4.13 SOIL AND WATER RESOURCES

All of the alternatives would impact soil and water resources within the VPA, as all of them contain plans for surface disturbance of some kind. Activities involving surface disturbance would disturb soils and water resources to varying degrees, due to the amount, placement, and type of surface disturbance; the disturbed soil's characteristics; and the surface hydrology.

The BLM manages 1,725,522 acres within the VPA. Many of the soils are derived from shale formations and are, therefore, highly erodible. Many of the soils also have limitations on rehabilitation after disturbance, which is one of the primary factors in evaluating the effects of other resource management decisions on soil and water resources. Table 4.13.1 displays acreage of soils with chemical or physical limitations and their percentage of the VPA. Some soil limitation areas overlap; therefore, the numbers listed in this table add up to a higher number than the total number of acres in the VPA.

TABLE 4.13.1. VERNAL SOILS WITH LIMITATIONS BY RFD AREA

Limitation	Altamont-Bluebell	East Tavaputs Plateau	Manila-Clay Basin	Monument Butte-Red Wash	Tabiona-Ashley Valley	West Tavaputs Plateau	TOTAL	% of VPA
Water Erodible	513	27,947	4,144	45,612	66,959	17,640	**162,815**	**9%**
Wind Erodible	15,997	410,494	34,760	560,157	267,055	73,191	**1,361,654**	**79%**
Sodic (sodium rich)	35	11,719	133	130,047	6,318	13,093	**161,345**	**9%**
Saline (high salt content)	6,679	40,006	1,816	219,781	83,096	14,473	**365,851**	**21%**
Gypsic (gypsum rich)	0	41,877	0	89,358	1,471	0	**132,706**	**8%**

For the purposes of this programmatic-level analysis, the acreages disclosed in Table 4.13.1 are assumed to be evenly distributed across the smallest nominal geographic area represented in each table. The analyses are done for all of the VPA, but table 4.13.1 lists limiting soils by RFD area so specific analysis can be done for future projects. The limitations of this type of broad scale analysis are best seen in cases when surface disturbance is concentrated in areas that are either highly erodible or highly non-erodible. Fortunately, limitations in analysis have been anticipated and will be compensated for by the surface stipulations found in Appendix M and site-specific analyses of water quality and soil stability. Approximate soil loss from water erosion due to oil, gas, and coal bed methane (CBM) leasing was analyzed by RFD area based on soil erosion potential (k-factor) and percent slope. Soils with a k-factor of ≥ 0.32 and a slope of greater than 10% were classified as erodible.

4.13.1 Impacts Common to All Alternatives

Surface-disturbing activities that are currently occurring and are expected to continue include grazing, access to and maintenance of existing oil and gas wells and access roads, recreation and OHV use, and woodland harvest/vegetation removal. As a result of surface-disturbing activities in areas having soils with limitations, impacts common to all alternatives include soil erosion, sedimentation, and impacts to surface and ground water quantity and quality. Surface disturbance

can result in loss of vegetation or prevention of revegetation, increased soil erosion and sedimentation, and increased salinity in surface waters. Erosion control practices for slopes greater than 20% would be the same for all alternatives, as per Utah's Non-Point Source Management Plan (UDEQ, 2000). Careful planning of development to ensure impacts to soil and water are limited is important in protecting water quality and soil productivity. The Utah BLM Standards for Rangeland Health (Appendix I) apply to soil resources in the VPA. All alternatives must adhere to Standards 1 and 4:

- Upland soils [must] exhibit permeability and infiltration rates that sustain or improve site productivity, considering the soil type, climate, and landform.
- BLM will apply and comply with water quality standards established by the state of Utah (R317.2) and the federal clean water and safe drinking water acts. Activities on BLM lands will fully support the designated beneficial uses described in the Utah Water Quality Standards (R317.2) for surface and groundwater.
- Site-specific conditions would need to be documented before modifying any prescriptions. Activities that would not comply with Standards 1 and 4 in the short term would require reclamation and rehabilitation to ensure water quality, soil productivity and sustainability. Additionally, the BLM would take measures to protect water quality, ensure soil productivity and sustainability in the event of wildland fire, drought, or other natural disasters, by reducing or eliminating livestock, wild horses, and/or wildlife forage allocations, recreational activities (e.g., camping and campfires, OHV use, etc.), and mineral exploration and acquisition until soils are stabilized. Monitoring would be used to determine the condition of water and soils and determine if water quality or soil productivity trends tended upward, downward, or static (considering the soil type, climate, and landform).

