not statistically different than baseline and does not result in an increase in maintenance costs.
	Minor	An increase in traffic volume that is statistically different than baseline, but does not result in an increase in realized maintenance costs.
	Moderate	An increase in traffic volume that is statistically different than baseline and results in a small, but realized increase in maintenance costs.
	Major	An increase in traffic volume that is statistically different than baseline and results in large, realized increase in maintenance costs
Duration	Temporary	An increase in traffic volume that does not continue once construction or exploration is completed.
	Short-term	An increase in traffic volume that occurs during exploration activities (i.e., construction of exploratory well pads or access roads, 10 years or less.
	Long-term	An increase in traffic volume due to the construction of production facilities (i.e., a production field and associated roads), more than 10 years.

4.10.2 Measurement Indicators

- *Measurement Indicator #1* ESTIMATED TRAFFIC INCREASE
- *Measurement Indicator #2* MILES OF ROAD CONSTRUCTION AND RECONSTRUCTION (LONG- AND SHORT-TERM)
- *Measurement Indicator #3* DETERMINE THE POTENTIAL GRAVEL QUANTITIES NEEDED

4.10.3 Impacts Common to All Action Alternatives

No resource components or leasing options were identified specifically for the transportation resource. There is no difference between action alternatives for transportation effects. As a result, the impacts of connected actions under the Reasonably Foreseeable Development Scenario (RFDS) are discussed in this section, assuming no restrictions or leasing options on oil and gas activities other that those listed on BLM form 3100-11. Oil and gas activity would be subject to the Best Management Practices (BMPs) listed in the *Dixie National Forest Oil and Gas Construction and Operating Standards and Well Site Design Requirements* contained in Appendix C and the *Surface Operating Standards and Guidelines for Oil and Gas Exploration and Development – The Gold Book* (BLM and USFS 2007).

Impacts to county and Dixie National Forest roads would primarily include maintenance of new and existing roads, and increased levels of traffic using these roads. Increases in traffic volume, especially related to increases in the number of large vehicles (e.g., semi trucks, etc.), can increase maintenance costs and create additional safety concerns (e.g., large vehicles entering highways). Maintenance of existing, new, and reconstructed roads used for oil and gas activities would be the responsibility of the lessee. Construction of new roads could provide access for inappropriate use of National Park Service Lands; however in specified areas, new roads would be gated and only used for oil and gas related activities. Any new road added to the system (production) would first undergo NEPA analysis and any temporary roads (exploration) would be removed and rehabilitated.

Beneficial impacts could include improvement of existing roads (such as adding or improving drainage, grading, improving surface condition) and overall improvement of the transportation system (i.e., planning road locations and types efficiently to meet access needs) to the road and maintenance standards in the Land and Resource Management Plan. Adverse impacts related to surface disturbance, removal of vegetation, erosion, wildlife collisions, IRAs, changes in air quality and fragmentation of wildlife habitats are discussed in the other sections of Chapter 4.

Measurement Indicators

- *Measurement Indicator #1* ESTIMATED TRAFFIC INCREASE

EXPLORATION DRILLING

For this EIS we are using the Fishlake National Forest's estimated traffic volumes by type that was created in support of their oil and gas leasing EIS. This information, currently in draft form, is provided as Appendix E. Traffic volume is directly correlated to estimated size of drill pads and amount of road construction/reconstruction. Estimated pad size for the Fishlake National Forest is the same (5.9 acres) as for the Dixie National Forest. The amount of new road construction per drill pad estimated on the Fishlake National Forest is 0.09 miles more than on the Dixie National Forest and the amount of reconstruction is 1.32 miles less. Although minor differences exist between the two Forests, these data are the best available and more applicable than UDOT (2006).

In summary, it is estimated that total one-way traffic volume would be up to 1,924 trips per exploration well. The RFDS (BLM 2007a) estimates 60 total exploration wells on the Dixie National Forest over a 15-year period. Total estimated traffic volume for these exploration wells is presented in Table 4.10-2. For the purpose of this analysis, it is estimated that it would take 120 days to complete each exploration well, including initial reclamation (Carter Reed, USFS, personal communication). Average daily traffic per exploration well is estimated to be 16 trips. The RFDS (BLM 2007a) predicts four exploration wells on the Dixie National Forest per year. Average daily traffic volume associated with exploration wells would thus range from 0, when no drilling is occurring, to 64 one-way trips if all four exploration wells were active at the same time. Although unlikely, it is assumed for this analysis that all four exploration wells would be active at the same time each year and that associated traffic would occur on all Highways. Under this extreme scenario, average daily traffic volume would increase from between three percent and 12 percent on the Dixie National Forest as a result of exploration drilling (Table 4.10-2). In terms of public safety, this increase would be short term (120 days) and negligible to minor in intensity. Regarding maintenance costs, the lessee would be responsible for maintenance until operations cease and there would be no effect on maintenance costs. If the oil and gas activity requires upgrading an existing Forest Service road to a higher standard, the Forest Service may agree to assume costs of maintenance at the higher standard after exploration is completed.

Table 4.10-2 Total Estimated Exploration Traffic Volume

Ranger District	One-Way Traffic Volume
Cedar City	28,860
Escalante	38,480
Pine Valley	9,620
Powell	38,480
Total	115,440

Table 4.10-3 Estimated Percent Increase in Average Daily Traffic Volume During Exploration Drilling

Highway	Pine Valley[1]	Cedar City[1]	Powell[1]	Escalante[1]
State Highway 18	4%			
State Highway 14		8%		
State Highway 148		12%		
State Highway 143		8%		
US Highway 89		5%		
State Highway 12 Red Canyon			3%	
State Highway 12 Upper Valley				5%
State Highway 12 Boulder				12%

[1] Assumes that 4 wells would be active at the same time and that associated traffic would occur on all highways.

PRODUCTION FIELD DEVELOPMENT

It is estimated that total one-way traffic volume would be up to 6,884 trips for development of a 20-well production field (Appendix E). For the purpose of this analysis, it is estimated that it would take at least two years (520 working days) to complete field development (Carter Reed, USFS, personal communication). Average daily traffic is thus estimated to be 13 one-way trips during the production field development stage. The RFDS estimates the development of one production field on the Dixie National Forest. For the sake of this analysis, it is assumed that a 20-well production field would be developed in each ranger district. Average daily traffic volume would increase from one percent to two percent on the Dixie National Forest as a result of field development (Table 4.10-4). In terms of maintenance costs and public safety impacts as a result of increased traffic and large vehicles pulling onto highways, this increase would be short term (two to three years) and negligible.

FIELD OPERATIONS

Once a field was developed, estimated average daily one-way traffic volume would be up to 15 trips for field operation (Appendix E). Average daily traffic volume increase would be similar to development (Table 4.10-3). In terms of maintenance costs and public safety, this increase would be long term (30 years) and negligible.

Table 4.10-4 Estimated Percent Increase in Average Daily Traffic Volume during Production Field Development

Highway	Pine Valley[1]	Cedar City[1]	Powell[1]	Escalante[1]
State Highway 18	1%			
State Highway 14		2%		
State Highway 148		2%		
State Highway 143		2%		
US Highway 89		1%		
State Highway 12 Red Canyon			1%	
State Highway 12 Upper Valley				1%
State Highway 12 Boulder				2%

[1] Assumes that one field is developed on each ranger district and that associated traffic would occur on all highways.

ABANDONMENT AND RECLAMATION

It is estimated that total one-way traffic volume would be up to 902 trips for field abandonment and reclamation (Appendix E). For the purpose of this analysis, it is estimated that it would take three years (780 working days) to complete abandonment and reclamation activities (Carter Reed, USFS, personal communication). Average daily traffic is thus estimated to be one to two one-way trips during the abandonment and reclamation stage. In terms of maintenance costs and public safety, this increase would be short-term (three years) and negligible.

