Specialist Report 8.0
Watershed Resources

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

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List of Acronyms & Abbreviations

BLM	Bureau of Land Management
BMP	Best Management Practices
CSU	Controlled Surface Use
EIS	Environmental Impact Statement
GIS	Geographic Information System
IRA	Inventoried Roadless Area
NA	Not Available for Leasing
NL	No Leasing
NSO	No Surface Occupancy
SITLA	State of Utah Institutional Trust Lands Administration
SLT	Standard Lease Terms
TL	Timing Limitation
WSA	Wilderness Study Area

8.0 WATERSHED RESOURCES

8.1 Introduction

This Specialist Report has been prepared in support of the Oil and Gas Leasing EIS on Lands administered by the Dixie National Forest, which is an environmental analysis to identify those lands with Federal mineral rights that should or should not be made available for oil and gas leasing. A more detailed description of the Purpose and Need is provided in Chapter 1 of the EIS and a description of the Proposed Action, Alternatives, and leasing options is available in Chapter 2

8.2 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.

8.3 Use of GIS

Alternatives were developed by assigning the leasing options described in Chapter 2 of the EIS, and summarized for this Specialist Report in Section 8.5.4.1, to site-specific resources, defined in this analysis as resource components, using geospatial data. Using a geographic information system (GIS), the spatial distribution of each resource component and associated leasing option were overlaid. Some lands on the Forest are not administratively available for oil and gas leasing (NA) and include Brian Head Ski Resort, wilderness areas, and the areas surrounding the Box-Death Hollow Wilderness Area that were withdrawn from leasing by the Utah Wilderness Act of 1984. . The most restrictive leasing option (i.e., NL or NSO) assigned to a particular resource component supersedes any less restrictive options (i.e., CSU or SLT) assigned to other resource components that occur in the same area or site-specific location. For example, where NSO was assigned to an area of high erosion potential that coincides with the habitat of a sensitive wildlife species assigned CSU, the NSO option would be applied to the area common to both of these resources. As a result, multiple lease options may apply to a resource component, depending upon its location, even if only a single option was specified for that resource component under an alternative. A full range of leasing options was incorporated into the development of alternatives so that the different alternatives would insure that differing levels of protection were addressed for each specific resource component.

Leasing options were applied to geographical areas that represent the spatial distribution of a resource component. However, it is important to note that leasing options are applied to the resource component and not simply to specific geographic areas and if unmapped resource components were identified in the future they would be protected by the same leasing option. Furthermore, the geospatial data used in this analysis is the best GIS data available; however, it comes from multiple sources and was created at varying scales. As a result, it is not assumed that these data are 100 percent complete or that they meet the US National Mapping Accuracy Standard of the Office of Management and Budget. Unless otherwise stated, GIS data was provided by the Dixie National Forest.

8.4 Description of Affected Environment

The overall health of aquatic ecosystems is strongly correlated with watershed conditions, particularly the conditions of wetlands, floodplains, and riparian areas. These areas form the interfaces between terrestrial and aquatic ecosystems and are vital to their function (Knopf et al. 1988, Gregory et al. 1991). Federal agencies are required to consider the impact of proposed activities on wetlands under Executive Order 11990 (to minimize the destruction, loss, or degradation of wetlands; to preserve and enhance the natural beneficial values of wetlands; and to avoid adverse impacts to wetlands where ratable). Impacts to jurisdictional wetlands are also regulated by Section 404 of the Clean Water Act, which requires the avoidance, minimization, or mitigation of impacts to wetlands. Jurisdictional wetlands are those that have permanent of seasonal water, hydrophytic (water-loving) vegetation, and soil characteristics influenced by saturated conditions (USACE 1987). Floodplains and riparian areas often meet these criteria and in many cases would be termed wetlands under Section 404 of the Clean Water Act. Floodplains receive further protection under Executive Order 11998, which requires Federal agencies to restore and preserve the natural and beneficial values served by floodplains.

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

The 300-foot buffer placed around all waterbodies is designed to protect the actual waterbodies (i.e., stream, lakes, reservoirs, and springs) and water resources (discussed in Specialist Report 7.0), as well as watershed resources. In this Specialist Report, the watershed resource components discussed are wetlands, stream channels, floodplains, and riparian areas. As most streams on the Dixie National Forest are steep mountain streams, the 300-foot buffer applied to waterbodies should adequately encompass all riparian areas and the majority of floodplains (Chris Butler, Personal Communication). Also, due to the steep topography and arid nature of the area, it is likely that most wetlands would be located near waterbodies and contained within the 300-foot buffer as well. As wetlands have not been mapped, any wetlands that do occur outside the 300-foot buffer are not represented in the maps, tables, and other figures presented in this Specialist Report. However, a 300-foot buffer would also apply to any such wetlands (measured out from the edge of the wetland), should they be located in future site-specific analyses. Furthermore, if site-specific analyses locate any riparian areas or floodplains that extend beyond 300 feet from a mapped waterbody, a larger buffer would be applied.

There are approximately 6,243 stream miles on National Forest System land within the boundaries of the Dixie National Forest (perennial and intermittent) and 1,971 mapped springs. In addition, there are over 1,079 lakes and reservoirs covering approximately 3,909 acres. With a 300-foot buffer applied to all these features, there are approximately 416,238 acres designated for the protection of streams, lakes, wetlands, floodplains, and riparian areas (Table 8.4-1). In this Specialist Report, all spatial discussions of baseline conditions (i.e., acreages) will use the acreage contained within the 300-foot buffer (416,238 acres) as a proxy to spatially represent the actual watershed resource components. This is done, because as mentioned above, the distribution of wetlands, floodplains, and riparian areas on the Dixie National Forest has not been mapped. While wetlands, floodplains, and riparian areas are expected to overlap in many areas and perform similar ecosystems functions, some functions are specific to each. To highlight the differences and similarities, each habitat type will be described separately in further detail. In addition, stream channel morphology is discussed in conjunction with the discussion on floodplains.

Table 8.4-1 Streams, Lakes, Reservoirs, and Springs on the Dixie National Forest and total acres within the 300-foot buffer.

Ranger District	Streams (miles)	Lakes and Reservoirs (number/acres)	Springs (number)	Area covered by 300-foot buffer (acres)
Pine Valley	2,080.7	196/612.4	786	138,781.4
Cedar City	1,454.1	372/1,925.2	583	83,184.5
Powell	1,389.8	200/224.9	383	96,077.4
Escalante	1,318.9	311/1,147.1	219	92,774.9
TOTAL	6,243.5	1,079/3,909.6	1,971	410,818.2

8.4.1 Wetlands

Properly functioning wetlands regulate the quality and quantity of water delivered to aquatic ecosystems, provide areas of high biological productivity, and provide wildlife habitat (EPA 2001). Wetlands are usually associated with slow moving or stagnant water, which helps improve water quality by providing depositional areas for sediments, organic matter and other pollutants, and prevents these materials from entering lakes and streams. The slow depositional environment associated with wetlands also buffers adjacent waterbodies from periods of high flow by capturing the water and slowly releasing it during dry periods. The storage and release of water during dry periods provides higher base flows in adjacent streams, which improves habitat conditions for aquatic organisms. Further, the combination of shallow water and large amounts of deposited organic matter and nutrients, makes wetlands one of the most biologically productive ecosystems on earth (EPA 2001). The high productivity includes a large variety of plant life, which provides the structure and complexity needed by aquatic organisms, terrestrial wildlife, and birds. Wetland vegetation also absorbs and removes excess nutrients that would otherwise be released to lakes and streams.

Wetlands on the Dixie National Forest can be grouped into three general classes, riverine, lacustrine, and palustrine (Brinson et al. 1995, Cowardin et al.1979). Riverine wetlands occur in floodplains and riparian corridors in association with stream channels. As a result, the distribution of riverine wetlands on the Dixie National Forest would often overlap with riparian and floodplain habitats. Lacustrine wetlands occur in the low-lying areas directly adjacent to lakes and reservoirs, and palustrine wetlands consist of all other wetlands not adjacent to streams or lakes. On the Dixie National Forest, palustrine wetlands are usually associated with small depressions and

characterized by shallow surface water depths and emergent vegetation. Examples of palustrine wetlands include wet meadows, sedge-dominated fens, seeps, and small ponds (USFS 1995). Due to a relatively dry climate and steep topography, most wetlands on the Dixie National Forest are typically small and are primarily riverine and lacustrine systems restricted to narrow bands bordering streams, small lakes, ponds, and reservoirs. As a result, it is assumed that the majority of wetlands would be within the 300-foot buffer applied to streams, lakes, reservoirs, and springs. However, wetlands outside of the buffer mapped in this analysis would also have a 300-foot buffer applied during administration of any future lease as described in Section 8.3 and 8.4.

8.4.2 Stream Channels and Floodplains

Stream channels generally consist of an active channel and associated floodplains. Streams are continually changing depending upon watershed conditions and hydrology, yet generally fluctuate around some dynamic equilibrium (USFS 2006). The morphology of an active stream channel may change beyond its normal range of conditions due to natural or human-caused perturbations to the stream or watershed conditions. For example, artificially high flows or flow velocities can lead to channel incision, bank erosion, channel widening, and armoring of the streambed. These changes can have their own adverse effects on aquatic ecosystems and are often difficult to reverse. Further, decreases in stream flow and/or increases in sediment supply can lead to channel aggradation and sedimentation of the streambed that can have negative impacts on aquatic habitat features such as pools, interstitial spaces, and spawning gravels.

Floodplains are flat-lying areas immediately adjacent to the active channel that are formed by water that overflows the active channel during periods of high flow (Dunne and Leopold 1978). The connection between stream channels and floodplains is extremely important and has a profound influence on both the geomorphology and ecology of streams. By providing overflow areas during high flow, floodplains reduce stream velocities in the active channel and reduce erosion. Inundated floodplains also provide essential rearing habitat for larval and juvenile fish, and provide much of the biological productivity of some river systems (Thorp and Delong 1994). Further, sediment deposited on the floodplain perpetuates floodplain development and provides nutrients for floodplain species such as cottonwood (USFS 2006). Large, lowland rivers that are unconstrained by geology have extensive floodplains; however, smaller mountain streams are often constrained by geology and have narrow floodplains (Gregory et al. 1991). The majority of streams on the Dixie National Forest are small and many of the floodplains may be contained entirely within the riparian area and within the 300-foot buffer applied to streams. A possible exception would be the East Fork of the Sevier River near the Dixie National Forest Boundary, which has large, better-developed floodplains (Chris Butler, Personal Communication). Any floodplains extending beyond the 300-foot buffer applied to streams would have an additional buffer applied, extending 300 feet from its outer edge. Also, as mentioned previously, many floodplains would likely overlap with riverine wetlands and may be considered jurisdictional wetlands under Section 404 of the Clean Water Act.

8.4.3 Riparian Areas

Functionally, riparian areas can be defined as the area between the active stream channel and the outward limits of flooding (Gregory et al. 1991, USFS 1986). As a result, these areas would functionally overlap with floodplains; however, riparian vegetation serves different functions than floodplains. As riparian areas are subject to frequent change, the vegetation is generally diverse and consists of plants that can tolerate a broad range of conditions. Riparian vegetation is extremely important to stream ecosystem function in that it provides shade, woody debris, and leaf litter inputs. Shade levels affect stream temperatures and habitat suitability for aquatic organisms. Further, woody debris provides habitat for aquatic organisms, particularly fish, and in small mountain streams leaf litter input from riparian vegetation is the primary source of organic material.

Due to its diversity and complexity, riparian vegetation provides invaluable habitat for a large variety of terrestrial wildlife. It is estimated that less than one percent of the landscape in the Western U.S. is covered by riparian vegetation, yet riparian habitats support more species of birds than surrounding uplands (Knopf et al. 1988). As with floodplains, many riparian areas would overlap with riverine wetlands and may be considered jurisdictional wetlands under Section 404 of the Clean Water Act.

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

8.4.4 Pine Valley Ranger District

There are 2,080.7 miles of streams and 786 springs on the Pine Valley Ranger District. In addition, there are 196 lakes and reservoirs covering 612.4 acres. The 300-foot buffer applied to these areas covers approximately 138,781.4 acres, or 29 percent of the Pine Valley Ranger District. Major watersheds include the Shoal Creek, Pinto Creek, Santa Clara River, Quail Creek, and Ash Creek watersheds. The largest waterbodies are the Upper and Lower Enterprise Reservoirs. Figure 8.4-1 shows the 300-foot buffer applied to streams, springs, lakes, and reservoirs on the Pine Valley Ranger District.

8.4.5 Cedar City Ranger District

There are 1,454.1 miles of streams and 583 springs on the Cedar City Ranger District. In addition, there are 372 lakes and reservoirs covering 1,925.2 acres. The 300-foot buffer applied to these areas covers approximately 83,184.5 acres, or 21 percent of the Cedar City Ranger District. The District is characterized by mountain valleys and high plateaus. There are two large lakes, Panguitch Lake and Navajo Reservoir. Panguitch Lake is the largest lake on the Dixie National Forest and constitutes 20 percent of the total water yield for the entire Forest. Some of the larger drainages on this district include Panguitch Creek, Mammoth Creek, Pass Creek, and Assay Creek (USFS 1995). Stream surveys conducted in 2004 (USFS 2004) indicate that changes to stream morphology have occurred on Castle Creek, Little Creek, and Bear Creek. Beetle kill of mature spruce forest may have increased flows on Castle Creek, which has led to widening of the stream channel. In contrast, decreased flows under drought conditions may have led to increased sedimentation and aggradation of the channel on Little Creek. The loss of riparian vegetation on Bear Creek due to grazing has also led to channel widening there. Further, grazing and roads have impacted riparian vegetation on Threemile Creek, which has led to increases in stream temperature (USFS 2004). Figure 8.4-2 shows the 300-foot buffer applied to streams, springs, lakes, and reservoirs on the Cedar City Ranger District.

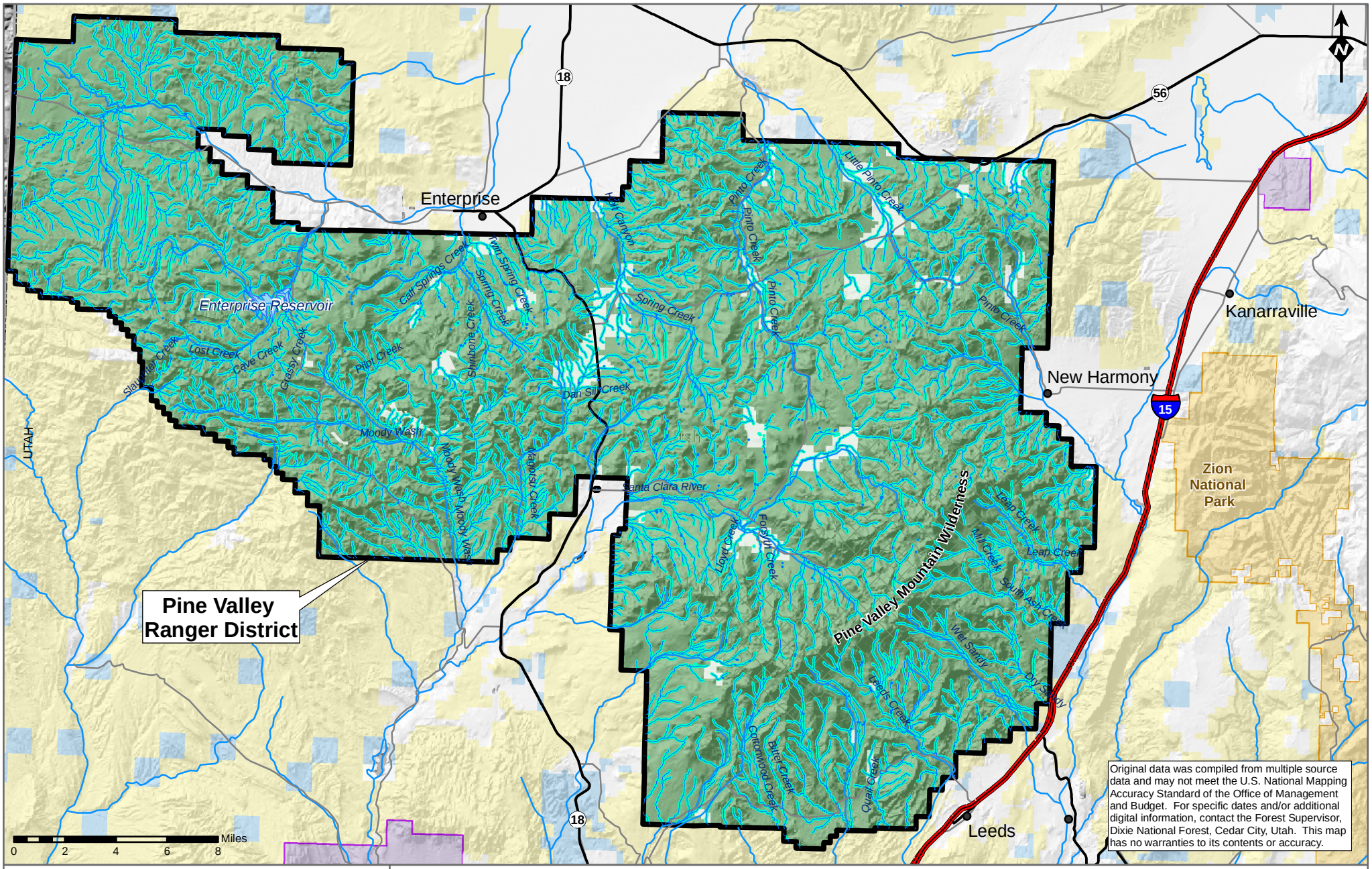
8.4.6 Powell Ranger District

There are 1,389.8 miles of streams and 383 springs on the Powell Ranger District. In addition, there are 200 lakes and reservoirs covering 224.9 acres. The 300-foot buffer applied to these areas covers approximately 96,077.4 acres, or 25 percent of the Powell Ranger District. Most lakes

on this district are small. Tropic Reservoir, the largest body of water, is located on the East Fork of the Sevier River. The East Fork of the Sevier River near the Dixie National Forest boundary is larger and less constrained by geology than other streams. As a result, there may be some floodplains that extend beyond the 300-foot buffer. Other major drainages include Cottonwood Creek, Deep Creek, Deer Creek, Hunt Creek, and Sanford Creek. In 2002, the Sanford Fire burned portions of the Cottonwood, Deep, Deer, and Sanford creek watersheds. The fire destroyed riparian vegetation, which led to high streambank instability, erosion, and the influx of large amounts of sediment (USFS 2005). Although streambank instability has begun to improve and sediment levels have decreased, full recovery of the riparian vegetation has been hampered by livestock grazing (USFS 2004). In some burned areas, riparian areas that were overgrazed are now dominated by rabbitbrush (*Chrysothamnus spp.*), which is a concern for future fires, as it will burn faster and hotter than riparian grasses/forbs/shrubs. Figure 8.4-3 shows the 300-foot buffer applied to streams, springs, lakes, and reservoirs on the Powell Ranger District.