4.13.1.1 Impacts Common to All Fire Management Decisions

Fire management would have short-term, adverse impacts to soils and water via prescribed burning or fuels reduction, which would increase erosion rates. Some areas would be difficult to reclaim because of the soil's physical and chemical limitations (e.g., soils with high sodium, salt, or gypsum content). Additional post-fire erosion (i.e., a short-term, direct, adverse impact) would occur from fire suppression activities such as the digging of fire lines and the bulldozing of roads.

However, in the long term, these fire management activities would reintroduce the natural fire return interval, thereby decreasing or eliminating the occurrence of catastrophic rangeland fires and promoting more productive rangelands with less water and soil degradation. The reduction of catastrophic fires would limit the aggressive fire suppression activities necessary for wildfire control, thereby minimizing indirect impacts to soil and water resources. As well, proper oversight for fire suppression activities would further reduce the potential for adverse impacts.

4.13.1.2 Impacts Common to All Lands and Realty Management Decisions

Lands and realty management decisions would have beneficial, long-term impacts to soils and water resources by pursuing locatable mineral withdrawals in specified areas within the VPA. Mineral withdrawals would provide indirect, long-term benefits to water quality by reducing soil erosion and sedimentation in streams.

On the other hand, pursuing public access under the various action alternatives would open specified areas up to recreation, potentially resulting in soil degradation along proposed travel routes and water quality degradation in stream corridors. Long-term direct adverse impacts would also occur where new ROWs are designated for development of roads or utility corridors.

4.13.1.3 Impacts Common to All Livestock and Grazing, Forage, and Wild Horse Management Decisions

The effects of livestock and grazing, forage and wild horse decisions on soils would generally be short-term and direct. Through monitoring and changes in range use, soils should not become degraded to the point where they lose productivity; therefore no long-term impacts should occur. Management decisions for livestock and grazing, forage, and wild horse resources would always result in loss of vegetative cover and subsequent wind and water erosion, and loss of biological soil crusts, where they occur.

Forage and wild horse management decisions would affect soils and water resources when AUMs for livestock, wild horses, and/or wildlife are adjusted in response to evidence from monitoring that water quality or soil degradation is eminent or occurring. Depending on season of use and duration, adjusting AUMs would be a short-term, direct, and potentially beneficial impact, as it would slow the loss of ground cover. On the other hand, greater forage utilization and more AUMs in a given area put greater stress on the soils via trampling and loss of cover. The loss of vegetation would have direct, long-term, adverse impacts to water quality and soil productivity, especially in areas with soil limitations.

With respect to livestock grazing, alternatives vary between season of use and duration of use. Due to growing seasons, effects on vegetation (and subsequently, on water and soils) vary depending on the season of use. For example, limiting grazing before periods of high runoff (generally due to spring runoff and late summer thunderstorms) reduces adverse impacts: banks that retain their vegetation are protected from erosion caused by high flows. A longer duration of use would result in greater impacts to vegetation, soils, and water in a given area.

All alternatives contain restrictions to livestock grazing during seasons of use as well. If all areas are grazed equally, all alternatives should help retain watershed health and provide indirect, long-term benefits to water quality by reducing soil disturbance during critical periods of vegetation establishment and soil vulnerability.

4.13.1.4 Impacts Common to All Minerals Management Decisions

All alternatives would result in surface disturbance, minerals exploration and development, and road building. With more land available for leasing and higher levels of development, the risk of adverse impacts to soil and water resources (both surface and groundwater) would increase. Under all alternatives, the effects of minerals decisions on water and soils would be direct, short- and long-term, and adverse.

General impacts to soil and water resources would be erosion, loss of soil productivity, increased runoff, landslides, flooding, and water quality degradation.

Direct, long-term, adverse impacts to surface water quality, in the form of increased sediment levels due to erosion and increased flows from runoff, would increase as the number of well sites increases.