- *Measurement Indicator #2* MILES OF ROAD CONSTRUCTION AND RECONSTRUCTION

It is estimated that an average of 0.66 miles of new road construction and 3.92 miles of road reconstruction would be needed for each exploration well. It is also estimated that 9.5 miles of new spur roads would be needed for a production field (BLM 2007a). Across the ranger districts, the percent increase in miles of Forest System roads over baseline would range from 6.9 percent to 13.5 percent (Table 11.5-5). Actual increases would be somewhat less as roads would be constructed over a 15-year period and in any year following the first exploration well, earlier exploration roads would be reclaimed and removed from the transportation network. Impacts to the existing transportation network would be short to long term depending on location of the road and success of reclamation for exploration roads. For production, impacts would be long term as the roads would be in existence for at least 10 years. The 284.3 miles of new road construction/reconstruction would not greatly augment (9.2 percent) the 3,078 miles of system roads already existing on the Dixie National Forest, or individual ranger districts; impacts would be minor.

Table 4.10-5 Estimated Miles of New Road Construction and Reconstruction over a 15-Year Period by Ranger District

Ranger District	Wells	New Road Construction Exploration Drilling	Road Reconstruction Exploration Drilling	New Spur Road Construction Production Field	Total Road Construction/ Reconstruction	Percent Increase Over Existing
Pine Valley	5	3.3	19.6	9.5	32.4	6.9%
Cedar City	15	9.9	58.8		78.2	7.7%
Powell	20	13.2	78.4		101.1	12.6%
Escalante	20	13.2	78.4		101.1	13.5%
Total	60	39.6	235.2		284.3	9.2%

- *Measurement Indicator #3* POTENTIAL GRAVEL QUANTITIES NEEDED

It is estimated that between 1,662 (four inches of gravel surface course) to 3,739 (eight inches of gravel) cubic yards of gravel would be needed for each mile of road construction/reconstruction. It is further assumed that a 5.9-acre well pad would require 6,887 cubic yards of gravel (Donald Wilcox, USFS, personal communication). In total, estimated maximum gravel needed is 1,476,218 cubic yards (Table 4.10-6). Gravel sources on the Dixie National Forest are limited and it is likely that gravel would have to be imported from off the Forest, such as from adjacent BLM-administered lands or from a private source. If gravel came from existing, permitted pits, impacts would be short term and minor to moderate depending on the amount of source material available. If new gravel pits are required, impacts could be long term if the pit remained active for many years. Impacts associated with new gravel pits on BLM-administered lands would be subject to a project-specific NEPA analysis.

Table 4.10-6 Estimated Amount of Gravel Needed for Road Construction/ Reconstruction and Well Pads over a 15-year Period by Ranger District

Ranger District	Wells	New Road Construction Exploration Drilling (miles)	Road Reconstruction Exploration Drilling (miles)	New Spur Road Construction Production Field (miles)	Total Road Construction/ Reconstruction (miles)	Maximum Gravel Needed (cubic yards)
Pine Valley	5	3.3	19.6	9.5	32.4	155,578.6
Cedar City	15	9.9	58.8		78.2	395,694.8
Powell	20	13.2	78.4		101.1	515,752.9
Escalante	20	13.2	78.4		101.1	515,752.9
Total	60	39.6	235.2		284.3	1,476,218.0

4.10.4 Impacts of Connected Actions by Leasing Option

No resource components or leasing options were identified specifically for the transportation resource. Effects of road building by leasing options assigned to other resources are described in other sections of Chapter 4.

4.10.5 Impacts by Alternative

With the exception of Alternative A, estimated traffic increase (*Measurement Indicator #1*), miles of road construction and reconstruction (*Measurement Indicator #2*), and potential gravel quantities needed (*Measurement Indicator #3*) would be the same under all alternatives. Impacts by alternative are thus the same and as described in Section 4.10.3: short (exploration)

to long term (development) and mostly negligible to minor. If gravel for road construction/reconstruction came from existing, permitted pits, impacts would be minor to moderate depending on the amount of source material available.

4.11 Socioeconomic Resources

4.11.1 Introduction

The terms used to describe the context and intensity of effects in this section are discussed in Section 4.1 and Table 4.1-1. Table 4.11-1 provides an example how these terms would apply to socioeconomic resources.

Table 4.11-1 Terms used to Describe Effects to Socioeconomic Resources

Attribute of Effect		Description relative to Socioeconomic Resources
Quality	Beneficial	An change in social or economic conditions that leads to economic prosperity in the form of increased employment, higher incomes, and an increased tax base, or that positively contributes to community values.
	Adverse	A population change for which a local community cannot accommodate and results in economic hardships as the need for public facilities and services arises, or community values are lost.
Magnitude (Intensity)	Negligible	A change in employment and earnings that does not lead to a statistical change in employment, incomes, or tax base.
	Minor	A change in employment and earnings that leads to a statistical change in employment, income, and tax base that impacts a small proportion (less than approximately 25 percent) of the public.
	Moderate	A change in employment and earnings that leads to a statistical change in employment, income, and tax base which impacts a large proportion (between approximately 25 and 75 percent) of the public.
	Major	A change in employment and earnings that leads to a statistical change in employment, income, and tax base which impacts a majority (greater than 75 percent) of the public.
Duration	Temporary	A change in employment and earnings that does not occur once construction or exploration is completed.
	Short Term	A change in employment and earnings that occurs during exploration activities (i.e., construction of exploratory well pads or access roads, 10 years or less.
	Long Term	A change in employment and earnings due to the construction of production facilities (i.e., a production field and associated roads), more than 10 years.

4.11.2 Measurement Indicators

- *Measurement Indicator #1* POTENTIAL LEASE BIDS, LEASE PAYMENTS, AND ROYALTIES GENERATED
- *Measurement Indicator #2* POTENTIAL AMOUNT OF FEDERAL RECEIPTS TRANSFERRED TO THE STATE OF UTAH AND RESPECTIVE COUNTIES
- *Measurement Indicator #3* POTENTIAL AMOUNT OF PROPERTY TAX LEVIED AGAINST PRODUCING WELLS
- *Measurement Indicator #4* NUMBER OF POTENTIAL JOBS GENERATED

- *Measurement Indicator #5* POTENTIAL LOSS TO GRAZING PERMITTEES
- *Measurement Indicator #6* POTENTIAL OFFSET OF RECREATION IN LEASING AREAS
- *Measurement Indicator #7* COST PER MILE OF ROAD MAINTENANCE FOR FEDERALLY MANAGED ROADS

4.11.3 Impacts Common to All Action Alternatives

The direct social and economic effects of oil and gas leasing on the Dixie National Forest would be increased employment and earnings in the area surrounding the Forest. The effects would actually occur in cities and towns surrounding Dixie National Forest and not on the Forest lands themselves. Additional spending by the oil companies and employees results in indirect and induced economic impacts in the area.

Energy development can bring with it economic prosperity in the form of increased employment, higher incomes, and an increased tax base. Development can also cause adverse effects if local communities cannot accommodate population increases associated with the development. The influx of workers and their families could cause changes in social structures and life styles and impose economic hardships if the need for public facilities and services arises before adequate local revenue sources are generated within the region. Challenges that communities might face include a shortage in the supply of permanent and rental housing, inadequate infrastructure, and an overburdened to medical facilities, schools, and public services. The intensity of impacts depends on site-specific factors such as local population size and growth rates, population densities in the affected communities and surrounding areas, proximity to regional population centers, availability of service and retail businesses, and institutional capabilities to plan for, manage, and finance necessary infrastructure facilities (U.S. General Accounting Office 1982).

The prosperity and severity associated with energy development is also a function of project scale and duration. Large projects in close proximity to population centers will affect local communities more profoundly than self-contained, small-scale projects located far from local communities. Projects that encourage large-scale movement of people into an area for short time periods may also present serious challenges to local communities.