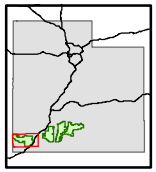
8.4.7 Escalante Ranger District

There are 1,318.9 miles of streams and 219 springs on the Escalante Ranger District. In addition, there are 311 lakes and reservoirs covering 1,147.1 acres. The 300-foot buffer applied to these areas covers approximately 92,774.9 acres, or 21 percent of the Escalante Ranger District. One of the prominent features in this district is Boulder Mountain, which is one of the largest high elevation plateaus in the United States. This plateau is dotted with hundreds of small lakes at elevations from 10,000 to 11,000 feet. Some of the larger lakes and reservoirs include Pine Lake, Cyclone Lake, Jacobs Reservoir, Roundy Reservoir, Grass Lake, Torgerson Lake, and North Creek Reservoir (USFS 1995). Roads and recreational use on Carcass and Pleasant creeks have impacted riparian areas and led to stream channel widening (USFS 2004). Figure 8.4-4 shows the 300-foot buffer applied to streams, springs, lakes, and reservoirs on the Escalante Ranger District.



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

FIGURE 8.4-1
Pine Valley Ranger District Watershed Resources



Horizontal Datum = NAD 83 Coordinate System = Zone 12N	1:320,000	28 February 2008

Legend

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

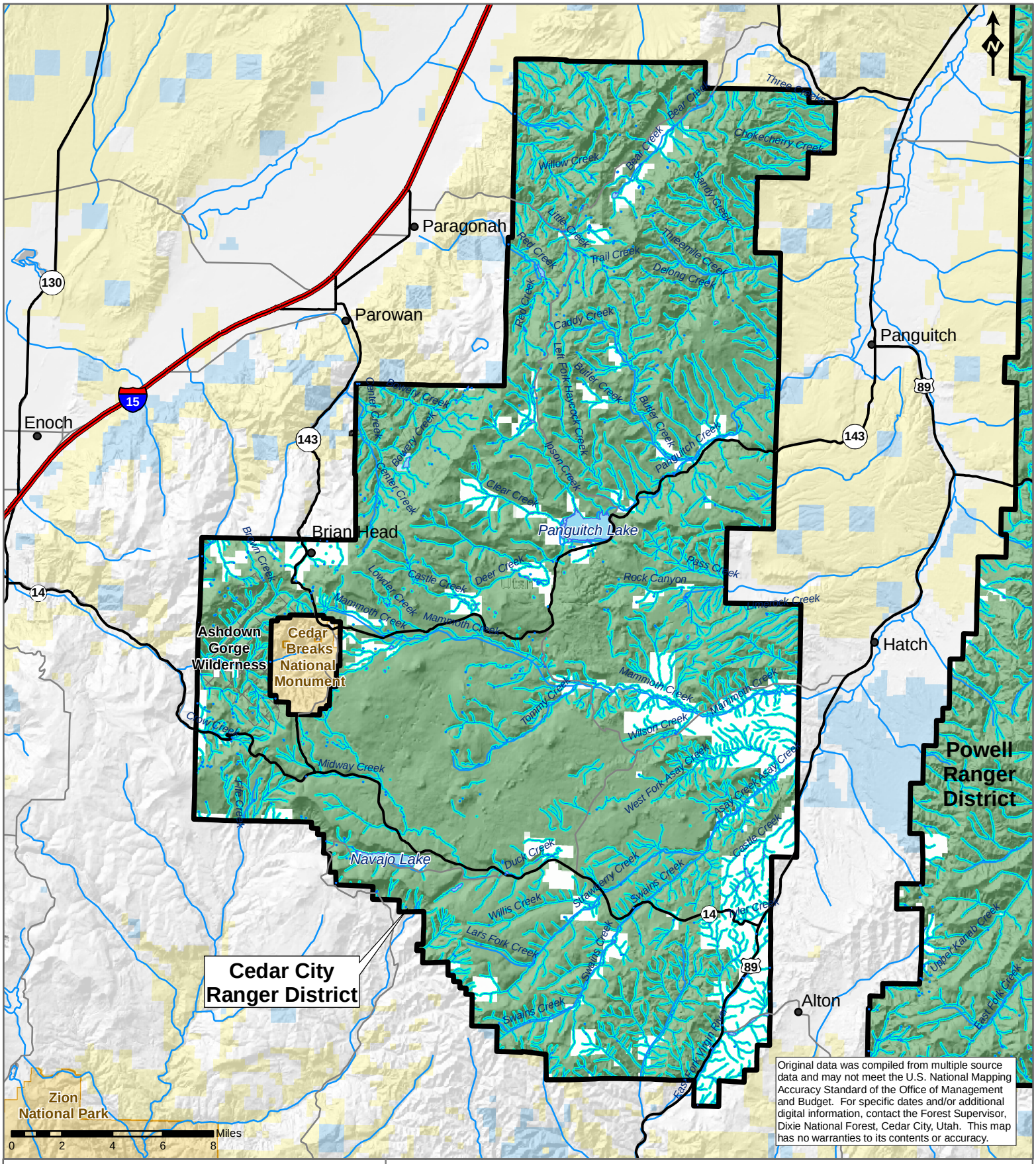
National Forest System Lands

- Dixie National Forest
- Wilderness Areas

Other Land Administration

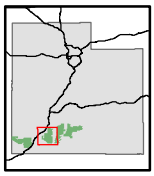
- Bureau of Land Management
- National Park Service
- Private
- State of Utah
- Tribal
- 300-foot Riparian Buffer

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



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

FIGURE 8.4-2
Cedar City Ranger District Watershed Resources



Horizontal Datum = NAD 83
Coordinate System = Zone 12N

1:320,000

25 October 2007

Legend

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

National Forest System Lands

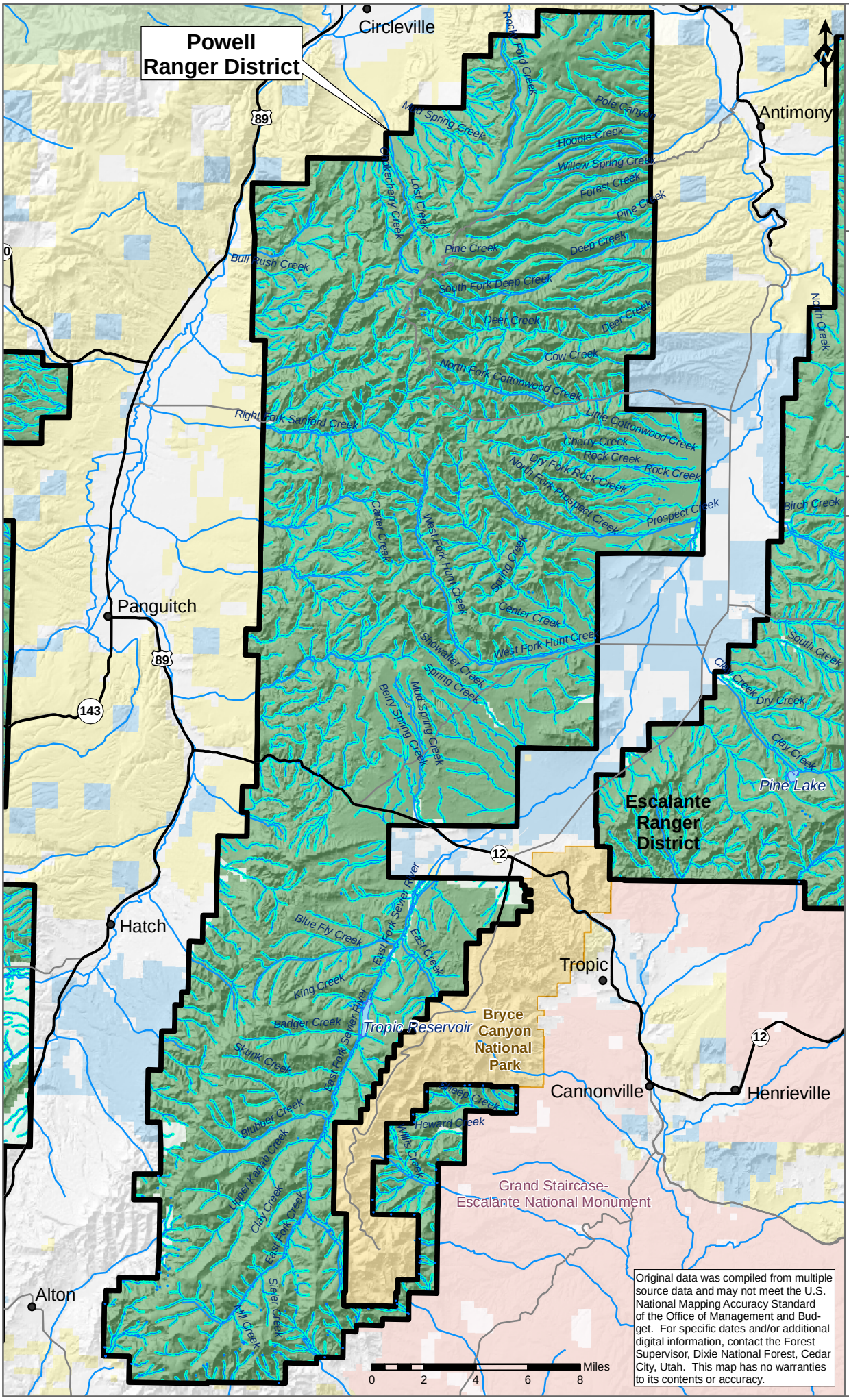
- Dixie National Forest
- Wilderness Areas

Other Land Administration

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

- 300-foot Riparian Buffer

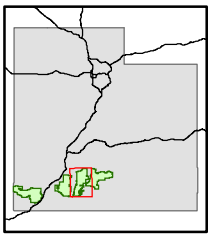
NOTES
(1) Not all roads are shown. Only some roads are depicted for orientation purposes.



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

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

FIGURE 8.4-3
Powell Ranger District Watershed Resources



1:320,000	28 February 2008

Horizontal Datum = NAD 83
Coordinate System = Zone 12N

Legend

- Springs
- Cities
- Highways
- Minor Roads (1)
- Streams
- Major Streams & Rivers
- Water Bodies
- 300-foot Riparian Buffer

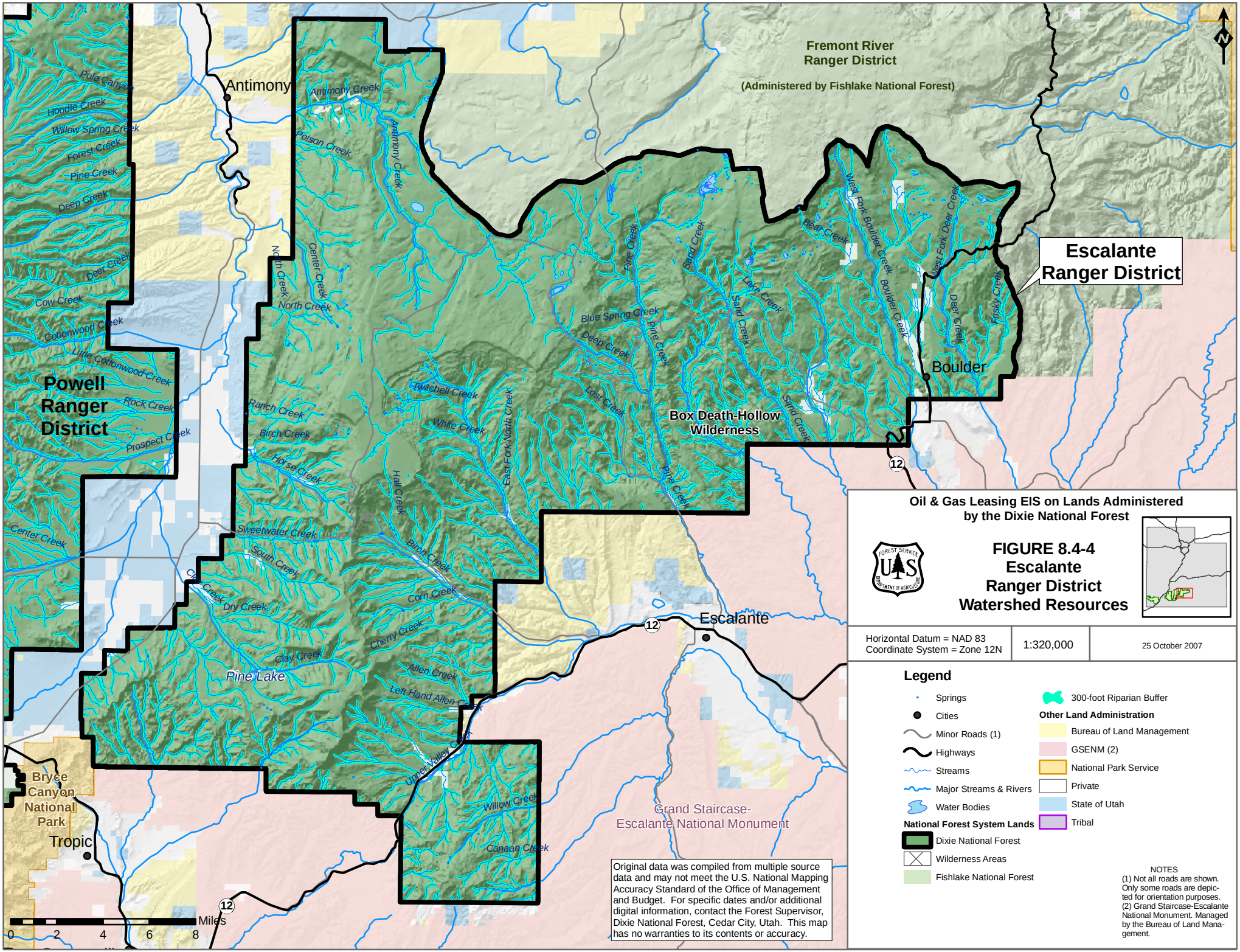
National Forest System Lands

- Dixie National Forest
- Wilderness Areas
- Fishlake National Forest

Other Land Administration

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

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



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

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

FIGURE 8.4-4
Escalante Ranger District Watershed Resources

Horizontal Datum = NAD 83 Coordinate System = Zone 12N	1:320,000	25 October 2007

Legend

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

National Forest System Lands

- Dixie National Forest
- Wilderness Areas
- Fishlake National Forest
- 300-foot Riparian Buffer

Other Land Administration

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

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

8.5 Impact Analysis

This section 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 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 Specialist Report, the direct and indirect effects of an action are discussed in combination for the affected resource components in Section 8.5.4. Cumulative effects are described by alternative in Section 8.5.5. For watershed resources, the resource components (defined in Section 8.3) identified for analysis are wetlands, floodplains, and riparian areas (described in Sections 8.4.1, 8.4.2, and 8.4.3, respectively). For this analysis, the spatial distribution of these resource components is assumed to overlap with the 300-foot buffer applied to waterbodies on the Dixie National Forest (see Section 8.4 for a more thorough explanation.)