Water quality may be affected by hazardous materials leaks or disposal of wastewater from wells.

Groundwater may become contaminated if drilling fluids and chemicals from the well bore escape into underground reserves or if minerals migrate between geological formations during drilling.

Groundwater impacts may also take the form of changes in total dissolved solids (TDS) or salinity; pollution from pipeline or storage tank leaks; leaks from mud pits; and disposal of water by injection wells.

If streambeds are altered during development, changes in volume or location of flows that feed streams would result from alterations.

Water channelization and runoff could result from improper road building and maintenance.

Due to the explosives used and the digging, leveling, and scraping required, mixing of soils and loss of vegetative cover may occur during exploration activities; construction of roads and well pads; and installation of pipelines.

Soils would be compacted due to the use of trucks and other heavy equipment.

Oil, gas, and CBM leasing under No Surface Occupancy or Closed to Leasing categories would result in no surface disturbance, and would have no impact on surface water quality. However, No Surface Occupancy areas could still impact groundwater quality. The CBM development process removes large amounts of groundwater and, in the VPA, reinjects it into the ground via injection wells. This can create changes in groundwater movement and has the potential to adversely affect groundwater. This results in a consumptive use of water, where wastewater is injected into deep areas to minimize adverse effects on water quality.

Special tar sand areas; Gilsonite, phosphate, oil shale leasing; and disposal of mineral materials, all with Standard Lease Terms, would result in indirect, long-term, adverse impacts to water quality in the form of increased soil erosion and sedimentation in streams (see Chapter 2, the alternative matrix, for acreages).

Reclamation and restoration of oil and gas, locatable minerals, surface minerals, and alternative energy sites would be required upon abandonment of sites to reduce long-term impacts.

4.13.1.5 Impacts Common to All Rangeland Improvement Decisions

The effects of rangeland improvements on soils and water would be generally beneficial, long-term, and direct.

Vegetation treatments, in the form of increased vegetative cover, would ultimately improve soil quality and would have indirect, long-term benefits to water quality and soil productivity through reduced soil erosion and sedimentation in streams.

Fencing of riparian areas would improve soil conditions within exclosures and protect water quality.

Water developments would provide water to upland range sites and keep livestock and other ungulates from seeking out water in sensitive riparian areas; riparian water quality would thus receive indirect, long-term benefits.

On the other hand, localized soils around the guzzlers, reservoirs, wells, and springs would be increasingly disturbed, as the water sources would attract ungulate traffic. Short-term adverse impacts would also occur due to surface disturbance during the building of guzzlers/reservoirs and pipelines and the improvement of wells/springs. These adverse impacts could be mitigated through proper placement and limitations on surface disturbance in areas with fragile soils or in floodplains.

4.13.1.6 Impacts Common to All Recreation Management Decisions

Recreational activities would have limitations in place that would reduce adverse impacts to soils. Limiting OHV use to designated trails would provide short- and long-term, beneficial impacts to soils and water resources. "Sacrifice" areas would be designated for OHV users in areas that are not ecologically sensitive and present little or no risk to soils, watersheds, and other components identified in the Utah BLM Standards for Rangeland Health (Appendix I). Some areas may need to be entirely closed to OHV use and planned travel routes.

Increasing visitor access to certain areas would have long-term, adverse impacts to soils and water; stream banks would be increasingly trampled, and more trails would likely be developed.

Proper management and public education would reduce adverse impacts to soils and water resources. The Tread Lightly Program is invaluable for encouraging OHV users to stay on existing trails, thereby decreasing impacts to soil.

4.13.1.7 Impacts Common to All Riparian Management Decisions

Proper functioning condition (PFC) is the minimum acceptable goal for riparian areas. Riparian-wetland areas would be maintained, restored, protected, and/or expanded to achieve PFC with respect to soils, vegetation, and hydrology/water quality. Thus, riparian management would have short- and long-term, direct, beneficial impacts to soils and water where use of streamside vegetation is reduced.

Maintaining plant stubble along the banks traps sediment and reduces stream bank erosion. Managing key riparian woody vegetation maintains bank stability by providing root structure, holding banks together, and reducing sediment transport. Maintaining riparian vegetation would also attenuate floodwaters and, therefore, lower runoff amounts and flooding levels.