Under the various leasing options for development of the Dixie National Forest's oil and gas resources, a variety of changes in the human environment of the six-county area (Garfield, Iron, Kane, Piute, Washington, and Wayne) could occur. Direct effects would include changes in employment and income that result from new jobs in the community for local residents during the exploration, development, and/or production phases. Indirect changes could take the form of increased business for local merchants and professionals (which would also increase the demand for labor), and possibly increase the population if development activities induce people to relocate permanently to the area. Increases in personal income could result, as well as changes in demand for housing, schools, and public services.

Of concern is the potential magnitude of these changes. The issue is one of capacity and capability of local communities to absorb and accommodate changes in population and requirements for public and private goods and services and whether the area's communities could accommodate inflows of human and material resources that could result from the leases. Two prime factors should therefore be considered: 1) the magnitude of the development activities (in terms of numbers of people and movements of materials and equipment and the associated flows

of money into the local economy) and 2) the economic base of the area (in terms of its degree of development to provide goods and services to its residents and visitors).

In the short term, the latter is relatively fixed; the baseline description of the six counties' socioeconomic characteristics described in Section 3.11 portrays the current status of employment, income, fiscal, and population variables. Although four counties in the six-county area are rural and sparsely populated (Garfield, Kane, Piute, and Wayne Counties), the remaining two counties, Washington and Iron Counties, each have a broad-based economy and a solid and growing population.

Because of the relatively minor amount of oil and gas exploration activity predicted by the RFDS, any impacts on counties in the six-county area are likely to be temporary, short term and minor. The geographic area where exploration would occur is vast and remote; the number of wells that would be drilled averages four per year over a 15-year period, and exploration will be spread throughout this large area. Finally, depending on where exploration occurs on the Dixie National Forest and its proximity to the nearest communities, impacts on those communities would vary from negligible to minor. Exploration in remote portions of the Forest could require crews to live on-site in temporary camps. In these situations, interaction with local communities would be minor and not likely to strain local resources. Exploration that occurs closer to the Forest boundaries could likely result in a higher level of interaction between work crews and the local community as contractors occupy nearby hotels and motels, eat meals, and purchase fuel and other sundry items from local merchants.

Longer-term impacts would occur during the operation/production phase. Under the RFDS, one production field with 20 wells would be developed within 15 years. In this phase, oil and gas workers could move into the area and bring their families with them. Some communities may be better prepared than others to absorb population increases and to deal with the social and economic situations that result.

Of interest to the socioeconomic impact assessment are the money and people aspects of the projected developments. Money flows (i.e., changes in demand for economic resources) and relocation of personnel (and dependents) are the direct causes of socioeconomic impacts. It is necessary, accordingly, to attempt to quantify the economic (material and human) resources associated with mineral exploration, development, and production on the Dixie National Forest.

Measurement Indicators

- *Measurement Indicator #1 –* POTENTIAL LEASE BIDS, LEASE PAYMENTS, AND ROYALTIES GENERATED

Under the Mineral Leasing Act of 1920, royalties are paid to the federal government for oil and gas production from public lands. Royalties are paid at 12.5 percent of production value. It is estimated that annual royalties paid to the federal government under the RFDS would be approximately $3.2 million (see Table 4.11-2).

Based on information collected by the U.S. Department of Interior, Mineral Management Service, the federal government collected $9.04 billion in oil and gas royalties in 2007. Using this amount as a guideline, the effect of $3.2 million in royalties generated by 20 producing wells on the Dixie National Forest is considered negligible for the six-county area. Depending on how this royalty income is eventually distributed to local governments and communities the impact could range from minor to moderate. The impacts would likely be long term depending on the length of time the wells remain productive.

- *Measurement Indicator #2* – POTENTIAL AMOUNT OF FEDERAL RECEIPTS TRANSFERRED TO THE STATE OF UTAH AND RESPECTIVE COUNTIES

Revenues from leasing are shared equally between the federal government and the state. Since the passage of the Mineral Leasing Act in 1920, Utah has received $962,468,000 from mineral revenues on federally-managed public lands in the state (BLM 2007d). Generally, one-half of the royalties paid to the Minerals Management Service are returned to the state of origin. Royalties related to production on Indian lands are returned to the appropriate tribe. The states have full discretion as to the distribution of federal mineral royalties as long as priority is given to areas with economic and/or social impacts from leasing activities.

In Utah, federal mineral royalties are distributed to several different accounts according to state law (Table 4.11-2). The largest recipients of federal mineral royalties in Utah are the Department of Transportation (UDOT) and the Permanent Community Impact Fund (PCIF). The funds distributed to UDOT are then distributed to local governments to fund special service districts in proportion to the amount of mineral lease money generated by each county. The Permanent Community Impact Fund (PCIF) makes loans and grants to state agencies and subdivisions of state government impacted by mineral resource development. Unlike the funds administered by UDOT, which are distributed in proportion to royalties generated in the county, the PCIF is distributed by a state-appointed board in response to proposals submitted by state agencies and local governments. Therefore, the distribution of funds by the PCIF to the various counties may vary from the amount of royalty generated.

The payments in lieu of taxes cited in Table 4.11-2 are not the payments in lieu of taxes made by the federal government for federal land in Utah, but are payments made by the state government to counties for lands controlled by the School and Institutional Trust Lands Administration, Utah Division of Parks and Recreation, and the Utah Division of Wildlife Resources.

Table 4.11-2 Distribution of Federal Mineral Royalties in Utah

	Percent
Permanent Community Impact Fund	32.5
State Board of Education	2.25
Utah Geological Survey	2.25
Water Research Laboratory	2.25
Department of Transportation	40.0
Department of Community and Culture	5.00
Permanent Community Impact Fund	Remainder

[1] The amount paid for Payments in Lieu of Taxes has been adjusted annually since 1994 according to the Consumer Price Index.
Source: Utah State Code, Title 59, Chapter 21.

The average annual production from 20 wells is estimated at 363,000 barrels, or 18,165 barrels per well per year. This is the average annual production per well for Utah from 1957 to 2006, weighted by the number of wells (UGS 2008). The 2008 Annual Energy Outlook released by the Energy Information Administration forecasts the price of crude oil to decline gradually from current levels to $70 per barrel in 2016 before rising to $113 per barrel in 2020 (Energy Information Administration 2007a). (This was before the widely fluctuating oil prices of 2008). Crude oil produced in the Rocky Mountain region is, at the time of this writing, selling for a discount compared to quoted prices for light, sweet crude due to refinery capacity issues. For

purposes of this impact analysis, and in concert with the Energy Information Administration (2007a), it is assumed that crude oil produced from the Dixie National Forest would sell for $70 per barrel (this would vary in the future with changes in actual oil prices). Given these assumptions, the amount of federal mineral royalties returned to the State of Utah is estimated at $1.6 million, while 40 percent of this amount, or $636,000, would be returned to the county of origin by UDOT (Table 4.11-3).

Table 4.11-3 Estimated Federal Mineral Royalties Paid Annually

	Amount
Annual Production, barrels	363,300
Selling Price per barrel	$70
Value of Production	$25,431,000
Federal Royalty Rate	12.5%
Federal Royalty Paid	$3,178,875
Amount Returned to the State	$1,589,738
Amount Returned to County of Origin by UDOT	$635,775

Source: Preparer's calculations

In addition to the funds returned directly to the county of origin by UDOT, there is a possibility that additional funds could be returned to the area through the PCIF. These funds are distributed in response to proposals submitted by local governments and state agencies. In the past, the six-county area has received more in awards from the PCIF than the amount of revenue that was generated by federal mineral royalties in the area.