NEPA requires that effects in an EIS be discussed in terms of context and intensity. In this Specialist Report, 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 Specialist Report, 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 8.5-1.

Table 8.5-1 Summary of Terms used to Describe Effects in the Specialist Report.

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.

8.5.1 Connected Actions

The Alternatives described in Chapter 2 do not authorize surface disturbance. Therefore, environmental impacts in this Specialist Report 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 which 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 Specialist Report, connected actions are the predicted disturbance from oil and gas leasing activity, which is discussed in Chapter 2 of the EIS.

8.5.2 Issue Statement

Post-leasing activities could impact flow and water quality of surface streams and groundwater, sensitive aquifers, developed water systems, floodplains, wetlands, and riparian areas.

This Specialist Report addresses impacts to wetlands, stream channels, floodplains, and riparian areas. Specialist Report 7.0 addresses flow, water quality, sensitive aquifers, and developed water systems.

Construction and operation of oil and gas facilities such as power lines, drill pads, drill rigs, roads, and production facilities could adversely impact floodplains, stream channels, and aquatic habitats through direct disturbance and increased sediment loads from new roads and well pad construction. Other impacts may include changes in timing and amount of surface runoff and stream flow. Oil and gas activities could adversely impact the function and values of riparian areas, particularly in narrow canyons or V-shaped valley bottoms where activities may be confined by these physiographic features. Wetlands, springs, and riparian areas are particularly vulnerable to pollution and increased sediment loads.

8.5.3 Indicators

In this Specialist Report, effects will be described using indicators developed for each resource. Using the environmental conditions described in Section 8.4 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.

Multiple measurement indicators were identified for water and watershed resources and the majority will be addressed in Specialist Report 7.0. This Specialist Report will use the following two indicators.

<u>Measurement indicators</u>

- Narrative description of potential effects to surface water flow and groundwater availability
- Acres of disturbance as compared to available

8.5.4 Direct and Indirect Effects

Under Alternatives B, C, D, E it is assumed that activities described under the 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 (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. In general, any land disturbing activity has the potential to impact watershed resources. Of all the activities predicted by the RFDS, seismic surveys present the lowest potential for impacts to watershed resources. Impacts from seismic exploration should be limited to a small potential for increased erosion due to wheel ruts, soil compaction, and the crushing of vegetation. Overall, the

amount of disturbance should be small enough that any increases in erosion would be localized and range from negligible to minor and be short term. The greatest potential for impacts to 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 will be discussed in additional sections below, the primary impacts of roads on watershed resources can be generalized for all watershed resources to primarily include a loss of wildlife habitat, increases in erosion and sediment delivery to streams, and the alteration of hydrology. These impacts could be negligible to major depending upon the location of roads relative to the various watershed resources and would generally be short term due to the reclamation of roads following exploration. However, if roads were to result in large changes in surface flow patterns or hydrology, the impacts can be difficult to reverse and may become long term. For an exploratory well pad, the types of impacts would be similar to those described for roads. Also, the impacts of roads and well pads associated with a production field would generally be the same as described for exploratory facilities; however, the impacts would be long term.

Oil and gas activity also has the potential to impact watershed resources through the inadvertent release of hydrocarbons or chemical pollutants. 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. Potential spills would likely be limited to small, localized events that would have a minor short-term effect on watershed resources under all alternatives.

Table 8.5-2 lists the leasing options assigned to the watershed resource components under each alternative. Descriptions of leasing options (and associated impacts on watershed resources) are described in Section 8.5.4.1. 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 8.5-2 Leasing Options Assigned Under Each Alternative

Resource Component	A	B	C	D	E
Wetlands, Floodplains, and Riparian Areas (including riparian vegetation)	NL	NSO 500 ft buffer NL 300 ft buffer	NSO 300 ft buffer	CSU 300 ft buffer	SLT

8.5.4.1 Impacts of Connected Actions by Leasing Option

This section summarizes the lease options described in Chapter 1 of the EIS and describes how they would apply to wetlands, floodplains, and riparian areas. 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 under SLT are described more extensively in Section 8.5.4.2. Impacts to watershed resources considering leasing option overlaps (i.e., overlaps with more restrictive leasing options assigned to other resources) are discussed in Section 8.5.4.3 (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 8B and the BLM and USFS Surface Operating Standards and Guidelines for Oil and Gas Exploration and Development – the Gold Book

(USFS and BLM 2007).

NOT AVAILABLE (NA)

NA applies to lands that are not administratively available for leasing and includes Brian Head Ski Resort, wilderness areas, and the 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. Further, there would be no effects to wetlands, stream channels, floodplains, or riparian areas occurring within these areas.

NL

A NL lease option does not allow leasing on specified lands for the protection of resources. Under NL, no direct disturbance to wetlands, stream channels, floodplains, or riparian areas would occur. NL applies to the entire Dixie National Forest under Alternative A and there would be no direct or indirect effects from oil and gas leasing. Under Alternative B, NL would apply to the 300-foot buffer. No new leases would be authorized within the 300-foot buffer and no direct impacts would occur. Indirect impacts to these areas could occur as a result of oil and gas activity on adjacent land. The types of indirect impacts that could occur are described in detail in Section 8.5.4.2 and 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. However, with proper implementation of BMPs applicable to road and well pad construction they would likely range from negligible to moderate and be short term for exploration activities and long term for production facilities.

Measurement Indicators

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.

Acres of disturbance as compared to available – No direct disturbance to wetlands, stream channels, floodplains, or riparian areas would occur.

NSO

There are two separate types of NSO stipulations that could apply to wetlands, floodplains, and riparian areas. The first type of NSO stipulation 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). Under Alternative B, this NSO is applied to a 500-foot buffer around streams, lakes, reservoirs, and springs. The 500-foot buffer to which NSO is applied is in addition to the 300-foot buffer, which would be under NL in Alternative B. The only disturbance that could occur within the 200 feet distance between the outer edge of the 300-foot buffer and the 500-foot buffer would be seismic exploration. Oil and gas resources within the 200-foot distance under NSO could be extracted via directional drilling from outside the buffer area. Further, an identical NSO stipulation is applied to Inventoried Roadless Areas (IRAs) under Alternative B and C and the dual analysis scenario of Alternatives D and E. Wetland, floodplain, and riparian areas within IRAs would be protected by this stipulation. Under this type of NSO, the only direct disturbance that could occur would be seismic exploration and potential, associated, equipment fluid 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 8.5.4.2. 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 wetland, floodplain, and riparian areas. Other potential indirect impacts may include the alteration of natural infiltration and flow paths, and hydrocarbon or chemical spills as discussed in Section 8.5.4.2. 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.

Measurement Indicators

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.

Acres of disturbance as compared to available – The only type of direct disturbance that can 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. This represents less than 0.1 percent of the total acreage available on the individual Ranger Districts.

The second type of NSO stipulation would apply to the 300-foot buffer in Alternative C. This NSO stipulation 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 other 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 stipulations 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 8.5.4.2 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 8.5.4.2.and would range from negligible to moderate and be short to long term depending on the location and type of disturbance.

Measurement Indicators

Narrative description of potential effects to surface water flow and groundwater availability –The construction of culverts and bridges at stream-road intersections could create localized areas of high flows and scour.

Acres of disturbance as compared to available – 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 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 0.1 percent of the total acreage within the 300-foot buffer area on the

individual Ranger Districts.

TIMING LIMITATION (TL)

TLs are seasonal restrictions that prohibit surface use during specified time periods to protect identified resource values. This stipulation does not apply to the operation and maintenance of production facilities unless the findings of analysis demonstrate the continued need for such mitigation and that less stringent, project-specific mitigation measures would be insufficient. In this analysis, a TL stipulation is not applied directly to any of the watershed resource components.

CSU

Under Alternative D, a CSU stipulation would be applied to the 300-foot buffer around wetlands, floodplains, and riparian 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 mitigation provided by SLT, Forest Service regulations, and operating orders. 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 used if facilities such as well pads or portions of roads are needed to extend into these areas. The exception would be for perpendicular stream crossings as explained above for NSO with Road Crossings. The intent of this CSU is to allow operators some flexibility in the location of facilities, while 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 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 8.5.4.2, the impacts of a spill would range from negligible to major, and generally be long term.

Measurement Indicators

Narrative description of potential effects to surface water flow and groundwater availability – Effects would be the same as described for NSO.

Acres of disturbance as compared to available – Acres of disturbance would be the same as described for NSO.

SLT

Standard lease terms (SLT) are contained in BLM Lease Form 3100-11, Offer to Lease and Lease for Oil and Gas. Under SLT, the lessee has the right to use as much of the leased lands as is necessary, as well as the right to build and maintain necessary improvements thereon. Section 6 of the standard lease form requires the operator to conduct operations in a manner that minimizes adverse impacts to the land, air, water, cultural, biological, visual, and other resources and land uses or users. In addition, if threatened or endangered species; objects of historic, cultural, or scientific value; or substantial unanticipated environmental effects are encountered during operations, all work affecting the resource must cease, and the land management agency contacted. SLT operations cannot violate any other Federal environmental protection laws (i.e., Clean Air Act, Clean Water Act, Endangered Species Act, etc.) and would be subject to existing requirements, including those in 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 8B). SLT would also 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.

Wetlands, floodplains, and riparian areas would be available under SLT under Alternative E. Also,

since no additional watershed specific constraints have been identified for the CSU stipulation under Alternative D, or for those areas overlapped by various TL stipulations, these areas would essentially be available under SLT as well. While SLT does not apply specific protection to wetlands, floodplains, and riparian areas, 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. If all facilities and operations, including roads, were moved the maximum distance (200 meters, 656 feet) 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 to watershed resources could occur. The possible impacts are discussed in Section 8.5.4.2, including a discussion of the measurement indicators.

8.5.4.2 Impacts of connected actions under SLT

Impacts in this section are discussed assuming no restrictions or stipulations 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 mentioned in beginning of Section 8.5.4.1. 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 8.5-3). Leasing options applied under the different alternatives would dictate the conditions under which the following impacts from connected actions may occur and are discussed in Section 8.5.4.3 (Impacts by Alternative).

Table 8.5-3 Projected Road Construction and Total Disturbance that could occur under SLT, 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	40.0		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

WETLANDS

Under SLT, direct impacts to wetlands could consist of seismic exploration, construction, and reconstruction of roads, exploratory well pads and associated facilities, and 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, vegetation removal, and the temporary redistribution of sediments from drill rigs and buggies. 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 hydrocarbon or chemical 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 channel morphology. Under SLT, these impacts could range from minor to major. However, many of the impacts can be avoided by the ability to move operations by up to 200 meters (656 feet), Section 404 of the Clean Water Act, and 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 8B and the BLM and USFS Surface Operating Standards and Guidelines for Oil and Gas Exploration and Development – the Gold Book (USFS and BLM 2007). The duration would be short term for impacts due to seismic exploration and possible spills, and long term for any filling of wetlands.

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 were described above for the direct fill of wetlands. Further, hydrocarbon or chemical 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 AND FLOODPLAINS

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 BMPs in Appendix 8B 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 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. In forested landscapes, 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. Impacts of roads could range from negligible to major depending upon the amount and location of a road 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.

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

Direct impacts to riparian areas would occur primarily as a result of vegetation removal due to seismic exploration, and the construction of well pads, access roads, and pipelines. Seismic exploration would be expected to impact riparian areas the least, with the most severe impacts coming 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 8.5-3, measurement indicator #2) 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 the BMPs contained in Appendix 8B and BLM and USFS (2007), 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.

Measurement Indicators

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.

Acres of disturbance as compared to available – The total disturbance that could occur relative to the different phases of oil and gas activity is listed by Ranger District in Table 8.5-3. A total 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. This represents less than 1 percent of the total acreage within the 300-foot buffer on the individual Ranger Districts.

8.5.4.3 Impacts by Alternative

The degree to which the impacts of connected actions (Section 8.5.4.1 and 8.5.4.2) 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 8.3). The watershed resource components were defined above in Section 8.5.

Table 8.5-4 shows the acres of wetland, floodplain, and riparian area resource components under each lease option by Alternative. Table 8.5-4 incorporates the amount of overlap with more restrictive leasing options (assigned to other resources) in addition to the leasing option assigned directly to these areas. While in general, the total acreage given for each resource component should be the same for each alternative, Table 8.5-4 has a number of discrepancies in this regard. This is due to the fact that limitations with the GIS database applied over an extremely large area result in an inability to accurately calculate acreages that match exactly between alternatives. There are two columns under Alternatives D and E. The first column under each alternative represents the acres with NSO in all IRAs. The second column represents the acres with leasing allowed under a less restrictive lease option in IRAs. As described in Chapter 2 of the EIS, the Roadless Area Conservation Rule does not strictly require a NSO stipulation be connected with mineral leases in IRAs and, in actuality, the stipulation that will be applied to IRAs under the dual analysis scenario is CSU. However, the Roadless Area Conservation Rule prohibits the road construction and timber removal that would be practically necessary for efficient oil and gas exploration and drilling on new leases, as well as the road building and timber removal necessary for building oil and gas production facilities on new leases. This would effectively prevent use of the lease surface for efficient exploration and development of oil and gas and this has been reflected in the impact analysis by assuming new leases in IRAs would essentially include a NSO stipulation. Approximately 35 percent of the wetlands, floodplains, and riparian areas on the Dixie National Forest fall within IRAs.

A more detailed table that separates the acreage by resource component and Ranger District will be available in Appendix B of the EIS. 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 will be highlighted and discussed.

Table 8.5-4 Acreage of Resource Components under each Leasing Stipulation by Alternative

Resource Component	Stipulation	Alternative						
		A	[3]B	C	D		E	
Wetlands, Floodplains, and Riparian Areas (including riparian vegetation)	NA	22,939	37,325	22,939	22,939	22,939	22,939	22,939
	NL	387,879	543,172	5,614				
	NSO		[1]82,338	[2]382,265	167,404	27,370	142,117	
	TL				121,641	199,110		
	CSU				98,836	161,400		
	SLT						245,762	387,879

[1]NSO for Alternative B is different than for Alternative C and is described in Section 8.5.4.1
[2]NSO acreage for wetlands, floodplains, and riparian areas under Alternative C actually includes two types of NSO stipulations as described in Section 8.5.4.1 and Section 8.5.4.3.
[3]The total acreage under Alternative B is larger than under the other alternatives because Alternative B would apply a 500-foot buffer around all waterbodies, rather than the 300-foot buffer applied under all other alternatives.

ALTERNATIVE A

No new leases would be authorized under Alternative A and approximately 6 percent of the 300-foot buffer area (410,818.2 acres) would be within areas not available (NA) for leasing. There would be no direct or indirect impacts to wetlands, stream channels, floodplains, and riparian areas as a result of oil and gas leasing activity. Unrelated actions could occur or continue to occur; however, they would not be considered connected actions related to oil and gas leasing and are not discussed in this Specialist Report.

Measurement Indicators

Narrative description of potential effects to surface water flow and groundwater availability – There would be no direct or indirect impacts to surface water flow and groundwater availability as a result of oil and gas leasing activity.

Acres of disturbance as compared to available – There would no disturbance associated with oil and gas leasing activity.

ALTERNATIVE B

Alternative B would apply a NL option to the 300-foot buffer around streams, lakes, reservoirs, and springs. It would also apply a NSO stipulation to a 500-foot buffer around these areas. Approximately six percent (37,325 acres) of the buffered areas are in areas not 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 stipulation applied (Table 8.5-4). The NSO stipulation applied under this alternative would not allow roads within the buffers, including perpendicular stream crossings. Under this alternative there would be no disturbance within the 300-foot buffer and only seismic exploration within 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 8.5.4.2 and would include primarily the delivery of sediment and contaminants to these areas, as well as possible changes in drainage patterns. 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.

Measurement Indicators

Narrative description of potential effects to surface water flow and groundwater availability – The alteration of flow into wetlands could decrease groundwater recharge and decrease the capability of wetlands to moderate stream fluctuations.

Acres of disturbance as compared to available – Under Alternative B, disturbance 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. Disturbance in this area 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 0.1% of the total acreage available on the individual Ranger Districts.

ALTERNATIVE C WITH NSO IN IRAS

Alternative C would apply a NSO stipulation to the 300-foot buffer. Approximately 6 percent (22,939 acres) of the 300-foot buffered areas would be within areas not 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 stipulations would apply. Approximately 69 percent (284,220 acres) would be under a general NSO stipulation 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, under Alternative C direct impacts to wetlands, floodplains, and riparian areas would be limited to seismic exploration over 69 percent of the mapped 300-foot buffer, with a small amount or road, culvert, and bridge construction allowed in 24 percent of the mapped 300-foot buffer. Leasing and associated impacts could not occur on seven percent. The impacts of seismic exploration would be as described for SLT in Section 8.5.4.2. Road-stream crossings could have impacts to stream channels as described in Section 8.5.4.2 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 8B and BLM and USFS 2007. The impacts of road stream crossings on wetlands, stream channels, floodplains, and riparian areas would be similar to those described in Section 8.5.4.2; however, they would be less severe as only small amounts of these 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 8.5.4.2.