4.13.1.8 Impacts Common to All Soil and Water Management Decisions

Soil and watershed decisions would reduce or eliminate the discharge of pollutants and sediment into surface waters, providing protection for fish, amphibians, wildlife, and water recreation. Decisions to limit development on steep slopes would have short- and long-term, direct, beneficial impacts to soils and water resources. Oil and gas well pads would not be permitted in active floodplains, protecting watersheds from sedimentation. With respect to biological soil crusts, the BLM would take measures to protect or restore soil crust functions and avoid soil crust areas where possible. The BLM would examine the effects of prescribed fire, post fire management, invasive weed control, energy development, grazing, OHV use, and range improvement projects prior to taking action.

Erodible soils on slopes between 20% and 40% are required to have an erosion control plan, as outlined in Appendix M. These stipulations would limit the soil loss from these areas and thus limit adverse impacts to soils and water resources in the VPA. Slopes less than 20% are not required to have an erosion control plan and would likely experience more soil loss than areas in

the high and very high erodibility categories. This analysis did not take into account road densities, which are a factor in soil loss. Erosion from roads that do not have an all-weather surface also would likely contribute sediment to total soil loss, but proper engineering design would limit or reduce these losses.

4.13.1.9 Impacts Common to All Special Designations

Designating new ACECs and expanding current ACECs would have long-term, direct and indirect, beneficial impacts to soils and water by protecting relevant and important values and limiting OHV travel to designated routes (although designation would not preclude oil and gas development within these areas). Specific management guidelines would be created for each ACEC and would require further analysis of impacts to soils and water resources. Special designations of ACECs would continue in Browns Park, Red Mountain-Dry Fork, Lears Canyon, Pariette Wetlands, and Red Creek Watershed; therefore, these designations will not be analyzed by individual alternative.

The designation of segments of the Upper and Lower Green River as Wild and Scenic Rivers also provides long-term, direct and indirect, beneficial impacts to soils and water, as it limits development along the river segments.

Wilderness Study Areas (WSA) would limit development in these areas resulting in short- and long-term, direct and indirect, beneficial impacts to soils and water.

4.13.1.10 Impacts Common to All Special Status Species Management Decisions

The effects of special status species decisions on water and soils would be beneficial, long-term, and direct, as they would limit development. All alternatives are similar: implementation of spatial and seasonal, no-disturbance buffers around critical habitat (e.g., raptor nests) would likely result in less development and surface disturbance and would thus cause indirect, long-term benefits to water quality and soil productivity in the form of reduced soil erosion and sedimentation in streams and fewer salinity increases. Inventories of these plant and animal resources would provide well-defined protection areas.

4.13.1.11 Impacts Common to All Travel Management Decisions

The effects of travel decisions on water and soils generally would be beneficial, long-term, and direct, primarily by limiting OHV activities to open areas and restricted travel routes. Soil and water resources are greatly affected by runoff from roads and trails; therefore, these travel limits would have indirect, long-term benefits to water quality and soil productivity in the form of reduced soil erosion and sedimentation in streams, and thus, fewer salinity increases.

Leaving newly permitted roads open would have an indirect, long-term, adverse impact on water quality, manifest as increased soil disturbance. Under all action alternatives, roads and trails currently causing resource damage would be maintained, upgraded and/or realigned. Roads and trails would be designed and built with water crossings that would allow for free passage of aquatic life. All action alternatives (A, B, and C) would have fewer long-term direct adverse impacts to soils and water resources than Alternative D – No Action, which is unspecified with respect to roads and trails causing resource damage.

4.13.1.12 Impacts Common to All Vegetation Management Decisions

Vegetation management including prescribed burns, mechanical and chemical treatments, and rangeland improvements would have short-term direct adverse impacts to soils and water

resources by increasing surface disturbance. Long-term indirect impacts would be beneficial due to increased ground cover. The impacts due to these management decisions are discussed under fire management and rangeland improvements.

4.13.1.13 Impacts Common to All Visual Resource Management Decisions

Visual resource management (VRM) decisions would be beneficial and long-term. They would directly affect water and soil resources by precluding some areas from surface disturbance due to their proximity to highways, scenic areas, and special designation areas. However, adverse, short-term, indirect impacts would occur if vegetation treatments were not implemented in VRM-sensitive areas.