Based on information collected by the U.S. Department of Interior, Mineral Management Service, Utah received $101 million in oil and gas royalties in 2007. Using this amount as a guideline, the effect of $1.6 million in royalty payments to Utah that would be generated by 20 producing wells on the Dixie National Forest is considered minor. County-specific effects cannot be determined, as it is not known which county or counties in the six-county area would receive royalty payments. The effects of these payments would vary depending on the county receiving them, with the effect being greater for a county with lower baseline economic activity than one with a larger economy. The length of time the wells would remain viable is unknown, but the royalty payments would continue as long as the wells produce, likely long term.

- *Measurement Indicator #3* – POTENTIAL PROPERTY TAXES PAID ON PRODUCTION

In Utah, oil and gas properties are centrally assessed by the Utah State Tax Commission. Property taxes are then levied by local governments. Taxes are assessed on all wells, regardless of surface ownership. During 2006, total oil and gas production was 38,908,985 barrels of oil equivalent, on which $12,895,362 in property taxes was charged. This is a ratio of $0.446 per barrel of oil equivalent produced. Applying this ratio to the estimated annual production of 363,300 barrels on the Dixie National Forest results in estimated property tax payments of $162,107 on a producing field with 20 wells, although the actual taxes assessed would depend on the county where the field would be located.

An increase of $162,107 in property taxes related to oil and gas properties is minor (a small but measurable change). The length of time the wells would remain viable is unknown, the impacts would likely be long term depending on how long the wells continue to produce.

- *Measurement Indicator #4* – NUMBER OF POTENTIAL JOBS GENERATED

Potential jobs generated in the six-county area would result from drilling activities and subsequent production under the RFDS. There are currently no oil and gas drilling companies located in the six-county area. Drilling companies would have to relocate to the area on a temporary basis as needed. Due to the specialized nature of the work and lack of an oil service industry in the area, most of the equipment and supplies necessary for drilling would have to be imported. Similarly, most of the drilling crews would likely be existing employees of the drilling companies.

The economic impact of drilling in the area would be living expenses of the drilling crews and supplies the drilling companies are able to purchase in the area. The majority of the supplies purchased locally would be food, lodging, and fuel. While the oil drilling crews would be located temporarily in the area and may not be reflected in government employment statistics, spending by the drilling companies and their workers would stimulate the economy.

Due to uncertainty regarding the location of the production field, the economic impacts are estimated for the region as a whole. The 20 production wells forecast by the RFDS would require between 10 and 20 permanent workers. This estimate is based on employment at similar sized oil fields in Utah. Wolverine Gas and Oil Corporation has between 10 and 19 employees at the Covenant Field in Sevier County, while Citation Oil and Gas Corporation also has between 10 and 19 employees at the Upper Valley Oil Field in Garfield County (Utah Department of Workforce Services 2008). There are 10 operating wells in the Covenant Field and 19 wells in the Upper Valley Field. Therefore, it is estimated that 15 permanent jobs would be created in the vicinity of the Dixie National Forest should a producing oil field with 20 wells materialize.

The average annual wage for the oil industry in Utah during 2006 was $64,763. Therefore, the 15 estimated permanent jobs would have an annual payroll of approximately $971,445.

In addition to the 15 direct jobs in the area generated by the operations, there would be additional indirect and induced employment that results from company and employee spending in the area. The RIMS II Input-Output model developed by the Bureau of Economic Analysis was used to determine the amount of additional jobs and wages in the area due to indirect and induced impacts.

The direct effect employment multiplier for the oil and gas extraction industry in the six-county area is 2.8839. The direct effect earnings multiplier is 1.3534 (Bureau of Economic Analysis 2008). So, for every new job created in the oil and gas extraction industry in the study region, an additional 1.88 jobs are created or sustained in other sectors of the region's economy. Likewise, for every additional dollar of wages paid by the oil and gas extraction industry in the six-county area, an additional $0.35 is paid in earnings to workers in other sectors.

Applying the employment and earnings multipliers to the estimated direct employment and wages paid to oil production workers under the RFDS, results in 43 total new jobs in the area and $1.3 million in wages (Table 4.11-4). The additional wages would result in an increase in state taxes of $105,969 annually. The increase in local taxes is estimated to be $62,451.

Table 4.11-4 Economic Impact of the Reasonably Foreseeable Development Scenario

	Impacts
Direct employment (jobs)	15
Direct wages	$971,445
Indirect and induced employment (jobs)	28
Indirect and induced wages	$343,309
Total employment (jobs)	43
Total wages	$1,314,754
State government fiscal impact	$105,969
Local government fiscal impact	$62,451

Source: Preparer's calculations.

The state and local tax impacts were calculated with ratios developed by quantifying the relationship between total earnings and selected state and local tax collections for 2003-2004 and 2004-2005, the latest years for which these data were available. The state tax ratio was 8.06 and the local tax ratio was 4.75.

Due to the scope and size of the proposed exploration activities, traditional boom and bust cycles associated with oil and gas exploration do not apply to the RFDS. The effects of adding 43 jobs in an area with a 2006 civilian labor force of 90,206 would be imperceptible. On an individual county level, an additional 43 jobs in Washington or Iron County would be negligible. If the production field is near the rural communities of Garfield, Kane, or Wayne Counties, the effects of the impacts would likely be minor. The effect of the impacts on Piute County would be moderate. Overall, the addition of jobs would likely be a mix of employees from the local areas and employees who move to the area. The impacts would likely be long term depending on the length of time the wells remain productive.

- *Measurement Indicator #5* – POTENTIAL LOSS OF AVAILABLE FORAGE/AUMS FOR GRAZING PERMITTEES.

Development of oil and gas leases could impact available grazing AUMs and affect forage available for grazing permittees. Unless all the disturbance predicted happened in one place on the smallest allotments, the impact on permittees as far as a loss of AUMS/allotment would be negligible to any individual permittee. Any effects would be more an inconvenience to the permittees from increased activity, potential gate management, and traffic during exploration and production through allotments. If grazing is displaced to another location within the six-county area, there will be no net change in economic activity associated with grazing in the general area and no economic impact, although reallocation of AUMs could impact individual permittees.

- *Measurement Indicator #6* – POTENTIAL RELOCATION OF RECREATION OUTSIDE/AWAY FROM LEASING AREAS.

Development of oil and gas leases has the potential to impact recreational use in the area. As described in Section 4.4, exploration and oil and gas construction activities in currently undisturbed primitive and semi-primitive settings would likely be followed by a decrease in recreation use in these areas as some users may feel that their recreation experience would be compromised because of intrusive sights and sounds not compatible with the natural setting. Use levels may rebound after wells are in place.

Oil and gas activities under SLT may lead to decreases in the usage and quality of certain developed recreation sites (including developed parks and access roads) because most users

would not expect the visual contrast, noise, or activities associated with oil and gas activities. Developed sites usually serve as destinations or hubs for recreation activities in the immediate area. Viewing oil and gas activities within the natural setting of a developed recreation site may cause users to be dissatisfied with their recreation experience. Under SLT, the impacts on developed recreation sites from noise and increased traffic due to oil and gas activities would be minor. Since traffic levels and noise are relatively high in the vicinity of these areas (many users present at one time and adjacent to roads) the increase in noise and traffic levels would be perceptible but would not likely cause users to abandon the site or be dissatisfied with their experience.

These direct impacts to the recreational values of developed and undeveloped recreation sites can have indirect negative effects on leisure/hospitality (tourism) spending and employment. The magnitude of this impact would depend on the proximity of the oil and gas activity to the recreation site, how noticeable the activity is to the recreational users, and the duration of the oil and gas activity. Due to the uncertainty in the location of the exploration and production activity included in the RFDS, these impacts cannot be determined with any certainty, If recreationists relocate to other locations within the six-county area, then the amount of recreation and associated spending would experience little change. Therefore, there would be little change in economic impact due to visitor spending.