Measurement Indicators

Narrative description of potential effects to surface water flow and groundwater availability – The filling of wetlands, whether via the construction of approximately 600 linear feet of roads within the buffer at each stream crossing or indirect sedimentation, would decrease the capability of wetlands to moderate stream fluctuations. The result could 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 possibility of these impacts occurring is less than under SLT given the restriction on surface occupancy. The construction of culverts and bridges at stream-road intersections could create localized area of high flows and scour.

Acres of disturbance as compared to available – 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 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 0.1 percent of the total acreage within the 300-foot buffer area on the individual Ranger Districts.

ALTERNATIVE D WITH NSO IN IRAS

Under Alternative D with NSO in IRAs, approximately six percent (22,939 acres) of the 300-foot buffered areas would be within wilderness and not available (NA) for leasing, 41 percent (167,404 acres) would be under NSO, and 54 percent (220,477) would be under CSU. Of the areas under CSU, 121,641 acres would have overlapping TL stipulations. The various TL stipulations would not provide protection beyond that provided by CSU. As described in Section 8.5.4.1, 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 would be the same as described for Alternative C.

Measurement Indicators

Narrative description of potential effects to surface water flow and groundwater availability – Effects would be the same as described for Alternative C.

Acres of disturbance as compared to available – Acres of disturbance would be the same as described for Alternative C.

ALTERNATIVE D WITH CSU IN IRAS

Under Alternative D with CSU in IRAs, approximately six percent (22,939 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) would be under CSU. Of the areas under CSU, 199,110 acres would have overlapping TL stipulations. The various TL stipulations would not provide protection beyond that provided by CSU. The same types of impacts as described for Alternative D with NSO in IRAs would have the potential to occur under this alternative and the impacts would be the same as described for Alternative D with NSO in IRAs. The difference between Alternative D with CSU in IRAs and Alternative D with NSO in IRAs is simply a matter of the amount of acres of streams, lakes, springs, wetlands, floodplains, and riparian areas 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.

Measurement Indicators

Narrative description of potential effects to surface water flow and groundwater availability – Effects would be the same as described for Alternative D with NSO in IRAs.

Acres of disturbance as compared to available – Acres of disturbance would be the same as described for Alternative D with NSO in IRAs.

ALTERNATIVE E WITH NSO IN IRAS

Under Alternative E with NSO in IRAs, approximately six percent (22,939 acres) of the buffered areas would be within wilderness and not 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 result of the large amount available under SLT, the impacts would essentially be the same as described for SLT in Section 8.5.4.2. However, with 36 percent of the buffered areas protected by NSO, the potential for impacts would be reduced relative to having the entire area available under SLT.

Measurement Indicators

Narrative description of potential effects to surface water flow and groundwater availability – Effects would be the same as described for SLT in Section 8.5.4.2.

Acres of disturbance as compared to available – Acres of disturbance would be the same as described for SLT in Section 8.5.4.2.

ALTERNATIVE E WITH SLT IN IRAS

Approximately 6 percent (22,939 acres) of the buffered areas would be within wilderness and not available (NA) for leasing. The remaining 94 percent (387,879 acres) would be available under SLT and both direct and indirect impacts would be the same as described for SLT in Section 8.5.4.2.

Measurement Indicators

Narrative description of potential effects to surface water flow and groundwater availability – Effects would be the same as described for SLT in Section 8.5.4.2.

Acres of disturbance as compared to available – Acres of disturbance would be the same as described for SLT in Section 8.5.4.2

8.5.5 Cumulative Effects

Cumulative effects are the total effect, including direct and indirect effects, on a given resource resulting from the incremental impact of past, present, and reasonably foreseeable future actions. They can result from individually minor, but collectively significant actions taken over a period of time. Cumulative effects may arise from single or multiple actions and the effects may be additive or interactive. The net adverse effect of interactive actions may be less than the sum of the individual effects (countervailing) or the actions may interact to create a net adverse cumulative effect that is greater than the sum of the individual effects (synergistic). The magnitude and extent of the effect on a resource depends on whether the cumulative effects exceed the ability of a resource to function at a desired level (CEQ 1997).

8.5.5.1 Description of Cumulative Effects Area

The Cumulative Effects Area (CEA) for watershed resources is all 6th level HUC subwatersheds occurring on the Dixie National Forest that are within the following boundaries: north of the Virgin River, east of the Union Pacific rail line located west of the Utah-Nevada border, south and east of US Highway 56 and Desert Mount Road, east of Interstate 15 north of Cedar City, and south and west of US Highway 12 on the Fremont River Ranger District (Figure 8.5-1). No data exists for one of the subwatersheds on the west side of the Pine Valley Ranger District and a buffer was created by extending a boundary west from the nearest subwatershed (Nephi Draw HUC 160300061301) along an existing dirt road to its intersection with the Union Pacific rail line at Brown, Nevada. These boundaries were placed on the 6th level subwatersheds due to the presence of several subwatersheds that covered only very small portions of the Dixie National Forest, but extended long distances from the Dixie National Forest boundary. The portions of these watersheds eliminated are likely beyond the extent of any cumulative effects. The CEA is approximately 3,528,829 acres

(Table 8.5-5).

RATIONALE

Impacts to watershed resources in areas downstream of the Dixie National Forest boundary are most likely to occur if oil and gas activity results in large changes in hydrology (i.e., alteration of drainage patterns, increases or decreases in stream flow, and accompanying changes in stream channel erosion). Environmental protection measures are expected to prevent changes in hydrology and if impacts do occur they are not expected to be of a sufficient magnitude to extend beyond the 6th level HUC subwatersheds that are included in the CEA.

Table 8.5-5 Land Ownership Within the Watershed Cumulative Effects Area

Land Ownership	Area (acres)	Percent of Total CEA
Bureau of Land Management (BLM)	1,000,286	28
National Park Service (NPS)	40,357	1
Private	560,755	16
State Lands*	174,904	5
US Forest Service (USFS)	1,749,616	50
Water	2,907	<1
Total	**3,528,829**	**100**

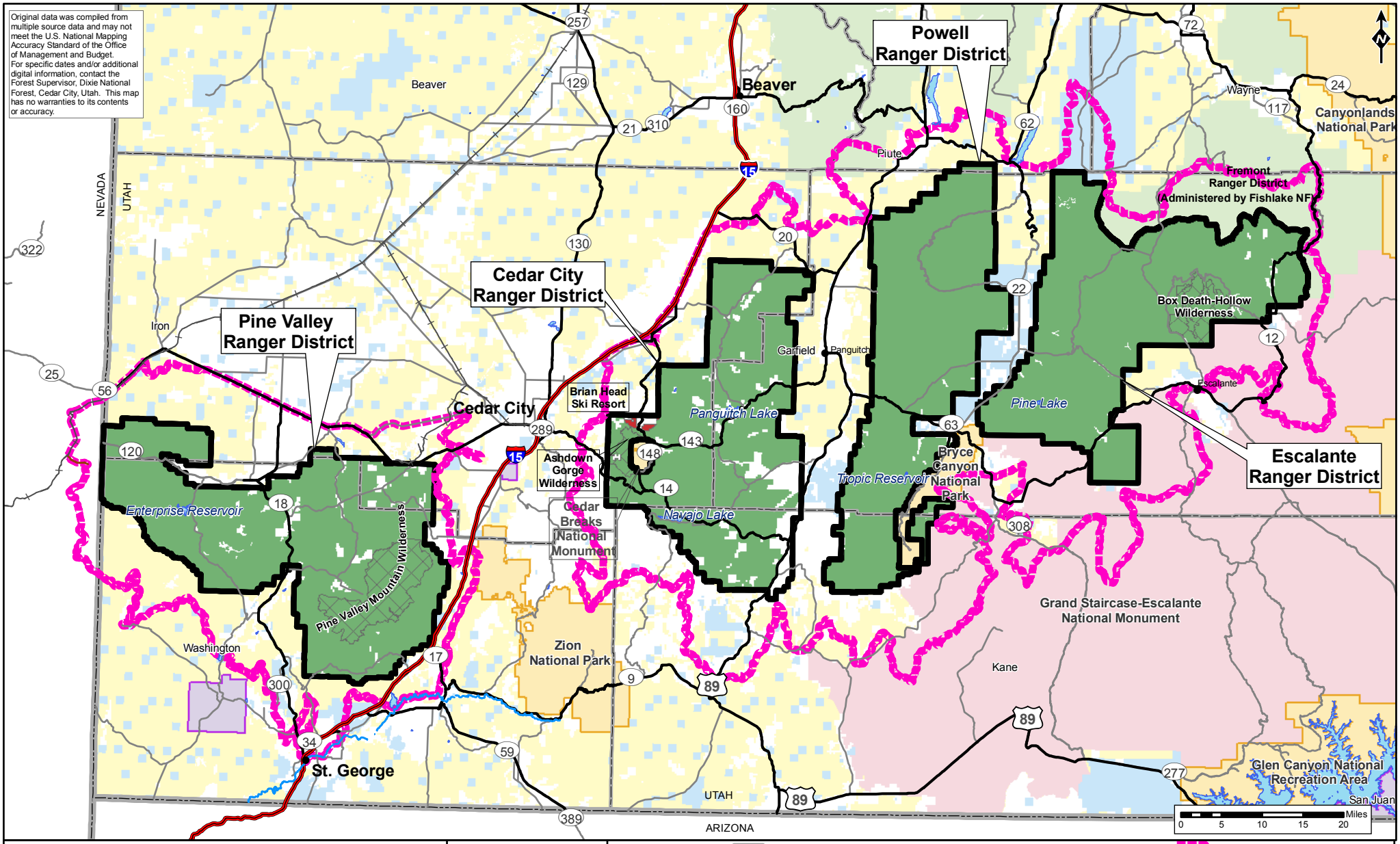
*Includes:

State Park (Nevada): 2,025 acres

State Parks and Recreation: 8,994 acres

State Trust Land: 156,955

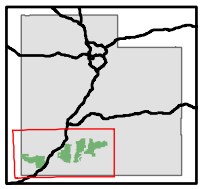
State Wildlife Reserve/Management Area: 6,931



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

FIGURE 8.5-1
Cumulative Effects Area
6th-Level Subwatersheds (Modified)

25 February 2008	1:1,000,000	Horizontal Datum = NAD 83 Coordinate System = Zone 12N



- Cities
- Railroad
- Minor Roads*
- Highways
- Freeways
- Virgin River
- Water Bodies
- County Boundaries
- State Lines

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

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

*Not all roads are shown. Only some roads are depicted for orientation purposes.
**Grand Staircase-Escalante National Monument. Managed by the Bureau of Land Management.
***Comprised of 6th-Level (HUC 12) Watersheds that comprise Dixie National Forest. Clipped to selected Highways, the Virgin River, and Railroads.

8.5.5.2 Past, Present, and Reasonably Foreseeable Actions

As shown in Table 8.5-5, approximately 50 percent of the CEA is covered by the Dixie National Forest and about one-half is other lands (predominantly private and BLM). However, the Dixie National Forest covers the majority of the upper elevation terrain within the 6th level watersheds that are included in the CEA. The upper elevations receive a larger amount of precipitation than the lower elevation areas dominated by private or BLM land and the majority of streams located on private and BLM land originate on the Dixie National Forest. In addition, the upper elevation portions of the watersheds included in the CEA provide much of the groundwater recharge important to watershed resources in the lower elevations. Additionally, when dealing with watersheds and stream networks, the conditions at a specific point in the watershed are usually a result of local conditions at that site combined with conditions in the upstream portions of the watershed. Conditions in the lower reaches of a watershed, however, do not necessarily have an affect on upstream reaches. As a result, in this section we are more concerned with the cumulative impacts to watershed conditions that may occur as a result of oil and gas activity near the place where the activity is occurring (on the Dixie National Forest) as well as the effect that these actions may have on downstream areas (lower elevation private and BLM lands). For this reason, in the analysis of cumulative effects, the past, present, and reasonably foreseeable actions on the Dixie National Forest have a proportionally greater focus than off-Forest actions.

Compared to historic conditions (late 1800s and early 1900s), watershed conditions have improved on many parts of the Dixie National Forest and on lands now managed by the BLM. However, recent past and present management activities have impacted watershed conditions. USFS (2006b) identified the following management activities as the key sources of impacts to watershed resources: road systems in riparian and wetland areas; livestock grazing; dispersed recreation - notably off-road vehicle use; water diversions and dams; uncharacteristic fire; timber harvest (including the associated road building); and minerals activity (including oil and gas exploration and development). Most of these activities have the potential to occur on Dixie National Forest and BLM lands, except timber harvest on BLM land is primarily limited to small-scale fuelwood harvest. Regarding private land within the CEA, approximately 10 percent (58,456 acres) is within established municipalities where it is assumed that the primary past, present, and future activities would be dominated by urban development. Development in within municipal boundaries is expected continue at an increasing rate due to expanding populations in nearby areas. The development of small-scale residential subdivisions and recreation type residences is also increasing on private land outside the municipal boundaries. Similar development is also occurring on State land managed by the State of Utah School and Institutional Trust Lands Administration (SITLA), particularly in the John's Valley area located between the Powell and Escalante Ranger Districts. Aside from such development, agriculture (including livestock grazing) is the primary use of private and State lands in the area, although some mineral development is also anticipated to occur in the area of John's Valley and will be discussed in more detail below.

Discussions on the past and present levels of the types of activities identified by USFS (2006b) as key sources of impacts to watershed resources are described below, along with the general watershed impacts that have resulted and the expected level of future activity.

ROADS

As discussed in Section 8.5.4.2, roads have the greatest potential for impacts to watershed resources. The construction of roads in close proximity to streams, including within wetland and riparian areas, has altered the structure and function of these areas within the CEA. Table 8.5-6 shows the miles of Forest Service routes that have the potential to, or are impacting watershed resources.

Table 8.5-6 Miles of Forest Service Routes Impacting Watershed Resources.

Route Impacts	Miles of Forest Service Routes			
	Pine Valley	Cedar City	Powell	Escalante
Route presents a high risk to soil and water resources	206.5	44.9	65.5	189.1
Route presents a moderate risk to soil and water resources	135.7	329.3	360.6	362.3
Route impacts stream channels, floodplains, wetlands, or riparian areas	385.1	346.9	152.8	478.0
Route crosses riparian areas	111.3	210.6	164.3	276.4
Route is in riparian areas (within banks or high water mark)	67.00	146.0	105.1	48.00
Route is within ½-mile of a riparian area	185.2	174.6	416.3	515.8
Route is within a stream channel		2.2		
Routes with stream crossing	640.5	591.7	682.7	604.3
Routes within wetlands		2.6		0.7
Routes within 200 feet of streams	700.7	670.1	815.8	710.2

Source: Dixie National Forest Route Analysis Database

Similar details on road/stream relationships are not readily available for the non-Forest portions of the CEA; however, a simple measure of road density can provide some indication about the potential for roads as a whole to impact watershed resources. This is based upon the assumption that the greater the network of roads in a watershed area (all else being the same), the greater the likelihood of channel alteration, sedimentation, etc. Throughout the CEA, there are numerous HUC 6 watershed areas with a road density of two miles/square mile or greater: notably these include off-Forest lands to the north of the Pine Valley Ranger District; much of the southern 2/3 of the Cedar City Ranger District; and a significant part of the Escalante Ranger District. A road density of two miles/square mile would also be considered high when considering road effects on a watershed. On the Escalante Ranger District, roads and recreation use on Carcass and Pleasant Creeks have impacted riparian areas and led to stream channel widening (USFS 2004). In general, the Dixie National Forest has a higher road density than the surrounding non-Forest lands in the CEA. In addition to road density, soil type, slope steepness, geology, and other aspects of a watershed are also related to potential impacts from roads.

In recent years, many roads and trails within the Dixie National Forest have been relocated away from streams or have been obliterated. The Duck Creek – Swains Access Management Project is a recent example of a project designed to lessen the impact of roads on riparian areas (USFS 2006b). This project is closing or decommissioning unneeded roads, which will potentially decrease the adverse affects to water resources. Further, in recent years, the USFS has placed more focus on proper road placement, design, and maintenance, all with an eye towards reducing impacts to water resources. Similar efforts have occurred on the Grand Staircase Escalante National

Monument (located to the south of the Escalante Ranger District) where motorized travel is extremely restricted and the BLM plans to implement road closure projects in the future as funding permits. Also, road development is restricted on much of the BLM land to the south of the Pine Valley Ranger District due to the presence of the Red Cliffs Desert Reserve (which restricts most development) and three wilderness study areas (WSAs) (Cougar Canyon, Red Mountain, and Cottonwood Creek) that are at least partially within the CEA (BLM 1999a). However, similar efforts to relocate or obliterate roads have not occurred on other areas, particularly on private and state lands. Rather, in many of these areas increased development (particularly residential development) is likely to increase the number of roads and the overall road density within the CEA.