4.13.1.14 Impacts Common to All Wildlife Management Decisions

The effects of wildlife management decisions on water and soils would be beneficial, long-term, and indirect, by limiting surface development. Most of the wildlife and fisheries management decisions involve seasonal constraints but would not necessarily preclude surface-disturbing activities.

The only impacts of wildlife and fisheries management decisions upon water and soils that can be measured are the preservation of crucial deer winter range and the reclamation of disturbance within sagebrush habitat. Reclamation of disturbance within sagebrush habitat would stabilize soils and increase vegetation, thereby benefiting soil productivity by reducing soil erosion and sedimentation in streams. The allowance of new surface disturbance within crucial winter range would result in indirect, long-term, adverse impacts to water quality and soil productivity. The BLM would provide habitat for a diversity of wildlife and fish species by limiting fragmentation, thereby keeping soils intact and sediment out of streams.

4.13.1.15 Impacts Common to All Woodlands and Forest Management Decisions

Salvage operations and permitted use of certain vegetation products in specified areas would result in indirect, short-term, adverse impacts to water quality and soil productivity in the form of increased soil erosion and sedimentation in streams. Adverse, short-term, direct impacts to water and soils would occur as soil erosion during treatments and harvesting.

However, in the long term, treatments and harvesting have the potential to reintroduce the natural fire return interval, indirectly reducing soil erosion through fewer catastrophic fires.

The effects of woodlands and forest management on soils and water would be reduced by following National BLM Forest Health and Forest Management Standards and Guidelines (BLM, 2004) to achieve desired future conditions and minimize impacts to water and soils, while providing for multiple uses of forest products.

4.13.2 Alternative Impacts

Surface disturbance activities for all alternatives and all effects would generally increase risks of adverse effects on water and soil resources by increasing erosion potential, sedimentation, soil compaction, loss of soil productivity, and impacts to biological soil crusts. Water quality would be impacted due to rises in salinity, sediment load, and increases in Selenium and Boron concentrations. The duration of these impacts would depend on the action. Mitigation outlined in Appendix M contains stipulations on surface disturbance that could be implemented to reduce impacts to soils and water resources; therefore some of the impacts discussed below would be reduced or eliminated.

4.13.2.1 Effects of Fire Management Decisions on Water and Soils

4.13.2.1.1 Alternatives A, B, and C

Under Alternatives A, B, and C, prescribed burns on 156,425 acres of the VPA would result in 3 times more surface disturbance than Alternative D – No Action. In the short term, 13% (20,335 acres) of the burned area would occur on water erodible soils, 79% (123,575 acres) would occur on wind erodible soils, 9% (14,078 acres) would occur on sodic soils, 20% (31,285 acres) would occur on saline soils, and 7% (10,949 acres) would occur on gypsic soils. Proper location of prescribed burns would limit adverse effects due to fire management.

4.13.2.1.2 Alternative D – No Action Alternative

Continuing current management would have fewer short-term adverse impacts and long-term benefits to water and soils from prescribed fire. Surface disturbance would be 3 times less under Alternative D – No Action than under Alternatives A, B, and C.

4.13.2.2 Effects of Forage Management Decisions on Water and Soils

4.13.2.2.1 Alternative A

Utilization under Alternative A is 50%, which provides more beneficial impacts to soils and water by limiting utilization, than Alternative D – No Action, which does not specify forage utilization. Approximately 245,649 AUMs are allocated under this alternative.

4.13.2.2.2 Alternative B

Utilization under Alternative B is 60%, which provides more beneficial impacts to soils and water by limiting utilization, than Alternative D – No Action. Approximately 244,034 AUMs are allocated under this alternative.

4.13.2.2.3 Alternative C

Utilization under Alternative C is the same as under Alternative A. Approximately 187,450 AUMs are allocated under this alternative, which is 58,678 fewer than Alternative D – No Action. This alternative would cause the fewest adverse impacts from forage utilization.

4.13.2.2.4 Alternative D – No Action

Forage utilization under Alternative D – No Action is not specified, which would result in long-term, adverse impacts to soils and water due to overutilization of forage and loss of cover. Approximately 246,128 AUMs are allocated under this alternative.