- *Measurement Indicator #7* – COST PER MILE OF ROAD MAINTENANCE FOR FEDERALLY MANAGED ROADS

Additional heavy truck traffic associated with drilling and operating activities has the potential to increase maintenance costs on federally managed roads in the Dixie National Forest. Given that the Reasonably Foreseeable Development Scenario predicts an annual average of four exploration wells, widespread road damage due to exploration activities is unlikely to occur. These impacts are addressed in greater detail in the Transportation Section (4.10).

4.11.4 Impacts of Connected Actions by Leasing Option

No resource components or leasing options were identified specifically for the socioeconomic resource. Effects of oil and gas activities by leasing options assigned to other resources are described in other sections of Chapter 4.

4.11.5 Impacts by Alternative

With the exception of Alternative A, potential lease bids, lease payments, and royalties generated (*Measurement Indicator #1*), potential amount of federal receipts transferred to the State of Utah and respective counties (*Measurement Indicator #2*), potential amount of property tax levied against producing wells (*Measurement Indicator #3*), and number of potential jobs generated (*Measurement Indicator #4*) would be the same under all alternatives. Impacts by alternative in regards to these measurement indicators are thus the same and as described in Section 4.11.3. Impacts related to the potential loss to grazing permittees (*Measurement Indicator #5*) are dependent upon where actual oil and gas activities would occur. The location of land available for lease varies by alternative, but regardless of the alternative, and given the large size of most grazing allotments and the comparably smaller amount of predicted disturbance associated with oil and gas activities, the impact on permittees as far as a loss of AUMS/allotment would be negligible for all alternative. Impacts related to potential offset of recreation in leasing areas (*Measurement Indicator #6*) and cost per mile of road maintenance for federally-managed roads (*Measurement Indicator #7*) are discussed in other section of Chapter 4.

Alternatives A through E range from not allowing leasing on most of the Dixie National Forest to identifying most areas of the Forest available for lease subject to all laws under standard lease terms and conditions (SLT) (Alternative E). Depending on which alternative is selected with the exception of Alternative A , various communities could be affected by oil and gas exploration.. Under each action alternative all of the oil and gas activities predicted in the Reasonably Foreseeable Development Scenario could occur at some location within the Dixie National Forest. Communities next to areas with more restrictive leasing options (i.e., NA, NL, and NSO) may be the least likely to be affected by oil and gas activity, while those located in close proximity to lands assigned less restrictive leasing option (i.e., SLT, TL, and CSU) are most likely to experience impacts, both positive and negative. However, oil and gas activities could occur in areas of the Dixie National Forest that are remote from any community and thus, a community's proximity to an area assigned a less restrictive leasing option would not necessarily result in a community impact if oil and gas activity occurred remotely within that area.

4.12 Air Resources

4.12.1 Introduction

Unlike other sections of this EIS, the context and intensity of the potential environmental effects of oil and gas operations on ambient air quality do not require qualitative descriptions such as those discussed in Section 4.1 and Table 4.1-1. That is because the air quality impact modeling results discussed in this section are quantitative estimates that are directly compared to applicable regulatory standards and require no additional qualitative descriptors attached to them. Unlike a regulatory evaluation for permitting a given facility design, when impacts are evaluated for compliance with the ambient air quality standards in the specific vicinity of the facility; the evaluation in this EIS discloses the potential impacts to air quality at different distances from a hypothetical, but representative, oil production facility, which could be located anywhere in the Forest.

Representative, known emission rates for oil exploration and production facilities were selected for air pollutant emissions in this analysis. Air dispersion models, based on unit emissions, were developed to allow for interpolation of emissions. Air dispersion modeling runs using emissions from a typical operation (exploration or production) were performed to verify the unit emission tables. Further discussion of the analysis process is discussed in the Air Quality Modeling Report contained in Specialist Report 13.0 (Air Quality)

Measurement Indicators

- *Measurement Indicator #1* CHANGE IN AIR QUALITY ABOVE AMBIENT CONDITIONS
- *Measurement Indicator #2* NAAQS EXCEEDANCES
- *Measurement Indicator #3* CHANGE IN VISIBILITY COMPARED TO NATURAL BACKGROUND CONDITIONS

4.12.2 Impacts Common to All Action Alternatives

No leasing options directly apply to air resources under any of the action alternatives. As a result, the impacts of connected actions under the RFDS are discussed in this section assuming no restriction or stipulations on oil and gas activities relative to air resources other than those

listed on BLM Lease Form 3100-11 (SLT) and the environmental protection measures that would be implemented by other laws and regulations as described in Section 1.8.5.2.

Impacts to the air quality resources would primarily result from oil field exploration and construction activities, oil field development, operating and maintenance activities, and sustainable production. The amount of dust generated by these activities would depend on the soil type, moisture conditions, and the amount of traffic on dirt or gravel roads. Vehicle exhaust emissions would primarily depend on the amount of traffic. Impacts to the air quality resources would be dependent on the distance from the activities and the elevations. Further discussion of the impacts is covered in the Air Quality Modeling Report contained in Specialist Report 13.0 (Air Quality).

There is the potential for oil and gas exploration and development activities in the Forest to encounter hydrogen sulfide gas in the subsurface. Hydrogen sulfide can be a component of petroleum and natural gas in widely varying concentrations. Hydrogen sulfide is a colorless gas that has a rotten egg odor at low concentrations and has no odor at high concentrations. If released to the ambient air, it can be irritating to the eyes and lungs at low concentrations (<100 ppm) and exhibit a range of toxic effects to human health at higher concentrations (>200 ppm). Hydrogen sulfide is normally managed within the same systems designed to contain the petroleum and natural gas during exploration and development activities. Small amounts of hydrogen sulfide released to the atmosphere at oil and gas facilities can result in a noticeable odor in the immediate vicinity of the facilities. Releases of significant amounts of hydrogen sulfide are minimized through precautions normally taken by industry personnel, but serious accidents can potentially cause significant impacts to human health for several thousand feet from the location of the release. When hydrogen sulfide is known to be present at a facility, warning signs are posted, special vents or incinerators are installed on equipment, contingency plans are prepared, and all workers at the facilities receive special training on dealing with accidental releases of the gas.

In addition to impacts on air quality resources, there are criteria pollutants that could be released during oil and gas exploration and development activities that can contribute to acid rain impacts. The criteria pollutants sulfur dioxide (SO_2) and nitrogen oxides (NO_x) are precursors to acid rain, which is a result of chemical changes in the atmosphere. Acid rain could affect the pH of the lakes and the vitality of the vegetation in each of the ranger districts. Also criteria pollutant emissions could have an impact on visibility and regional haze. Regional haze is caused by fine particles in the air (emitted directly or formed as secondary pollutants formed from NO_x and SO_2 emissions) that settle out very slowly. Increased criteria pollutant particulate emissions resulting from well field development could affect the visibility of the entire forest.

4.12.2.1 Construction and Exploration

The primary potential emissions resulting from exploratory drilling activities are NO_x, sulfur oxides (SO_x), and Volatile Organic Compounds (VOCs) from engine exhaust, product management, and tank breathing losses. Construction of the well pads will also result in measurable emissions of particulate matter smaller than 10 microns (PM_{10}) (see Table 4.12-1). Exploratory and construction impacts are localized and short term. VOCs is a generic term for a variety of organic compounds. VOC impact analyses require regional photochemical modeling. There is no practical technical approach for estimating VOC general impacts, and this must be performed on a project-by-project basis. For this reason, this analysis focuses on the impacts of criteria air pollutants.

Based on the Utah air quality regulations and the Utah SIP, dust emissions cannot exceed 20 percent opacity, based on a US Environmental Protection Agency (EPA) Method 22 observation, at the leased property boundary. Emissions from construction and exploration, without best management practices, would not be expected to exceed Class I or Class II standards because of construction duration, low emission rates, existing good air quality and dispersion. BMPs for dust control might be needed when there is regular public access near the drilling site. With any industrial activity, owners and operators must comply with the Clean Air Act and the Utah Air Quality Regulations, which regulate both operations that cause air emissions and air emissions.