Road maintenance, repair, construction, and reconstruction will continue to occur in various locations throughout the CEA and several of these projects are listed in Table 8.5-7. These projects often involve at least some ground disturbance, with consequent erosion; however, these types of projects can also correct poor drainage and actually improve water quality. An example of this would be the Cottonwood Wash Road (located within the Grand Staircase-Escalante National Monument and within the boundaries of the CEA), which is restricted by the BLM's management plan to maintenance for stabilization to prevent erosion and sediment loading in drainages (BLM 1999b).

LIVESTOCK GRAZING

Much of the CEA experienced intense overgrazing in the late 1800s and early 1900s prior to active management. Although impacts continue to occur, grazing practices have improved considerably in recent years. The level of grazing occurring on the Dixie National Forest has been relatively constant over the past five years (USFS 2006b), with moderate impacts on watershed resources, particularly riparian areas. For example, in 2005 and 2006 only 64 and 65 percent of riparian sites sampled, respectively, attained the current Forest standards and guidelines, which are to maintain at least 70-percent of the linear distance of all riparian ecosystems in at least an upper mid-seral successional stage (USFS 2005, 2006c). The result of over-utilization of riparian ecosystems by grazing livestock is a reduction in plant cover, decreased streambank stability, and increased soil compaction, which can decrease surface water infiltration and increase surface water runoff (USFS 1995). In some areas of the Dixie National Forest, grazing activities have contributed to the conversion of riparian vegetation from the typical deep-rooted, hydric vegetation to less desirable species such as Kentucky bluegrass (USFS 2006c). Grazing on the Dixie National Forest is expected to continue at current levels; however, correct application of revised criteria for grazing should result in fewer undesirable impacts to riparian areas. Grazing also occurs on all other BLM-managed land within the CEA and is expected to continue at present levels (BLM 2007b). Impact of grazing on riparian areas on some portions of BLM land has had similar impacts as described for the Dixie National Forest (BLM 2007b). However, on the St. George BLM District, grazing does not occur on the Red Cliffs Desert Reserve (BLM 1999a). Also, on the Grand Staircase-Escalante National Monument, grazing is currently being managed with consideration given to ensuring that water quality standards are being met (BLM 1999b). . Grazing also occurs on private lands within the CEA, and may have higher levels of impacts due to a lack of oversight and monitoring.

DISPERSED RECREATION

Dispersed recreation activities, particularly camping and OHV use that is concentrated along riparian areas, can remove riparian vegetation, compact soils, and create roads and trails that interrupt flow patterns and increase sediment delivery to stream channels. Within the entire CEA, OHV use has experienced a dramatic increase in the recent past and is likely to continue to increase (USFS 2006b, BLM 2007b, 2007c). However, in many areas of the CEA, it is anticipated that travel management projects will lead to decreased impacts. For example, the proposed Dixie National Forest Motorized Travel Management Project will restrict OHV use to designated routes

and largely eliminate off-trail or cross-country motorized travel. Within the Grand Staircase-Escalante National Monument, OHV use is already limited to designated routes (BLM 1999b) and the proposed RMP (BLM 2007c) for BLM land managed by the Kanab Field Office (most areas in between and to the south of the Cedar City and Powell Ranger Districts) would similarly limit OHV use. There are also areas closed to motorized use such as the Red Cliffs Desert Reserve and the three WSAs south of the Pine Valley Ranger District. However, there are also many areas within the CEA where cross-country motorized travel is not restricted, including private land, state land, and much of the BLM land not mentioned above. Also, regarding other types of dispersed recreation (i.e., camping); much of the CEA (including federal, state, and private land) is open to such use without regulation. Exceptions are the Grand Staircase-Escalante National Monument, which regulates all dispersed recreation, and the Red Cliffs Desert Reserve, which also regulates most dispersed recreation and prohibits camping. Given the regulations being implemented, impacts to watershed resources from dispersed recreation are likely to remain near current levels or slightly increase (USFS 2006b).

WATER DIVERSIONS

Dams and other water diversions, both on and off the Dixie National Forest, have resulted in changes to the quantity and timing of stream flow. For example, much of the water in streams coming off the Dixie National Forest is diverted and used for irrigation or municipal use; as this occurs, water quality deteriorates (BLM 2007c) and in many cases streams are diverted to the point that water does not reach the major rivers (BLM 2007b). Also, large dams alter hydrology by storing water for release during the irrigation season, for example, the Sevier River and its tributaries are regulated by storage reservoirs. Water demand is expected to increase due to increasing populations.

FIRE

Historically, fire played a major role in ecosystem processes for many of the vegetation types within the CEA, particularly on the Dixie National Forest. Historical fire levels within the entire CEA likely averaged 3 percent per year, with up to six percent burning in active years (USFS 2006b). However, 150 years of fire suppression has created large mosaics of dense fuel loads in many watersheds within the CEA, which has increased the frequency of large, severe fires. The largest fire season since 1970 was in 2002, in which 57,745 acres burned. Large, severe fires remove vegetation and decrease infiltration rates increasing the potential for large flood and sedimentation events, which can remove or bury riparian vegetation, alter floodplain surfaces, and alter channel morphology (Dwire and Kauffman 2003, Wondzell and King 2003). For example, the Sanford Fire that occurred in 2002 has resulted in changes to channel morphology and riparian vegetation in the Cottonwood Creek, Deep Creek, Deer Creek, and Sanford Creek watersheds (USFS 2004). The frequency of large, severe fires is expected to increase in the future due to the limited acres than can be treated to reduce fuel loads.

The use of prescribed fire and mechanical fuel treatments are also anticipated to increase over the next 5-10 years. On the Dixie National Forest, from 2004-2006, an average of 4,345 acres have been burned by prescribed fires per year. The amount burned by prescribed fires on the Forest will likely increase to over 10,000 acres per year in the near future. Most of the prescribed fires are small (average of 563 acres) and are low to moderate intensity. Because of the low intensity, and the ability of riparian and wetland vegetation to recover quickly following fire, most prescribed burns have very minor, short-term effects on watershed resources (Dwire and Kauffman 2003, Wondzell and King 2003). Further, an increase in the number of prescribed fires and mechanical fuel treatments should ultimately lead to a decrease in the number of large, uncharacteristic fires.

TIMBER HARVESTING

Within the CEA the majority of logging occurs on the Dixie National Forest as most BLM, private, and State lands are in lower elevation areas dominated by pinyon-juniper woodlands. Timber harvest in most of these areas would be limited to fuelwood (green or dead and down) harvesting, post cutting, and Christmas tree cutting. However, on the Cedar City BLM District, there are also numerous planned thinning and fuels treatment projects (see Table 8.5-7). On the Dixie National Forest, historical logging, even-aged management, and historical fire suppression have created relatively dense, mid-succession, mixed conifer forests with relatively large accumulations of woody debris and fuel (UDNR 2003). In recent years, the number of acres harvested per year has generally decreased relative to historic levels as the emphasis of timber harvests has shifted from promoting wood growth (for production) to ecosystem health. Harvests such as clearcuts are rare; more frequent are commercial thinning treatments, salvage cuts, sanitation cuts, and thinning for stand improvement and to reduce susceptibility to bark beetle outbreaks. The levels of recent timber harvest have been variable and almost entirely in response to spruce beetle outbreaks. Timber harvests (mainly commercial thinning operations) were relatively high in 1998 (31,252 acres; 53 percent commercial thinning) and 1999 (20,280 acres; 94 percent commercial thinning). Annual harvest totals between 2000 and 2007 were only 2,657 acres on average and consisted mainly of sanitation cuts (61 percent), salvage cuts (19 percent), and improvement cuts (11 percent) in an attempt to create conditions favorable to tree regeneration and increased diversity in order to reduce the risk of severe outbreaks. The continued strategy of the Dixie National Forest's timber program is to reduce susceptibility to bark beetle attacks (USFS 2006a).

MINERALS ACTIVITY

Past oil and gas activity within the CEA has been relatively low, with the Upper Valley Field being the only producing oil field. The Upper Valley Field is located on a both the Dixie National Forest and on BLM-managed land. It is located southwest of Escalante and consists of 33 wells. It was developed in 1964 and production is projected to continue into the future. In the past few years there has been a renewed interest in oil and gas within the CEA and there are currently 122 authorized leases and 14 pending leases, with a combined total lease area of 101,682 acres (BLM 2008). While these leases occur throughout the CEA, they tend to occur in clusters. Some of the larger clusters are to the south and north of the Cedar City Ranger District, in between the Cedar City and Powell Ranger Districts, and off the southeast corner of the Escalante District (an extension of the Upper Valley Field). Only the Upper Valley Field is currently active. The only other recent activity on these leases has been the drilling of a few (5) wildcat wells on state and private land, all of which have been plugged and abandoned (UDNR 2008a). While the lease acreage is not reflective of potential surface disturbance area, it may be likely that the larger lease areas and the lease clusters may eventually have a greater area of surface disturbance than a smaller, isolated lease. Further, it can be assumed that similar types of impacts as were described for on-Forest leases could occur on these leases as well. Also, there is the possibility of unquantified drilling for coal bed methane on SITLA land within the John's Valley area within the next 15 years. This would likely involve not only drilling but also establishment of a gas delivery system to market the gas if it occurred in paying quantities. Production would most likely be gas rather than oil. One of the five wells that was plugged and abandoned was a coal bed methane well in this area.

In addition to oil and gas activity, there are currently 25 separate minerals activities, more than half of which are on BLM land surrounding the Pine Valley Ranger District. These mineral activities are all very small operations (less than five acres) and primarily target materials such as sandstone, limestone, silica, rhyolite, alabaster, and travertine (UDNR 2008b). There are a few larger mines for iron, gold, and silver; however, all of these are inactive or in some stage of reclamation.

The largest planned mining activity in the near future is a proposed coal mine about three miles

south of the town of Alton, between the Cedar City and Powell Ranger Districts. The project, which is in the planning stage, is being called the Coal Hollow project and is proposed by Alton Coal Development, LLC. This proposed surface coal mining project involves federal (BLM) and private lands, with the bulk of the coal resource on federal lands. Preliminary plans would mine the coal from private lands first (about 570 acres) and then expand onto adjacent federal lands (about 1,430 acres). The estimated total surface disturbance from coal mining in the operation would entail about 2,000 acres including haul roads and surface facilities, over about 20 years of mining. Coal mines are regulated to ensure that excessive erosion does not occur, that stream water quality standards are met, and that the land is ultimately reclaimed; however, there is likelihood of some occasional or short-term sediment loading in the streams within the affected watersheds.

Table 8.5-7 Reasonably Foreseeable Future Actions that may Affect Watershed Resources

Project	Project Description	Approximate Project Location	Potential Impacts to Watershed Resources
Projects on the Dixie National Forest			
Motorized Travel Planning	Would designate identified routes open to motorized use. With designation of a motorized travel system, cross-country travel would generally be prohibited.	All Ranger Districts on the Dixie National Forest	Would limit cross-country travel and lessen impacts to watershed resources
Wild and Scenic River Suitability Study	A draft EIS analyzing the suitability of 80 Utah streams, including 6 on the Dixie National Forest for inclusion in the National Wild and Scenic River System	Pine Valley, Cedar City, and Escalante Ranger Districts.	Would provide additional protection to watershed resources surrounding the 6 eligible streams.
Bumblebee Fuels Treatment			
Pine Valley Campground Bridge Construction	A new vehicle bridge would be constructed across the Upper Santa Clara River. The Bridge will replace an older culvert and will provide for fish passage.	Campground is located 3 miles east of the town of Pine Valley.	Some riparian vegetation may be removed for construction of the new bridge. A large span will likely improve hydrologic function at the site and improve stream channel morphology
Edward Spring Vegetation Treatment			
UNEV Pipeline	Would install a petroleum pipeline from Salt Lake City to Las Vegas. The project would be located in the same ROW as the Kern River pipeline, which was last disturbed for another pipeline in 2003.	Pine Valley Ranger District, surrounding BLM land.	ROW would cross several streams, removing small amounts of riparian vegetation and possible disturbing the streambed.
Midway-Deer Valley Scenery Enhancement and Vegetation Treatment	Would remove dead vegetation and decadent aspen, including the salvage logging of dead spruce. The project would also include the construction of 3.8 miles	In the Midway-Deer Valley area along State Highway 14, sixteen miles east of Cedar City.	Surface disturbance, road construction, and prescribed burning of riparian meadows can alter natural infiltration rates, increase erosion and alter

Project	Project Description	Approximate Project Location	Potential Impacts to Watershed Resources
	of temporary roads and the prescribed burning of riparian meadows.		proper watershed function.
North Fork Buried Fiber optic line	Would bury fiber optic line along existing roads from Duck Creek Village to private lands along the North Fork of the Virgin River.	Cedar City Ranger District	Minimal impacts are expected to occur. Potential impacts could include the removal of some riparian vegetation near stream crossings.
Panguitch Lake Power Line Realignment	Would relocate 1.2 miles of 12.5 kV power line. Work would involve construction of a new overhead power line and removal of the old line.	Area is approximately 17 miles southwest of Panguitch on the Cedar City Ranger District	Potential impacts could occur if new road construction is needed.
Webster Flat Road Reconstruction and Easement	Would involve reconstruction of 4 miles of arterial gravel road, including road relocation, widening, improved drainage, additional surfacing, approximately 0.41 miles of new construction, and approximately 0.71 miles of road obliteration.	Road is located south of Highway 14 on the Cedar City Ranger District	Increased road density could channel surface water runoff and interrupt hydrological function, particularly if roads are constructed near streams or riparian corridors.
King Creek Campground Thinning	Thin trees in King Creek Campground to prevent insect and disease mortality and remove hazard trees.	King Creek Campground, Powell Ranger District	Impacts should be minor due to use of developed roads, but could include localized increases in erosion.
Clayton Salvage	Timber salvage of 248 acres of dead and dying spruce on the Griffin Top Plateau.	Escalante Ranger District, approximately 14.5 miles northwest of Escalante.	Surface disturbance, road construction, and timber can increase erosion, alter flow paths, and increase flow volumes and velocities, which can alter channel morphology.
Pockets Vegetation Management	Would include commercial timber harvest, pre-commercial stand treatment, fencing, and travel management. The Project covers an area of 8,564 acres and would include commercial timber harvest on 4,721 acres of conifers and 2,647 acres of aspen, including 82 acres along the Antimony Creek drainage. Smaller areas would receive additional treatments. In addition, 9 miles of new roads would be required, 7.0 miles of unauthorized roads would be designated NFS	Escalante Ranger District	Timber harvest could increase erosions rates, especially in the areas along the Antimony Creek drainage. Further, removing vegetation along the drainage may reduce shade levels and increase flow volumes and velocities, which can alter channel morphology. The construction or authorization of user-created roads within the drainage can also increase sediment delivery and alter surface water hydrology. Roads outside the drainage

Project	Project Description	Approximate Project Location	Potential Impacts to Watershed Resources
	roads, and 13.4 miles of existing NFS roads would be improved.		may also channel flow, lead to channel developments in upland areas, and reduce natural infiltration, all of which may lower water tables and negatively impacts wetlands and riparian vegetation.
Bug Lake Salvage Project			
Projects on BLM			
New Harmony Fuels Treatment	Reduce pinyon, juniper, and oak fuel loading on several hundred acres using a variety of methods, including chainsaws, mechanical and possibly herbicides.	5 miles northeast of New Harmony, UT (East of the Pine Valley Ranger District)	Surface disturbance and vegetation removal can increase erosion.
South Beaver Fuels Treatment	Reduce primarily pinyon and juniper fuel loading on several hundred acres using lop and scatter and bullhog treatments	5 miles south of SR-20 (north of Cedar City Ranger District)	Surface disturbance and vegetation removal can increase erosion.
Highway 56 Fuels Treatment	Similar project as the project described above on several hundred acres.	3 miles east of New Castle (north of Pine Valley Ranger District)	Surface disturbance and vegetation removal can increase erosion.
North Hills Lop and Scatter	Similar project as the project described above on several hundred acres.	5 miles north of Enterprise (north of Pine Valley Ranger District)	Surface disturbance and vegetation removal can increase erosion.
Enterprise Fuels Treatment	Similar project as the project described above on several hundred acres.	5 miles east of Enterprise (north of Pine Valley Ranger District)	Surface disturbance and vegetation removal can increase erosion.
Fremont Aspen Veg Treatment	Enhance aspen conditions on up to 900 acres by removing invasive junipers and stimulating young aspen growth. Involves hand thinning and prescribed fire. Some sagebrush would be treated with fire.	In the Burnt Peak area north of SR 20 (north of Cedar City Ranger District)	Surface disturbance and vegetation removal can increase erosion.
Kolob Stewardship Veg Treatment	Enhance forest health of Ponderosa Pine forest by selective thinning. Up to 400 acres.	East of Kolob Reservoir (west of the Cedar City Ranger District)	Surface disturbance, road construction, and timber removal can increase erosion, alter flow paths, and increase flow volumes and velocities.
Thunder Ridge Stewardship Veg Treatment	Selective thinning and removal of merchantable timber on up to 1,000 acres.	12 miles up Parowan Canyon (Cedar City Ranger District)	Surface disturbance, road construction, and timber removal can increase erosion, alter flow paths, and increase flow volumes and velocities.