Table 4.12-1 Construction Emissions-PM

Source Name	Pollutant	Emission Rate (gram/sec)
NG Exploration Flare	CO	0.0532
	NO_x	0.0098
	PM_{10}	0.00089
Well Pad Construction[1]	PM_{10}	4.946E-7
	$PM_{2.5}$	7.574E-8
Road[2]	PM_{10}	0.00238
	$PM_{2.5}$	0.000363

[1] Values include well pad construction, construction traffic, drilling traffic, and test and completion traffic.
[2] Values for roads, from Trinity Consultants (Trinity 2004)

Vehicle traffic volume estimates, which were used to derive road dust emission rates were prepared consistent with the "Highway Freight Traffic Associated with Development of O&G Wells" document prepared in 2006 by Daniel Kuhn of the Utah Department of Transportation.

The evaluation of air quality impacts from exploration activities included the following activities that affect air quality:

- Construction of 5.9-acre drilling locations
- A diesel fuel-fired drill rig engine with emissions consistent with the 13.5 tons NO_x and 3.5 tons SO_2 per well reported in the WRAP Oil and Gas Emission Inventory prepared in December 2005 by Environ and the 2005 Wyoming field survey from which that data was developed. The WRAP study indicated the mean drilling time is approximately 90 days per well around the clock. Therefore, the longer term average impact predictions effectively assume four wells drilled back to back in relatively close proximity
- Construction of 1.1 miles of new access roads
- Support traffic to supply, maintain, and staff the drilling effort
- A low volume of flaring of natural gas during exploration, equal to 100 Masco per year

Impact analyses were conducted for distances ranging from 0.5 to 200 km from the source and at receptor elevations that were 2,500 feet higher, the same, and 1,000 feet lower relative to the source. The highest concentrations at the receptors were found to be in the model runs where the receptors were at the same elevation as the source. Table 4.12-2 documents the predicted criteria pollutant NO_2, SO_2, and PM_{10} concentration ($\mu g/m^3$) and visibility impairment impacts at a variety of distances for the scenario where the receptors were at the same elevation as the source.

Table 4.12-2 Exploration Drilling Impacts

Pollutant	Period	Class I	Class II	Concentrations ($\mu g/m^3$) at kilometers			
		Increment	Increment	1	5	10	20
Sulfur Dioxide (SO_2)	3-hour	25 $\mu g/m^3$	512 $\mu g/m^3$	35.77	11.60	5.27	2.36
	24-hour	5 $\mu g/m^3$	91 $\mu g/m^3$	20.44	6.63	3.01	1.35
	Annual	2 $\mu g/m^3$	20 $\mu g/m^3$	5.11	1.66	0.75	0.34
Nitrogen Dioxide (NO_2)	Annual	2.5 $\mu g/m^3$	25 $\mu g/m^3$	19.74	6.27	2.88	1.31
PM_{10} (Particulate Matter < 10 Microns)	24-hour	8 $\mu g/m^3$	30 $\mu g/m^3$	5.10	0.92	0.38	0.16
	Annual	4 $\mu g/m^3$	17 $\mu g/m^3$	1.28	0.23	0.09	0.04
Visibility	Δdv	0.5[1]	NA	1.844	1.824	1.954	1.133
	$\%\Delta b_{ext}$	NA[2]	NA	20.3%	20.0%	21.6%	12.0%
	Days Δdv >0.5	Less than baseline	NA	1	1	2	1
	Days Δdv >1.0	Less than baseline	NA	0	0	0	0

[1] Visibility threshold 98th percentile of delta dv for 20% of best days.
[2] Percentage of light attenuation due to scattering and absorption.
Data is based on maximum impact values listed in Appendix A of the modeling report.

The modeling results shown in Table 4.12-2 indicate that emissions from exploration activities would comply with the applicable NAAQS for Class II areas at all distances shown. The results also indicate there could be potential problems with compliance with NAAQS for Class I areas for SO_2 out to between 5 and 10 km, and out to about 10 km for NO_2.

4.12.2.2 Production Field Development, Operating and Maintenance

The potential emissions resulting from oil field development are NO_x, SO_2, and VOCs from the production facilities and PM_{10} emissions from the operating and maintenance activities associated with the field development. The Air Quality Modeling Report developed generalized emissions from a 20-well oil field development scenario. Emission estimates in the report were based on the equipment needed to support oil exploration and/or oil field development. Estimates in the report are conservative and utilized the following resources: Utah State Government's "Analysis of Emissions from O&G Wells in Utah", the O&G Emission Inventory Workbook for the Uinta Basin Study, information from existing oil field development on the Dixie and Fishlake National Forests, regional and national oil and gas field emission analyses, and EPA and industry emission factors to develop the emission estimates. Table 4.12-3 summarizes the emissions expected from a 20-well oil field in the Dixie National Forest. Note that these are estimates only and will vary depending on the actual location of the oil field, the geology of the producing formations, and quantity of fossil fuel present.

Table 4.12-3 Production Field Development Emissions

Source	PM_{10} (lb/hr)	NO_x (lb/hr)	SO_2 (lb/hr)
Compressors	0.05	3.98	0.00
Heater Treaters	0.07	0.95	0.01
Dehydration Units	0.01	0.19	0.00
Well Pumps	4.40	58.52	4.10
Production Flare	0.00	2.45	0.00
Roads	11.40	1.11	0
Total	15.93	69.57	4.11

The density of well fields, well field characteristics, and success of development will be the factors to determine impacts. As stated above with any industrial activity, owners and operators must comply with the Clean Air Act and the Utah Air Quality Regulations, which regulate both operations that cause air emissions and air emissions. During the pre-construction stage of any proposed well field development, operators of the well field will have to perform site specific permitting that includes refined air dispersion modeling (see requirements of Section IV, Appendix C).

4.12.2.3 Sustainable Production

The potential emissions resulting from sustainable production fields are primarily nitrogen oxide (NO_x), sulfur dioxide (SO_2) and PM_{10} resulting from oil and gas production and ongoing oil field operating and maintenance activities. The emission estimates in Table 4.12-3 for production field development would also apply to sustained production. The impacts of specific pollutants are evaluated based on elevation and distance from the field. Impacts resulting from oil field development are further discussed in the Air Quality Specialist Report (13.0). A summary of the impact analysis in the report is presented below.

The modeling for the production field included the following activities that affect air quality:

- Construction of twenty 5.9-acre drilling locations
- One diesel fuel fired drill rig engine with emissions consistent with the 13.5 tons NO_x and 3.5 tons SO_2 per well reported in the WRAP Oil and Gas Emission Inventory prepared by Environ and the 2005 Wyoming field survey from which that data was developed. The WRAP study indicated the mean drilling time is approximately 90 days per well, around the clock. Therefore, the longer-term average impact predictions effectively assume four wells drilled back to back in relatively close proximity.
- One exploratory flare flaring off small quantities of gas
- Total ground disturbance including new roads, well pads, central processing, and staging areas would be 270 acres.
- Support traffic to supply, maintain, and staff the drilling and pumping effort
- Twenty 1.0 MMbtu/hr heater / treater separators, one at each well pad
- Twenty diesel powered 100 HP well pumps to extract oil, one for each well
- Two 0.5 MMbtu/hr dehydrators and one 500 HP compressor processing a low volume of natural gas at partial capacity

Diesel-fired well pumps are assumed because the development sites are expected to be remote from the electric power grid. Though a slight amount of natural gas production is included for conservatism, producible natural gas is not routinely expected and is not anticipated in sufficient quantity to power the well pumps.

Impact analyses were conducted for distances ranging from 0.5 to 200 km from the source and at receptor elevations that were 2,500 feet higher, the same, and 1,000 feet lower relative to the source. The highest concentrations at the receptors were found to be in the model runs where the receptors were at the same elevation as the source or higher. Table 4.12-4 documents the predicted criteria pollutant NO_2, SO_2, and PM_{10} concentration (µg/m^3) and visibility impairment impacts at a variety of distances for the scenario where the receptors were at the same elevation as the source.