8.5.5.3 Cumulative Effects by Alternative

ALTERNATIVE A

Under Alternative A, no new oil and gas activity would occur and there would be no cumulative effects.

ALTERNATIVE B

The potential for direct cumulative effects to watershed resources would be eliminated under Alternative B by the application of a NL option to a 300-foot buffer around streams, lakes, reservoirs, and springs and a NSO stipulation to a 500-foot buffer around these resources. However, adverse cumulative effects could occur from the construction of roads, exploratory well pads, and particularly a production field in adjacent upland areas if these facilities are constructed in areas with high road densities, areas that have been impacted by past wildfires, or in areas that may be impacted by future timber harvest or vegetation management. These effects would primarily be associated with the increased potential for erosion in these areas. Large fires and timber harvest can reduce the ability of precipitation to infiltrate and increase surface water runoff and erosion (Wondzell and King 2003). Building roads, well pads, and production fields in these areas would exacerbate the problem as these facilities also have the potential to reduce natural infiltration and channel surface water runoff. Further, an increase in road density can also increase the magnitude and frequency of high flow events. The impacts of these processes on watershed resources are described in Section 8.5.4.2. Through the application of the BMPs in Appendix 8B and BLM and USFS (2007), the cumulative impacts would remain in the range of minor to moderate. Impacts would be short term for exploration activities and long term for production facilities. Changes in hydrology could also affect downstream (i.e., off-forest) areas, particularly those that also have high road densities. Areas on the Forest that may be particularly susceptible to these types of cumulative effects are the Cottonwood, Deep, and Deer creek watersheds (Powell Ranger District) that were impacted by the Sanford Fire in 2002; the area to be affected by the Clayton Salvage Project (Escalante Ranger District); the Antimony Creek watershed that will be affected by the Pockets Vegetation Management Project (Escalante Ranger District); the area to be affected by the Midway-Deer Valley Scenery Enhancement and Vegetation Treatment Program (Cedar City Ranger District), and; watersheds with road densities greater than two miles/square mile. The location of these watersheds is described in Section 8.5.5.2. Other management activities such as livestock grazing, dispersed recreation, and water developments are not expected to be of a magnitude sufficient to result in cumulative effects to watershed resources when combined with the effects of oil and gas activity in upland areas.

ALTERNATIVE C

The NSO stipulation applied to a 300-foot buffer around streams, lakes, reservoirs, and springs under this Alternative would limit the likelihood of oil and gas activity directly contributing to cumulative effects, though less so than under Alternative B because of narrower buffer width, and the fact that perpendicular stream crossings would be allowed within 24 percent of these buffers. Further, seismic exploration could occur in all the buffered areas. Seismic exploration is not expected to produce disturbance sufficient to contribute to cumulative effects and Appendix 8B specifies BMPs that should reduce the amount of sediment contributed from stream crossings to negligible levels. However, if the road crossings are constructed in riparian or floodplain areas impacted by fire (particularly the Cottonwood, Deep, and Deer creek watersheds on the Powell Ranger District) or in riparian areas heavily impacted by grazing, the result would be an increase in bank erosion and sediment introduction beyond that expected if the crossing were constructed in areas characterized by abundant riparian vegetation. Further, if the area impacted by road and bridge construction is subjected to future heavy grazing the impacted area may be slow to re-vegetate following reclamation (for an exploratory well) or post-construction stabilization (for a

production field). Increases in sediment delivery and bank erosion can result in adverse impacts to stream channels as described in Section 8.5.4.2. Given the BMPs mentioned, these impacts would be relatively minor and short-term for roads associated with exploratory wells.

For a production field, the impacts may range from minor to moderate and be long term due to the length of time that roads would be present. For example, the longer the roads are present the greater the likelihood of an event such as a severe fire occurring in the area, which would exacerbate erosion problems.

Under Alternative C, there is also the potential for cumulative effects if oil and gas activities occur in adjacent areas impacted by the management activities described. As the amount of disturbance in adjacent areas would be the same as for Alternative B, the types of potential cumulative effects to wetlands, stream channels, floodplains, and riparian areas would be similar as described for Alternative B. However, given the narrower buffer under Alternative C, disturbance in upland areas has the potential to be located closer to wetlands, stream channels, floodplains, and riparian areas than under Alternative B. As a result, the potential for impacts watershed resources is increased.

ALTERNATIVE D WITH NSO IN IRAS

NSO applied to IRAs would prevent disturbance on 41 percent of wetlands, stream channels, floodplains, and riparian areas on the Dixie National Forest. As a result, there would be no cumulative effects resulting from disturbance directly related to oil and gas activity in these areas. Direct disturbance to these resources not within IRAs and would consist of seismic exploration and the potential for spills due to the possibility of having oil gas facilities in increased proximity to these resources. Mechanical disturbance would be prohibited, which eliminates the potential for sediment related impacts in areas that have high road densities (these areas are described in Section 8.5.5.2) or have been degraded by grazing, dispersed recreation, or fire. As a result, the impacts would be negligible to moderate and short-term as described for Alternative C.

As the amount of disturbance that could occur in areas adjacent to watershed resources is the same under this Alternative as for Alternative B and C, the potential indirect cumulative effects would be the same as described for those alternatives.

ALTERNATIVE D WITH CSU IN IRAS

Under this Alternative, 13 percent of the buffered areas created for the protection of wetlands, stream channels, floodplains, and riparian areas would be off limits to oil and gas development (six percent would not be available for leasing and seven percent would be under NSO). The remainder of these areas would be available for leasing under CSU. Overall, potential cumulative effects under this alternative would be similar as described for Alternative D with NSO in IRAs; however, given the lesser amount of water and watershed resource components that would be under NSO, the potential for cumulative effects would be greatly increased.

ALTERNATIVE E WITH NSO IN IRAS

Direct disturbance to watershed resources could occur in areas not within IRAs and would consist of seismic exploration, construction and reconstruction of roads, exploratory well pads and associated facilities, and production wells with their associated facilities. The construction and reconstruction of roads presents the greatest potential for cumulative impacts to water and watershed resources if construction occurs in areas that have high road densities (these areas are described in Section 8.5.5.2) or have been degraded by grazing, dispersed recreation, or fire. Furthermore, areas developed for oil and gas have an increased probability of being subjected to additional future degradation. For example, Dwire and Kaufman (2003) indicate that riparian areas are more susceptible to long-term degradation by wildfire if impacted by past human disturbance.

Overall, these processes would produce cumulative effects to stream channels and floodplains by increasing the potential for erosion and sediment deposition. Cumulative effects to wetlands and riparian areas would be more associated with the additive effect of vegetation removal, which would alter the structural integrity of these areas, and the alteration of flow paths due to roads. The impacts of altered drainage patterns on these areas are described in Section 8.5.4.2. Taken together, impacts may range from minor to major depending upon the location and amount of oil and gas activity. For example, a single exploratory well or a small amount of roads within a degraded area may only have minor cumulative impacts, but a production field or multiple wells with their associated roads would have major impacts. Impacts would be both short term and long term.

ALTERNATIVE E WITH SLT IN IRAS

The cumulative effects under this alternative would be the same as described for Alternative E with NSO in IRAs

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A summary of the cumulative effects from the different alternatives is shown in Table 8.5-8.

Table 8.5-8 Summary of Cumulative Effects

Past Actions	Present Actions	Future Actions	Alternative	Cumulative Effect
Road construction and dispersed recreation in wetland and riparian areas has resulted in reduced function of these resources and increase in sediment in some locations on the Forest and impacts are likely the same in much of the CEA. Livestock grazing and fire have impacted wetland and riparian areas on the Forest. Livestock grazing is prevalent in all of the CEA. These activities have reduced the ability of the soil to naturally absorb precipitation in upland areas. The result is an increase susceptibility to additional disturbance.	The impacts of roads, grazing, development, and dispersed recreation continue to occur in many areas within the CEA.	The impacts of roads and dispersed recreation should remain about the same. Grazing impacts should lessen slightly with improved management. The frequency of large, severe fires is likely to increase in the future. Several projects have the potential to impact watershed resources in the future including several timber harvests.	**Alternative A** No new leases would be authorized and there would no direct or indirect impacts to wetlands, stream channels, floodplains, and riparian areas as a result of oil and gas activity.	There would be no cumulative effects of oil and gas activity due to the lack of direct and indirect effects.
			Alternative B NL and NSO leasing options would prevent direct disturbance to watershed resources.	Cumulative effects could occur as a result of oil and gas activity in upland areas degraded by past and future management activities. Impacts would range from minor to moderate.
			Alternative C NSO stipulations would prevent most direct disturbance to watershed resources. However, perpendicular road crossings could occur on 24% of the designated buffers.	Cumulative effects could occur as a result of road crossings if they occur in areas with high road densities or in areas previously degraded by livestock grazing or fire. Impacts would be mostly minor and both long and short term Cumulative effects could also occur as a result of oil and gas activity in degraded upland areas as described for Alternative B.
			Alternative D with NSO in IRAs NSO would prevent most direct disturbance in 41 percent of the buffered areas. Direct disturbance could occur in the remainder of the buffered areas under CSU.	Cumulative effects would be the same as described for Alternative C.
			Alternative D with CSU in IRAs Direct disturbance could occur in all but 13% of the buffered areas.	Cumulative effects would be the same as described for Alternative D with NSO in IRAs.
			Alternative E with NSO in IRAs NSO would prevent most direct disturbance in 41 percent of the buffered areas. Direct disturbance could occur in the remainder of the buffered areas available for leasing.	Cumulative effects could occur both as result of direct disturbance in wetlands, stream channels, floodplains, and riparian areas, but also from disturbance in adjacent areas. The impacts would range from minor to major. Cumulative effects could also occur as a result of oil and gas activity in degraded upland areas as described for Alternative B.

			Alternative E with SLT in IRAs Direct disturbance could occur in all buffered areas available for leasing.	Cumulative effects would be the same as described for Alternative E with NSO in IRAs.

8.5.6 Summary

Impacts to watershed resources may occur from direct disturbance under those Alternatives where direct disturbance is allowed within these areas. Also, impacts may occur under all alternatives as a result of oil and gas activity in adjacent upland areas. Under all alternatives, roads present the greatest potential for impacts; however, many of these impacts may be reduced if all BMPs are successfully implemented.

8.6 Compliance with Other Laws and Regulations

Other laws and regulations that apply to wetlands, floodplains, and riparian areas are Executive Orders 11990 and 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.

Oil and gas leasing activities would have the potential to impact wetlands, floodplains, and riparian areas under Alternatives D and E if BMPs are not followed or operations are not moved by the 200 meters (656 feet) allowed under SLT. All other Alternatives would be in compliance with these laws.

8.7 Forest Plan Consistency Determination

All alternatives would be within the Land and Resource Management Plant direction to maintain at least 80-percent of potential ground cover within 100 feet from the edges of all perennial streams, lakes and other waterbodies, or to the outer margin of the riparian ecosystem where wider than 100 feet. Alternative E could potentially violate the management direction for roads to not parallel streams.

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Appendix 8A – Stipulation Forms

NO SURFACE OCCUPANCY STIPULATION
Streams, Lakes, Springs, Wetlands, and Riparian Areas – 500-foot Buffer
Alternative B

No surface occupancy or use is allowed on the lands described below (legal subdivision or other description).

A 500-foot buffer zone from the high water point of any perennial streams, lakes, springs, wetlands, and riparian areas. 100-year floodplains are not included in this stipulation. This prohibition includes all surface disturbing activities such as roads, well pads, and other facilities. Some but not all of these features are mapped, so the actual areas of no surface occupancy would be determined based on actual ground conditions.

For the purpose of:
Minimizing the contributions of sediments to watercourses, and minimizing the potential for spills or leaks to contribute pollutants to streams or other water features.
This stipulation provides restrictions greater than in 36 CFR 228.108(j) under Standard Lease Terms due to the specific prohibition of surface occupancy within the buffer zone.

A request for a waiver, exception, or modification (WEM) to the above lease stipulation may be requested along with the submission of a Surface Use Plan of Operations (36 CFR 228.104). Any changes to this stipulation will be made in accordance with the land use plan and/or the regulatory provisions for such changes. (For guidance on the use of this stipulation, see BLM Manual 1624 and 3101 or FS Manual 1950 and 2820).
R4-FS-2820-14 (8/92)

NO SURFACE OCCUPANCY STIPULATION
Streams, Lakes, Springs, Wetlands, and Riparian Areas – 300-foot Buffer
Alternative C

No surface occupancy or use is allowed on the lands described below (legal subdivision or other description).
All areas within 300-foot buffer of the high water point of all perennial streams, lakes, springs, wetlands, and riparian areas. 100-year floodplains are not included in this stipulation.
This stipulation applies to all surface disturbing activities, such as roads, pads, powerlines, and pipelines, but allows for perpendicular or near-perpendicular crossings such a needed for linear features like roads, pipelines, and powerlines as long as they are designed to minimize effects.

For the purpose of:
Reducing the contributions of sediments to watercourses, and minimizing the potential for spills or leaks to contribute pollutants to streams or other water features.
This stipulation provides restrictions greater than in 36 CFR 228.108(j) under Standard Lease Terms due to the specific prohibition of surface occupancy within the buffer zone.

A request for a waiver, exception, or modification (WEM) to the above lease stipulation may be requested along with the submission of a Surface Use Plan of Operations (36 CFR 228.104). Any changes to this stipulation will be made in accordance with the land use plan and/or the regulatory provisions for such changes. (For guidance on the use of this stipulation, see BLM Manual 1624 and 3101 or FS Manual 1950 and 2820).
R4-FS-2820-14 (8/92)

CONTROLLED SURFACE USE STIPULATION

Streams, Lakes, Springs, Wetlands, and Riparian Areas – 300-foot Buffer
Alternative D

Surface occupancy or use is subject to the following special operating constraints.

Special measures may be required within 300 feet of the high waterline of perennial streams, lakes, springs, wetlands, and riparian areas to minimize soil disturbance.

Platforms or other stabilizing structures may need to be installed to avoid blading and minimize soil disturbance for the establishment of well pads, roads, and other facilities. In general, the manner in which development activities would be permitted would be more restricted than Standard Lease Terms permit. This stipulation is not intended to prohibit perpendicular or near perpendicular stream crossings for linear facilities such as roads, power lines, and pipelines which are adequately designed to minimize effects.

On the lands described below:

Within 300 feet of the high waterline of perennial streams, lakes, springs, wetlands, and riparian areas that occur across the Dixie National Forest as shown in Figures 8.4-1, 8.4-2, 8.4-3, and 8.4-4, and as found on the ground during evaluations of proposed activities.

For the purpose of:

This stipulation provides greater protections than under Standard Lease Terms. This stipulation would minimize soil disturbance within the buffer zone.

Any changes to this stipulation will be made in accordance with the land use plan and/or the regulatory provisions for such changes. (For guidance on the use of this stipulation, see BLM Manual 1624 and 3101 or FS Manual 1950 and 2820).

Appendix 8B - Dixie National Forest Oil and Gas Construction and Operating Standards and Well Site Design Requirements

Dixie National Forest Oil and Gas Construction and Operating Standards and Well Site Design Requirements

I. INTRODUCTION

The following operating standards and well site design requirements would be required by the Dixie National Forest for oil and gas facilities and operations to assure consistency with management objectives for the Forest. These operating standards should not be confused with stipulations contained in the applicable Federal oil and gas lease(s) which specify requirements regarding surface occupancy and timing within the specific areas in the lease. Operating standards must be consistent with the rights and restrictions established in the applicable lease(s) and are applicable to all drilling and production operations, unless otherwise approved by the responsible officer based on site-specific conditions.

These operating standards supplement the general requirements of the Surface Operating Standards and Guidelines for Oil and Gas Exploration and Development (Gold Book) and Best Management Practices in place by the responsible agencies at the time of approval, and the Forest Service, Region 4 Oil and Gas Roading Guidelines. Copies will be made available to operators at first notification of proposed operations.

Authority to require such standards is provided by the Mineral Leasing Act of 1920, as amended, Federal Regulations at 36 CFR 228.106-108 (Submission, Review, and Requirements of Surface Use Plans of Operations) and 43 CFR 3162.3 (BLM procedures for approval of post-lease applications for operations).

II. PURPOSE

These operating standards have been developed to help operators meet agency and Forest requirement when planning operations and preparing their Surface Use Plan of Operations and to assure overall consistency with Forest Service management objectives/direction. They have been developed based on experience with oil and gas operations on National Forest System lands as needed to prevent or mitigate effects and conflicts with other uses.