Table 4.12-4 Sustainable Production Impacts

Pollutant	Period	Class I	Class II	Concentrations (µg/m^3) at kilometers			
		Increment	Increment	1	5	10	20
Sulfur Dioxide (SO_2)	3-hour	25 µg/m^3	512 µg/m^3	83.8	27.18	12.34	5.52
	24-hour	5 µg/m^3	91 µg/m^3	47.9	15.53	7.05	3.16
	Annual	2 µg/m^3	20 µg/m^3	11.97	3.88	1.76	0.79
Nitrogen Dioxide (NO_2)	Annual	2.5 µg/m^3	25 µg/m^3	115.2	36.78	16.93	7.70
PM_{10} (Particulate Matter < 10 Microns)	24-hour	8 µg/m^3	30 µg/m^3	82.58	14.84	6.14	2.59
	Annual	4 µg/m^3	17 µg/m^3	20.64	3.71	1.53	0.65
Visibility	Δdv	0.5[1]	NA	7.730	7.636	8.043	5.184
	%Δbext	NA[2]	NA	116.6%	114.6%	123.5%	67.9%
	Days Δdv >0.5	Less than baseline	NA	93	94	95	81
	Days Δdv >1.0	Less than baseline	NA	57	59	57	47

[1] Visibility threshold 98th percentile of delta dv for 20% of best days.
[2] Percentage of light attenuation due to scattering and absorption.
Data is based on maximum impact values listed in Appendix A of the modeling report.

Modeled emission impacts for the case where the receptors are at the same elevation as the source (Table 4.12-4) indicates potential compliance problems with the Class II NAAQS out to distances between 5 and 10 km for NO_2; and between 1 to 5 km for PM_{10}. The modeling results indicate potential compliance problems with the Class I NAAQS out to distances between 10 and 20 km for SO_2; 5 to 10 km for PM_{10}; and 40 to 50 km for NO_2. Note that provincial background pollutant concentrations vary and need to be considered for all air dispersion modeling evaluations.

The modeling also indicated that these impacts would be less if the receptors are lower than the source, with compliance with all NAAQS occurring for Class I areas within about 10 km from the source. This modeling indicated compliance with all NAAQS for Class I areas within a distance of about 10 to 15 km and all Class II areas within about 2.5 to 5 km when the receptors are lower than the source.

The emission inventory for this analysis was conservative in that it assumed one new well was being drilled while the full field was operating, and also assumed that diesel-fired pumps were used at each well head. NO_2, SO_2, and visibility impacts would be decreased if either no well drilling occurred simultaneously with the operation of 20 wells or if enough natural gas was recovered onsite to fuel the well pumps so diesel-fired pumping would not be required. NO_x, SO_2, and visibility impacts would be approximately 90 percent lower if electric power lines were built to power the oil production field and no fuel was needed to operate the well pumps.

4.12.3 Impacts by Alternative

With the exception of Alternative A, estimated changes to ambient conditions (*Measurement Indicator #1*) and NAAQS exceedances (*Measurement Indicator #2*) would be the same under all alternatives. Changes in visibility compared to natural background conditions would be the same under all alternatives except Alternative A. Visibility, based on %Δbext is greatest between 10 and 15 kilometers on flat terrain. Impacts by alternative are thus the same and as described in Section 4.12.2.

4.13 Unavoidable Adverse Impacts

Unavoidable adverse impacts are the residual adverse impacts that would remain after mitigation. The alternatives described in this EIS do not apply mitigation beyond what is provided by the BMPs described in Section 2.6 and the various leasing options (i.e., NSO, CSU, and TL). The impacts described for each resource are after taking these measures into account and no further mitigation would be applied to lessen any of the impacts described. As a result, the impacts described in this chapter represent the unavoidable adverse impacts. Additional mitigation may be developed during more site-specific NEPA analyses.

4.14 Relationship of Short-Term Uses and Long-Term Productivity

NEPA requires consideration of "the relationship between short-term uses of man's environment and the maintenance and enhancement of long-term productivity" (40 CFR 1502.16). This chapter provides the required disclosure of effects from oil and gas leasing activity projected to occur over the next 15 years by the Reasonably Foreseeable Development Scenario (RFDS, BLM 2007a). In general, short-term use is equated with exploration activities, including seismic exploration and exploratory drilling as described in the RFDS. Exploration activities have the greatest potential to impact long-term productivity if they: 1) result in the direct loss of wildlife habitat that is of substantial importance to a population, 2) result in large increases in erosion and sediment delivery to streams, or 3) remove vegetation that would not recover in the short term (i.e., mature forest).

With the exception of Alternative A, the amount of disturbance associated with exploration activities would be the same across all alternatives. This would include approximately 143 acres of disturbance on the Pine Valley Ranger District, 369 acres on the Cedar City Ranger District, and 452 acres on both the Powell and Escalante Ranger Districts (Table 2.2-2). As detailed in this chapter, the potential for impacts to long-term productivity are the least under Alternative B. Alternative B applies restrictive leasing options to many resources that would be particularly susceptible to losses in long-term productivity. In contrast, Alternative E does not apply restrictive leasing options and would result in the greatest impacts to long-term productivity. Alternatives C and D apply various leasing options to resources that may be susceptible to losses in long-term productivity, and they have varying impacts to short-term uses of the oil and gas resources on the Dixie National Forest.

4.15 Irreversible and Irretrievable Commitments of Resources

An irreversible commitment of resources occurs if the commitment is permanent and cannot be changed once made. An irretrievable commitment of resources occurs when resources are used, consumed, destroyed, or degraded during oil and gas leasing activity and cannot be reused or recovered for the life of the activity (temporary) or beyond (permanent). Disturbance to the baseline natural conditions described in this chapter may be irretrievable for the duration of exploration or for the life of a production field. However, the disturbance may be reversible after the exploration or production is completed and the affected resources restored through reclamation. Commitments of resources that are irreversible are automatically irretrievable. Table 4.15-1 summarizes irreversible and irretrievable commitments of resources. The table does not consider alternatives as the disturbance predicted by the RFDS does not vary across alternatives, and although leasing options affect where the disturbance could occur, some disturbance is expected to occur to each resource regardless of alternative. The exception would be Alternative A, which does not authorize new oil and gas leases and would not have any irreversible or irretrievable commitments. For IRAs and eligible Wild and Scenic Rivers, several of the alternatives would allow disturbance that may be irreversible to the legal designations of these areas, as discussed in Table 4.15-1.

Table 4.15-1 Irreversible and Irretrievable Commitments of Resources

Resource	Irreversible Commitment?	Irretrievable Commitment?[1]	Nature of Commitment
Visual Resources	No	Temporary	Oil and gas activities would alter the scenic value to the landscape. However, the scenic values of the affected areas would be regained over time with proper reclamation.
IRAs and eligible WSRs	Yes (Alternatives D and E)[2] No (all other alternatives)	Temporary/Permanent[2]	Oil and Gas Activity within IRAs and within the corridor around eligible Wild and Scenic Rivers would impact roadless characteristics, wilderness attributes, and outstandingly remarkable values. Proper reclamation would restore these values. Impacts would be greater under Alternatives D and E for IRAs and Alternative E for eligible Wild and Scenic Rivers, as discussed below under footnote number two.
Recreation Resources	No	Temporary	Oil and gas activities would displace recreation use. Any recreation resource lost would be regained over time with proper reclamation.
Fish and Wildlife	No	Temporary	Oil and gas activities would displace species though direct disturbance and habitat loss. Habitat and species abundance would recover over time with proper reclamation.
Special Status Species	No	Temporary	Same as for Fish and Wildlife

Resource	Irreversible Commitment?	Irretrievable Commitment?[1]	Nature of Commitment
Water and Watershed Resources	Yes	Permanent	Oil and gas activity may fill wetlands, alter floodplains, and remove riparian vegetation. These impacts would be reversible for floodplains and riparian areas once these areas were restored. However, once the structure and function of a wetland is lost or altered, the same level of function cannot be fully restored, even with proper reclamation. Furthermore, changes to stream channel morphology may not recover, even with proper reclamation. As a result, the impacts to these resources would be a irreversible commitment of resources. Sediment related water quality impacts from construction in wetlands, floodplains, or riparian areas, or on upland areas susceptible to erosion would persist for the life of the development, but would return to baseline conditions following reclamation. Inadvertent impacts to lava fields over sensitive aquifers would recover over time once the source of impacts was removed.
Soils and Geologic Hazards	Yes	Permanent	Soil loss/displacement related to road, pipeline, and well pad construction would occur, particularly if these facilities are located in areas with steep slopes or high erosion potential. Physical disturbance of soils would result in a loss of productivity, a loss that would take centuries to naturally recover, even with proper reclamation. Impacts to cave resources (e.g., collapse or contamination) would also be an irreversible commitment of resources, as the cave could not be restored (particularly in the case of a collapse) through reclamation.
Vegetation	No	Temporary	Oil and gas activity would disturb and/or remove vegetation. Disturbance may include mature forest stands. Once mature forest stands are removed they are lost for the growing time of the tree species removed (greater than 100 years for some species). However, the loss would not be irreversible as mature stands can be reestablished. Introductions of non-native and invasive species would represent a loss in productivity of the vegetation communities affected, but would be reversible given proper eradication efforts.
Transportation	No	Temporary	Oil and gas activity would increase the use of the transportation system, but use would return to baseline levels following exploration or production.

Resource	Irreversible Commitment?	Irretrievable Commitment?[1]	Nature of Commitment
Socioeconomic Resources	No	Temporary	Oil and gas activity would increase jobs and income in the counties, while at the same time possible reducing recreation as a source of income. And changes income and jobs would return to some other level once oil and gas activities cease.
Air Resources	No	Temporary	Oil and gas activity would result in some minor degradation of air quality during construction and operation. Air quality would return to baseline conditions following construction and operation.

[1] Temporary indicates an irretrievable impact that would extend though exploration, production, and the time needed for reclamation. Permanent indicates duration would be in perpetuity and would be irreversible.
[2]. Under Alternative D and E with leasing allowed in IRAs (2001 Roadless Area Conservation Rule not in effect), road construction could occur in IRAs. Constructed roads could eventually be reclaimed and the roadless characteristics and wilderness attributes of an IRA restored. However, reclamation would take place over a long time span and the areas would not be able to be managed as IRAs in the foreseeable future, which would represent an irreversible commitment of this resource. Similarly, under Alternative E, road construction could occur within the river corridor of eligible Wild and Scenic Rivers, which would make these areas ineligible to be managed as wild rivers until proper reclamation takes place. It is unknown when these rivers would again be analyzed for inclusion in the National Wild and Scenic River system, this would represent and irreversible commitment of this resource.

4.16 Compliance with Other Laws and Regulations

Oil and gas leasing as described in the various alternatives would be in compliance with all other applicable laws and regulations, except as described below.

4.16.1 2001 Roadless Area Conservation Rule

Alternative A, B, C, and Alternatives D1 and E1 with NSO applied under the dual analysis would be in compliance with the 2001 Roadless Area Conservation Rule. Alternatives D2 and E2 with leasing allowed in IRAs would allow road building and timber harvest in IRAs, which would not be in compliance with the 2001 Roadless Area Conservation Rule.

4.16.2 Executive Orders 11990, 11998, and Section 404 of the Clean Water Act

These laws require federal agencies to avoid the degradation of wetlands and floodplains. Section 404 of the Clean Water Act requires a permit for the discharge of fill in jurisdictional wetlands and prior to granting a permit the applicant must show that the wetland was avoided or impacts to the area minimized. If a permit were granted, the applicant would be required to mitigate the impacts.

4.16.3 Migratory Bird Treaty Act and Bald and Golden Eagle Protection Act

The Migratory Bird Treaty Act and Bald and Golden Eagle Protection Act prohibits take of migratory birds and eagles. Oil and gas leasing with BMPs properly implemented, including appropriate surveys and mitigations (of the location) prior to disturbance, would prevent take of sensitive raptors and eagles. Take of migratory birds is to be avoided when feasible on USFS lands but some incidental, unintentional take is expected.

4.16.4 Clean Air Act

Any oil and gas development activities would have to comply with the Clean Air Act, the Utah air quality rules and regulations, as well as oil and gas specific US Environmental Protection Agency (EPA) regulations. A discussion of the permitting requirements is located in Section

3.12.4 of Chapter 3. There are currently several New Source Performance Standards (NSPS's) and National Emission Standards for Hazardous Air Pollutants (NESHAP's) that are directly related to emission limits from oil and gas production facilities. In addition, it can be expected that there will be more regulations developed by EPA that control emissions from the oil and gas industry. As such, companies would have to comply with all existing and future state and federal air quality rules and regulations in order to construct and continue operation.

4.17 Forest Plan Consistency Determination

In general, the Land and Resource Management Plan (USFS 1986) was considered during the development of all alternatives. However, as noted in the description of alternatives in Chapter 2, Alternatives C and D would require amendments to the Land and Resource Management Plan. Areas where the alternatives may be inconsistent with the Land and Resource Management Plan are noted below.

4.17.1 Visual Resources

Alternative D would not be in compliance with the Land and Resource Management Plan or the 2000 Scenery Management System Amendment to the Land and Resource Management Plan for High SIO and potentially some Moderate SIO areas. Alternative E would not be in compliance with the Land and Resource Management Plan or the 2000 Scenery Management System Amendment for Very High, High, and some Moderate SIO areas. Alternatives A, B and C are consistent with the 2000 Scenery Management System Amendment to the Land and Resource Management Plan.

4.17.2 Recreation Resources

Leasing options listed in Appendix C of USFS (1986) imply that all Rural, Roaded, and Semi-Primitive recreation areas in addition to all "winter sports sites" and "recreation sites" should be NSO, thus leasing options for several of these recreation resources under Alternatives B, C, and D would not be in compliance with the Land and Resource Management Plan.

4.17.3 Fish and Wildlife

USFS (1986: Appendix C-2) recommends NSO leasing options "adjacent to roads, rivers, trails, etc." Thus, Alternatives D and E ("Fisheries Habitat") would not be consistent with the Land and Resource Management Plan.

4.17.4 Special Status Species

See Table 4.6-8 in Section 4.6 for compliance with the Land and Resource Management Plan for MIS species.

USFS (1986: Appendix C-2) recommends NSO leasing options in all big game winter ranges. Alternatives B, C, D, and E would not be consistent with the Land and Resource Management Plan.

USFS (1986: Appendix C-2) recommends NSO leasing options "adjacent to roads, rivers, trails, etc." Thus Alternatives D and E for Sensitive Fisheries Habitat would not be consistent with the Land and Resource Management Plan.

Alternatives C, D, and E (CSU, TL, and SLT, respectively) may also not be in compliance with the guideline Wildlife and Fish Resource Management in Management Area 5B, which recommends “Do not eliminate presence of any browse species” (USFS 1986:4-104).

4.17.5 Water and Watershed Resources

Alternative E could potentially violate the management direction for roads to not parallel streams. As described in Section 4.16.2, Alternative D and E would not necessarily comply with the management direction to comply with Executive 11990, 11988, and Section 404 of the Clean Water Act.

4.17.6 Vegetation Resources

Alternative E would violate the Land and Resource Management Plan directive for NSO lease options within Research Natural Areas.