III. PROCESS

Approvals of proposed operations on lease are subject to the application, review, and approval provisions specified in Onshore Oil and Gas Order No. 1, other Onshore Oil and Gas Orders, and all applicable laws and regulations. Surface disturbing proposals must be evaluated under the requirements of the National Environmental Policy Act of 1969 and the Energy Policy Act of 2005. Operators are encouraged to obtain these operating standards from the Forest Service early in the planning and approval process and to incorporate them into their Surface Use Plans of Operations to help streamline the NEPA analysis and approval process. If not incorporated into the initial SUPO, the Forest Service will work with the operator to revise the SUPO to include them or may otherwise require them as Conditions of Approval (COA).

Other standards or mitigations may be required based on site-specific evaluations of proposed activities. They may be modified if needed to address site-specific conditions. Operators are required to comply with all other applicable laws and regulations.

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IV. OPERATING STANDARDS

These standards apply to the lease holder, contractors, and their sub-contractors. The term "operator" as used herein, includes the lease holder and/or company authorized to conduct operations on the lease or their contractors, subcontractors, and all employees or agents thereof.

1. The operator shall submit for review and approval, a detailed construction and maintenance plan for all exploration and production facilities and roads to be constructed or improved (reconstructed) for operations. Unless otherwise approved by the responsible Forest Service officer, pad designs must be consistent with requirements contained in the Dixie National Forest Well Site Requirements (Attachment 1). A road-use permit (or specific approval as part of the Surface Use Plan of Operations) must be obtained from the Forest Service for commercial use, improvement, and maintenance of National Forest System roads under authority of the National Forest Roads and Trails Act. Road designs must be generally consistent with the Forest Service guidelines provided in the Oil and Gas Roading Guidelines, R-4.

2. The designs for roads, pads, and other facilities are subject to approval by the Forest Service. The designs must be approved and signed by a qualified licensed engineer. Any modifications to approved plans are subject to Forest Service review and approval.

3. Existing roads will be used to the extent possible as long as the existing alignment can be used or improved to the required standard. Additional roads or rerouting of existing road segments, if needed, shall be minimized and approved by the Forest Service prior to construction. Roads or road segments replaced and/or abandoned by construction of new roads or rerouting must be reclaimed by the operator. Road locations and designs must be generally consistent with the Forest Service guidelines provided in the Oil and Gas Roading Guidelines, R-4.

4. Locate and design roads and drainage structures to prevent slope failure and minimize impacts on water quality. To the maximum extent feasible, locate facilities, including service and refueling areas, on benches upslope from streams, lakes, ponds, riparian areas, and floodplains.

5. A pre-construction meeting including the responsible company representative(s), contractors, and the Forest Service must be conducted at the project work site prior to commencement of operations. Earthwork must be construction staked prior to this meeting. Approval of the designs and earthwork staking by responsible Forest Service official is required prior to beginning earthwork.

6. A Spill Prevention Control and Countermeasures (SPCC) Plan consistent with the current EPA Region VIII Oil and Hazardous Substances Regional Contingency Plan must be filed with the Forest Service and approved by the authorized officer prior to conducting any construction and operations on National Forest System lands. The plan must address the potential for spills to occur from haulage of materials and supplies to the construction/operations site(s) as well as drilling and production facilities. Material Safety Data Sheets (MSDS) for all potentially hazardous

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substances used for operations used for operations must be available on-site. Operators must be trained in MSDS protocols.

7. All surface disturbing activities, including reclamation, must be supervised by a qualified on-site responsible designated company representative(s) familiar with the approved plans as well as terms and conditions of approval. The designated representative(s) must be available for contact within the vicinity of the project area or by telephone at all times that operations are in progress. The name and contact telephone number of the designated company representative(s) must be filed with the responsible Forest Service official. A copy of all approved permits with specifications relative to operations in the project area must be available for inspection at the project site.

8. Topsoil must be salvaged from the area to be disturbed, stored, and protected from erosion and contamination until redistributed over recontoured areas for reclamation. The depth of topsoil to be salvaged must be determined though testing and approved by the Forest Service. Methods of topsoil handling and storage must be approved in project plans and specifications and/or appropriate project permits.

9. All vegetation removed by operations must be stored, used for reclamation, or disposed of as approved in project permits or as specified by the Forest Service. The operator must reimburse the Forest Service for the fair market value of all merchantable timber removed or damaged during operations. Prior to vegetation disturbance/removal all noxious weeds must be removed from the site and handled by approved methods needed to prevent spread of seeds.

10. Where determined appropriate by the responsible Forest Service officer, the operator may be required to bury pipelines and powerlines in or adjacent to roads to reduce surface disturbance and visibility. Designs must provide sufficient depth of cover and signs to indicate the type of pipeline(s), location, and depth to prevent damage from road maintenance and other surface disturbing activities in conformance with applicable Federal and State regulations.

11. Where feasible and appropriate, the operator will 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.

12. Where needed to protect wildlife, the operator will be required to construct fences and/or nets on reserve pits or use other approved methods to prevent wildlife use or entrapment.

13. Stream crossings will be planned and constructed to minimize disturbance of the riparian and aquatic habitats by locating crossings at the most advantageous location and by crossing at or near the perpendicular. Structures must be designed to allow fish passage as needed to maintain habitat. Measures must be taken to minimize disruption of stream substrate. When no longer needed for operations, crossings must be removed and the stream and banks restored to pre-disturbance conditions/stream hydraulics. Sediment control measures must be used to minimize sediment introduction during all operations. Timing restrictions (construction and reclamation) may be needed to protect fisheries as coordinated with the Utah Division

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of Wildlife Resources and through permitting with the Utah Division of Water Rights, Stream Alteration Program.

14. Unless otherwise specified by the responsible Forest Service officer, new oil and gas access roads shall be closed to the public. Operators must construct and maintain gates to Forest Service design standards at intersections of project access roads with National Forest System roads or other highways to prevent unauthorized traffic from entering. A locking system will be required to allow a Forest Service lock in addition to the operator's lock.

15. Off-road vehicle travel is prohibited unless specifically approved in project permits.

16. Roads used for drilling and production operations which remain open to public traffic must be properly signed to warn the public of project traffic and associated hazards. Signs must be consistent with the Manual on Uniform Traffic Control Devises, Federal Highway Administration.

17. Vehicle operators must obey posted speed restrictions. If speed restrictions are not posted, the operator and contractors must observe safe speeds commensurate with weather and road conditions.

18. Watering and/or application of appropriate dust suppressants shall be used if dust becomes a concern for visibility and sediment transport. Suppressants and application procedures are subject to approval by the responsible Forest Service officer.

19. Unless otherwise approved by the responsible Forest Service officer, all production pads will be fenced to prevent entry by the public and livestock. Designs and specifications are subject to Forest Service approval.

20. Sediment control structures will be used to catch sediment at the base of fill slopes on exploration and production pads. If silt fences are used, they must be constructed with adequate support and maintained to assure that they function at all times, including the winter season and spring runoff.

21. Establishment of staging areas or camp areas outside of the area permitted for surface disturbing operations for project personnel (operator or contractors) on National Forest System lands is subject to Forest Service approval.

22. All permanent survey markers within the area to be disturbed, including section corners, benchmarks, geodetic survey monuments, etc. must be located and flagged for protection prior to any surface disturbance activities. Disturbance or relocation of monuments requires the approval of the agency responsible for their use and preservation.

23. Water needed for operations must be obtained in accordance with State water law. The location and design of diversions on National Forest System lands are subject to review and approval of the responsible Forest Service official.

24. The operator and all contractors shall take measures needed for the prevention of fires started as a result of their operations and to suppress fires that are started as a

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result of their operations. Fire suppression equipment must be available to all personnel in the project area consisting of shovels, axes, and other appropriate hand tools. At least one properly rated fire extinguisher must be available in each vehicle and around all machinery such that they are readily assessable for suppression of fires. During times of severe fire danger when fire restrictions are implemented by order of the responsible Forest Service officer, all operations must be conducted in conformance with the order. The operator may be required to submit and implement a Fire Prevention/Suppression Plan for review/approval by the responsible Forest Service official.

25. All vehicles and other gasoline/diesel-powered equipment must be equipped with properly functioning spark arresters and mufflers. Spark arresters must meet Forest Service specifications in accordance with USDA Forest Service Spark Arrester Guide.

26. The operator will be held responsible for damage and suppression costs for fires started as a result of operations. Fires must be immediately suppressed to prevent spreading and must be reported to the responsible Forest Service officer.

27. The operator must maintain structures, facilities, improvements, and equipment in a safe and neat manner and in accordance with approved permits. The operator must take appropriate measures in accordance with applicable Federal and State laws and regulations to protect the public from hazardous or conditions resulting from the operations. Such measures must include, but are not limited to, posting signs, building fences, or otherwise identifying the potentially hazardous site or condition.

28. All accidents or mishaps resulting in resource/property damage and/or serious personal injury must be reported to the responsible Forest Service officer as soon as possible.

29. The operator may be required to locate pads and facilities in areas where they can be effectively screened from view from sensitive areas. Production facilities must be located and designed to minimize visibility from sensitive viewing areas. Painting of facilities with a non-reflective paint in the color that would best blend with the background will be required. The color will be determined by the operator with approval of the responsible Forest Service officer.

30. The operator must comply with all applicable laws and regulations pertaining to the storage, use, and disposal of hazardous substances and solid or liquid waste. All fluids, chemicals, and solid wastes must be properly contained on-site. Reserve pits, catchment ponds, and bermed areas must be constructed to prevent seepage into the ground or adjacent areas. A minimum of 2-feet of freeboard must be maintained in all reserve pits and ponds at all times to prevent overflow and spillage into adjacent areas.

31. Chemical containers should not be stored on bare ground or exposed to the sun or moisture. Containers and labels are subject to degradation and punctured drums could leak contents onto the ground. Chemical containers should be maintained in good condition and placed within secondary containment in case of a spill or puncture. Secondary containment facilities must be of sufficient size to contain all appropriate fluids, including diesel or other fuels.

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32. Sanitary facilities must be available to operators and contractors in the project area and properly used and maintained to prevent pollution. The installation of sanitary facilities, other than self-contained chemical toilets is subject to State and Forest Service approval.

33. Unless other methods are specifically approved, all solid wastes, contaminated soil materials, drill cuttings, petroleum products, and other fluids must be properly contained on-site. Disposal of associated waste materials must be at a facility licensed by the State to accept such materials.

34. Harassment of wildlife is prohibited. Pets must be properly restrained to prevent harassment of wildlife, livestock, government officials, and the public.

35. Move-in and move-out of heavy construction and drilling equipment will not be allowed during the opening weekends of the general big-game hunts or holiday weekends (including the observed holiday) from noon the previous day until midnight on Sunday or the observed holiday. Use and maintenance of National Forest System roads is regulated under authority of the National Forest Roads and Trails Act and the National Forest Management Act.

36. Vegetation seeding methods and seed mixes (species and amounts) used for interim and final reclamation must be approved by the Forest Service. Reclamation and revegetation plans and standards for success must be approved in project plans or permits. All vegetation materials, seeds, soil amendments, and sediment control materials must be certified that no noxious weed seed or noxious weeds are present. The operator is responsible for control and eradication of noxious weeds in project area, and the control and eradication of any invasive plant species not present at the site prior to operations, until such time as reclamation standards are met and the company is relieved of further reclamation responsibilities.

37. Vehicles and equipment shall be free of mud, soil, plant materials, and other debris which could contain noxious weed seeds prior to coming onto the Forest. This is needed to avoid transporting noxious weeds, or invasive species to sites on the Forest.

38. The operator shall follow Forest guidelines designed to prevent the introduction and spread of aquatic nuisance species (Dixie and Dixie National Forest Supplement, Forest Handbook 2509.16, chapter 1.

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Dixie National Forest Well Site Requirements

V. WELL SITE DESIGN REQUIREMENTS

A. General Requirements

The operator should propose locating the well site in cooperation with Forest Service personnel on the most nearly level location obtainable that would accommodate the intended use. However, potential well site locations should not be evaluated on the basis of site conditions alone. Access to the well site for road and possible future pipeline locations must also be considered in determining the most suitable location. What may be gained on a good location could be lost from an adverse access route. Plan the well site from the long-term standpoint, assuming a discovery could be made. Future pipeline locations are to be proposed by the operator as a part of his proposal on each well site.

Adjust the well site layout to conform to the best topographic situation. Avoid disturbance of drainages and locate reserve pits away from water courses. Deep vertical cuts and long fill slopes should be avoided. The cut and fill volumes should be balanced, excluding the topsoil and subsoil needed to backfill the reserve pit.

A contour map shall be developed for all well pad locations as an aid in the design of pad settings to the existing topography. This will allow the operator to plan the construction of facilities and the surface manager to evaluate impacts and calculate the bond more expeditiously and accurately. Maps should be prepared to a scale of 1 inch equals 20 feet horizontally and a contour interval of 2 feet vertically, or as otherwise directed by the responsible Forest Service officer.

Once this information is compiled, finished site elevations, cut and fill slopes and their respective catch points, drainage, balanced earth work, adequate storage area locations and other necessary construction features shall be determined and included with the drawings/specifications. Submittals shall include a well site plan (see Drawing No. 1), details of berms, diversion ditches, pits, catchments and other appurtenances and design features. Provide data to support drainage structure design.

B. Clearing

The site must first be cleared of all brush and trees. All merchantable timber must be purchased by the operator prior to cutting, at the appraised price determined by the Forest Service. Grasses and small shrubs need not be removed; however appropriate measure will be required to prevent the spread of noxious weeds and nuisance species prior to starting excavations if they occur on the site. Trees and brush will be disposed of by removal from the Forest, by burning, chipping, or other approved methods needed to prevent the spread of insects. Tree trunks less than 8 inches in diameter and slash can be stockpiled at an approved location to be spread over reclaimed areas. Burning permits will be required and are issued by the Forest Service. Burning would only be permitted if the fire danger is low to moderate.

C. Topsoil Removal and Storage

Surface soil material (topsoil), if present, will be stripped from all areas where surface

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disturbance is necessary and stockpiled. All topsoil will be removed in a separate layer, avoiding mixing with other excavated materials, and stored in a stockpile to prevent loss from erosion or contamination, and from which topsoil may be easily recovered. The depth of surface soil material to be removed and stockpiled will be specified by the Forest Service but will generally include the A Horizon. The topsoil and subsoil stock piles must be located to prevent contamination from the blooie line, flare line, and other operations. Stockpiles shall be contained by silt fencing, ditches and traps or other containment measures to prevent erosion, contamination and loss. If topsoil stockpiles are to remain for more than a single season, seeding with an approved seed mix will be required to minimize loss from erosion and preserve fertility and biological activity.

D. Site Grading

Cut and fill slopes will be such that stability can be maintained for the life of operations. Cut and fill slopes will be constructed as follows (exceptions can be made depending on the type and competency of material encountered):

Height of Slope	Slope
0 – 5 feet	3:1
6 – 10 feet	2:1
over 10 feet	1.5:1

All fills will be free of vegetation and will be compacted in lifts no greater than 12 inches in thickness to a minimum of 90 percent Proctor dry density sufficient to prevent excessive settlement.

The drill site or pad surface will be surfaced with crushed gravel to a depth sufficient to support anticipated loads throughout the life of the well. Usually a depth of 12 inches of gravel is required.

E. Site Drainage

Diversion ditches having the minimum dimensions of 3 feet horizontal to 1 foot vertical (3:1 ditch) will be constructed around the site to divert existing drainages and surface runoff from flowing onto the site. Hydraulic design for ditches is required to determine capacity. The ditch(s) will be located at the top or base of the cut slope (to be determined based on site-specific conditions) and around the toe of the fill slopes (see Drawing No. 1 – Construction Requirements for Typical Well Sites). Straw dykes, catch basins, energy dissipaters or other approved structures will be constructed in the ditch outflow to trap any sediment and dissipate erosive flows. Provide data to support drainage structure designs. A culvert might be necessary where the access road enters the site.

A berm will be constructed around the perimeter of the site to contain all precipitation, spills, and other fluids from leaving the site. The berm will be a minimum of 18 inches high, 12 inches wide at the top, and have 1.5:1 side slopes. Berms will be compacted for stability and to reduce permeability as needed to contain fluids. The site surface will be graded at a minimum of 1 percent to drain to the reserve pit. Use silt fencing, ditches and traps or other containment at toe of fill slopes to prevent erosion and contamination.

The drainage pattern to be constructed will need to be designed for each site, depending on

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site-specific conditions.

F. Construction and Maintenance of Reserve Pits

Reserve pits will be constructed of sufficient size and capacity for the necessary fluids for drilling and to contain any runoff from the drill site. The pad will be graded to empty into the reserve pit or alternative pit or buried tank. Winter operations may require larger pits/tanks due to snow accumulations and runoff. Pits will not be constructed within intermittent or perennial drainage channels. If the operator has concerns that drainage from the pad could contaminate reserve pit muds, the pad can be constructed to drain into alternative lined pits or buried containment tanks.

It is preferred that pits be constructed in undisturbed materials and below the natural ground level to minimize the risk of failure. Where conditions exist that require pits to be constructed of embankment materials, the following criteria are required:

1. The area on which the embankment is to be placed will be cleared of all materials including vegetation, topsoil, and unconsolidated soils and gravels.

2. A foundation keyway will be designed and constructed into native materials to dimensions based on site-specific conditions to provide adequate anchoring and sealing of the embankment.

3. The embankment will be constructed using impermeable materials on slopes of 3:1 into the pit and 2:1 outside the pit. The embankment will have a minimum of 10-foot top width. The materials will be compacted to 95 percent Proctor density.

The following are requirements for construction and maintenance of all reserve pits:

4. Pits must be constructed to contain fluids without leaks throughout the life of operations. If pit liners other than clay coatings are used they must be constructed of sufficiently durable and watertight materials to prevent leakage. Compacted bedding material consisting of sand, clay, or other grout may be required to prevent rocks from puncturing the liner and to seal cracks.

5. A minimum of 2-foot freeboard will be maintained in the pit at all times during the drilling operations or if the pit is left unreclaimed over the winter.

6. If wildlife concerns exist, netting or some other approved method will be used to prevent wildlife use of the pit.

G. Site Reclamation for Nonproductive Wells

Reclamation of the entire site will be required and will commence immediately after drilling, testing, and well plugging/abandonment are complete. The site will be restored to as nearly as practical to its original condition (approximate original contour). Cut and fill slopes will be reduced and graded to conform to the adjacent terrain.

Reserve pits must be allowed to dry before they are backfilled. Fluids that will not dry must be removed from the Forest. All polluting substances or contaminated materials, such as

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oil, oil-saturated soils and gravels will be removed and disposed of at a State licensed facility licensed to receive these materials. Exceptions to allow for reserve pit solidification may be made if the operator can demonstrate to the responsible Forest Service officer that this method would be effective based on site-specific conditions.

Drainages will be reestablished and temporary measures will be required to prevent erosion on the site until all reclamation and revegetation standards established for the site are met.

In general, the well identification standpipe will be set such that it can be buried by at least two feet of soil. A final determination will be made on a case-by-case basis.

After final grading and before replacement of topsoil, the entire surface of the site shall be scarified to eliminate slippage surfaces and promote root penetration. Topsoil will be spread over the site to achieve approximate uniform stable thickness consistent with the established contours.

The site will be seeded and/or planted with a seed mix as approved in the SUPO or as otherwise approved by the responsible Forest Service officer. Nutrients and soil amendments will be applied to the disturbed surface soil needed to meet the revegetation standards.

A temporary fence will be constructed around the site until reclamation standards have been met. The fence design is subject to Forest Service approval will be designed to prevent entry by livestock or wildlife as needed for the specific area. The fence must be maintained such that it is functional at all times as intended to prevent livestock use and unauthorized access by the public. The operator is responsible for damages to the reclaimed condition of the site due to unauthorized access until final reclamation standards are met and the fence is removed. The operator will be responsible for eradicating noxious weeds and nuisance species each season until the final revegetation standards have been met. Once all reclamation standards have been met, the operator is responsible for removal of the fence, gate, and associated structures and materials.

H. Site Reclamation for Producing Wells

Interim and final reclamation for producing wells will be accomplished for portions of the site not required for the continued operation of the associated facilities. All disturbed surfaces will be treated to prevent erosion and to compliment the esthetics of the area. A new site plan will be required encompassing the facilities required for operation and interim reclamation measures. Generally, the following measures will be required:

1. The reserve pit will be reclaimed as previously discussed.
2. All polluting substances and contaminated materials, including contaminated soil and gravels will be disposed of as previously discussed.
3. All cut and fill slopes and other disturbed areas not needed for production operations will be contoured to match the surrounding area, topsoiled, and revegetated as previously discussed.
4. The berm will be reestablished on the production pad where removed to accomplish the reclamation discussed in the previous item.

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5. The pad perimeter and reclaimed area will be fenced. Once reclamation standards have been met for the reclaimed portion of the original pad the fence will be relocated onto the perimeter of the production pad.
6. Measures such as painting facilities an appropriate color, and other practical measures will be used to decrease visibility of the site as viewed from sensitive areas such as roads, highways, and recreation areas. Noise suppression devices and submersible pumps (if feasible) may be required as needed to meet scenic, wildlife, and recreation objectives for the area.

I. Site Maintenance

The site will require periodic maintenance to ensure that drainages remain functional and that surfaces are properly treated to reduce erosion, contamination, fugitive dust, invasion by undesirable plant species, and impacts to the adjacent areas.

All garbage, debris, and foreign materials shall be contained on site in a cage or other enclosure then will be removed to an established/licensed landfill or other recognized facility.

J. Site Reclamation for Production Wells

When production pads and production facilities are no longer needed, the facilities must be removed and final reclamation measures completed as previously prescribed for nonproductive wells. Abandoned or unneeded facilities will be removed/reclaimed within two years. In place abandonment of any facilities such as powerlines, pipelines, etc. will require approval of the Forest Service. If approved, appropriate measures to stabilize and decontaminate them will be required.

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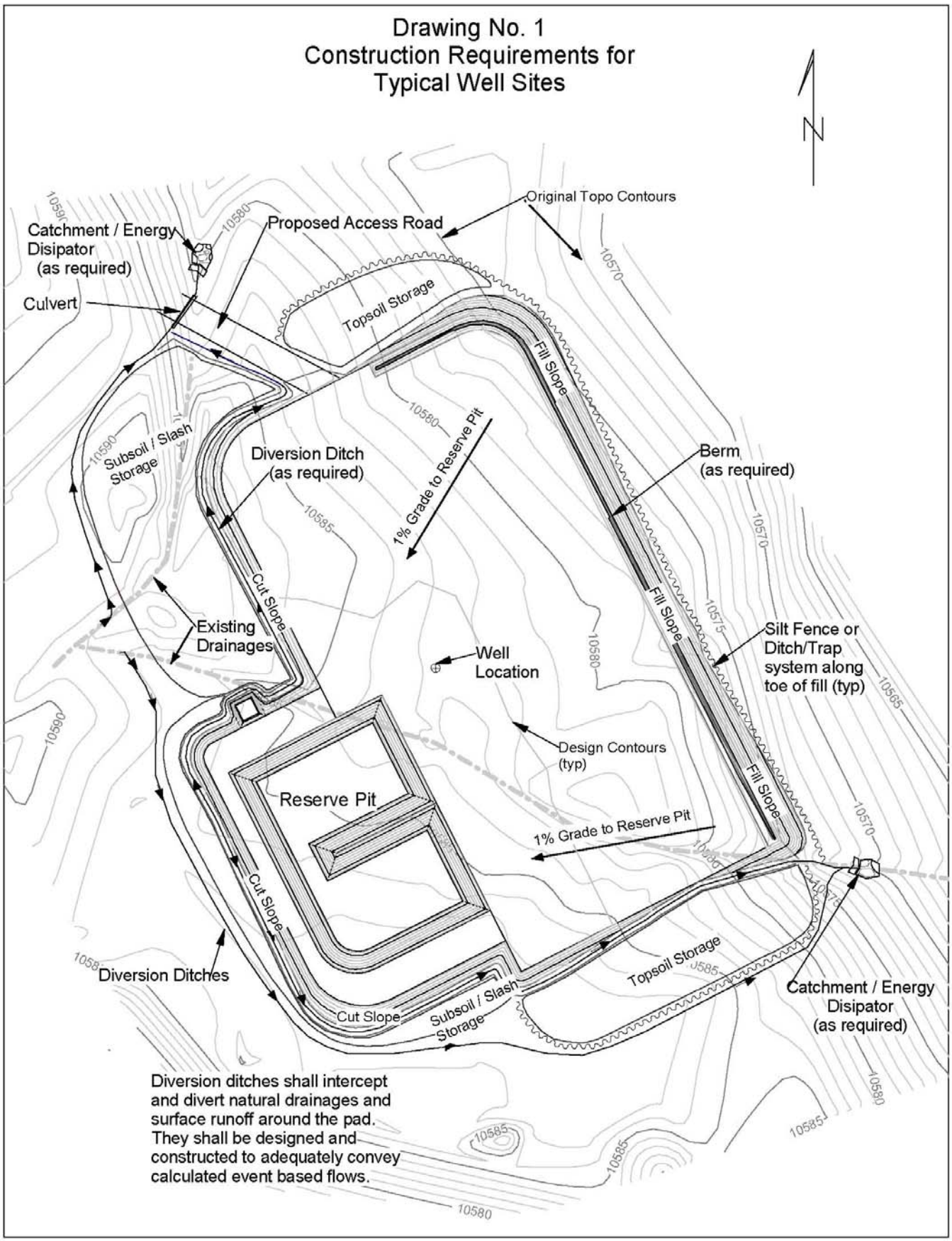
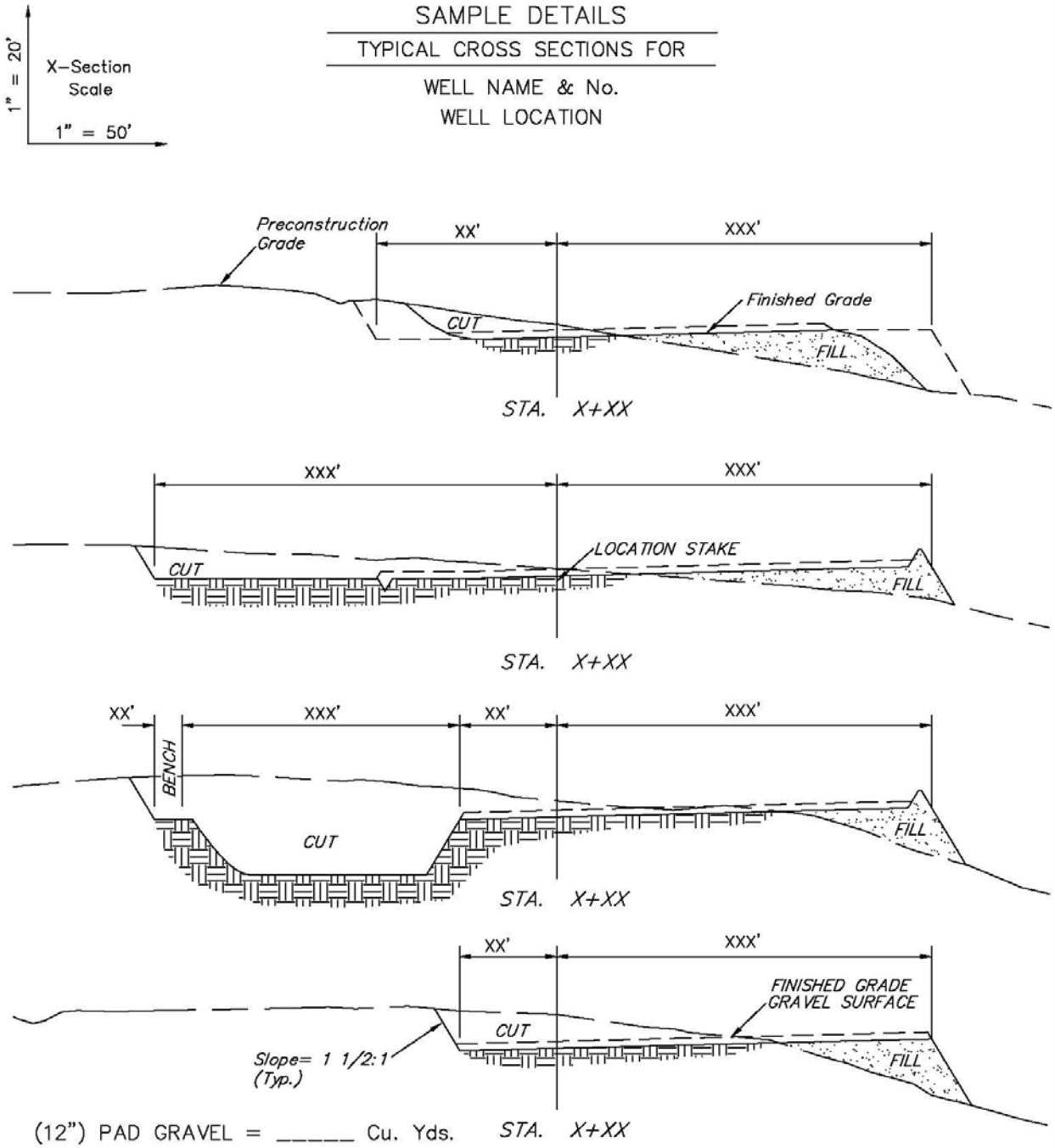

Drawing No. 1
Construction Requirements for
Typical Well Sites
N
Original Topo Contours
Proposed Access Road
Catchment / Energy
Disipator
(as required)
Culvert
Topsoil Storage
Fill Slope
Subsoil / Slash
Storage
Diversion Ditch
(as required)
1% Grade to Reserve Pit
Berm
(as required)
Cut Slope
Existing
Drainages
Well
Location
Silt Fence or
Ditch/Trap
system along
toe of fill (typ)
Design Contours
(typ)
Reserve Pit
1% Grade to Reserve Pit
Diversion Ditches
Catchment / Energy
Disipator
(as required)
Diversion ditches shall intercept
and divert natural drainages and
surface runoff around the pad.
They shall be designed and
constructed to adequately convey
calculated event based flows.
10590
10580
10570
10585
10575
10565

SAMPLE DETAILS

TYPICAL CROSS SECTIONS FOR

WELL NAME & No.
WELL LOCATION



(12") PAD GRAVEL = _____ Cu. Yds.

NOTE:
FILL QUANTITY INCLUDES
__% FOR COMPACTION

APPROXIMATE YARDAGES

CUT

Topsoil Stripping (based on xx") = _____ Cu. Yds.

Remaining (excavation) = _____ Cu. Yds.

TOTAL CUT = _____ CU.YDS.

FILL = _____ CU.YDS.

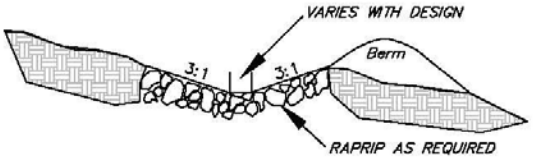
TOPSOIL STORAGE REQUIRED = _____ Cu. Yds.

SUBSOIL STORAGE REQUIRED = _____ Cu. Yds.

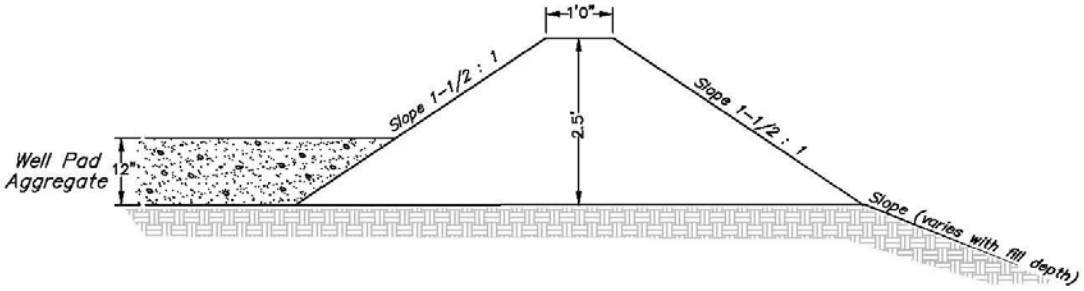
SAMPLE DETAILS

DETAIL SHEET

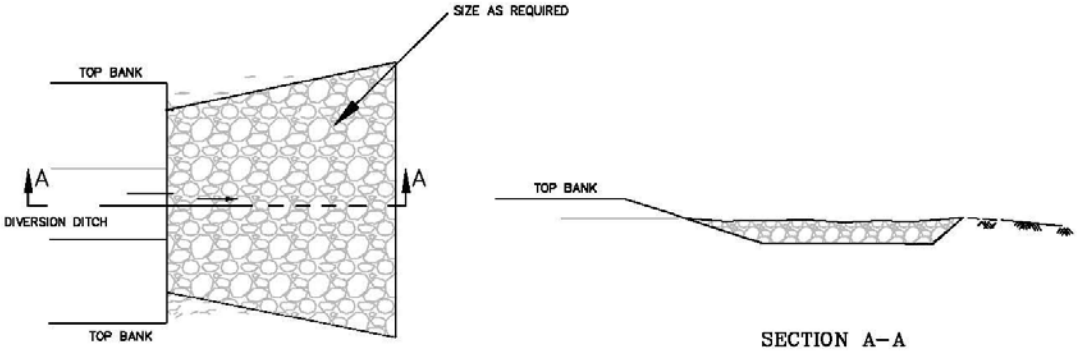
WELL NAME & No.
WELL LOCATION



DIVERSION DITCH (DETAIL)
(Only Where Specified)



BERM (EDGE OF LOCATION)
(NO SCALE)



PLAN VIEW

SECTION A–A

ENERGY DISSIPATER (DETAIL)