4.13.2.3 Effects of Lands and Realty Decisions on Water and Soils

4.13.2.3.1 Alternative A

Alternative A would pursue public access to the White River and Indian Trust Lands in Bitter Creek and near the confluence of South and Sweetwater Canyons. This alternative would have increased, adverse impacts to soil and water resources, due to increased public access as compared to Alternative D – No Action, where no increased access would be pursued and agricultural entry would be precluded in withdrawal areas.

4.13.2.3.2 Alternative B

Alternative B would not pursue access to the White River and would only pursue administrative access across Indian Trust Lands in Bitter Creek and near the confluence of South and

Sweetwater Canyons. With respect to access, this alternative would have similar effects to soils and water as Alternative D – No Action.

4.13.2.3.3 Alternative C

Alternative C would pursue access to the White River and Indian Trust Lands in Bitter Creek and near the confluence of South and Sweetwater Canyons. As well, an easement would be pursued for the old Uintah Railroad bed from the Utah/Colorado state line to Watson in Evacuation Creek. This alternative would have more adverse impacts to soil and water than Alternative D – No Action and other action alternatives.

4.13.2.3.4 Alternative D – No Action

Alternative D – No Action precludes agricultural entry on 35,900 acres of land. Mineral and agricultural withdrawals under Alternative D would provide fewer indirect, long-term adverse impacts to water quality and soil productivity than other alternatives by reducing soil erosion and sedimentation in streams. Alternative D would not pursue public access to any new land.

4.13.2.4 Effects of Minerals Decisions on Water and Soils

Table 4.13.2 shows the acreages of erodible soils by RFD area for oil, gas, and CBM leasing. The areas with No Surface Occupancy or No Leasing were removed from the acreages analyzed. The largest source of sediment input to waters is expected from slopes 0-20%, with ≥0.32 k-factor. These acreages have been highlighted in the table. Impacts to soils would have indirect, short- and long-term adverse impacts to water quality through subsequent sedimentation and salinity rises.

The RFD area with the highest amount of water erodible soils not subject to surface stipulations is Monument Butte-Red Wash. This area also has the greatest number of potential wells, with 1,700 oil and 3,100 gas wells identified for reasonably foreseeable development. The location of wells within the RFD areas may or may not be on BLM lands; therefore, the analysis may overstate the amount of water erodible areas that would be impacted on BLM lands.

TABLE 4.13.2. ACRES OF VPA ERODIBLE SOILS OPEN TO OIL AND GAS DEVELOPMENT, BY RFD AREA

Erodible Soil	Altamont-Bluebell	East Tavaputs Plateau	Manila-Clay Basin	Monument Butte-Red Wash	Tabiona-Ashley Valley	West Tavaputs Plateau
Alternative A						
KFACT < 0.32, Slope = 0-10%	6,217	20,142	3,147	102,581	17,001	11,886
KFACT < 0.32, Slope = 11-20%	0	0	1,097	0	1,687	0
KFACT < 0.32, Slope = 21-40%	0	5,574	780,30	7,999	34,935	0
KFACT ≥ 0.32, Slope = 0-10%	**1,732**	**7,320**	**4,153**	**50,448**	**19,548**	**1,696**
KFACT ≥ 0.32, Slope = 11-20%	**0**	**854**	**0**	**3,618**	**5,480**	**0**
KFACT ≥ 0.32, Slope = 21-40%	0	0	5,419	24,954	45,570	0
Total	***7,949***	***33,890***	***13,816***	***189,600***	***124,221***	***13,582***
Alternative B						
KFACT < 0.32, Slope = 0-10%	6,217	20,200	3,173	102,813	17,001	12,406
KFACT < 0.32, Slope = 11-20%	0	0	1,097	0	1,687	0
KFACT < 0.32, Slope = 21-40%	0	5,574	0	7,999	35,061	0
KFACT ≥ 0.32, Slope = 0-10%	**1,732**	**7,680**	**4,153**	**52,246**	**19,548**	**2,405**
KFACT ≥ 0.32, Slope = 11-20%	**0**	**854**	**0**	**3,618**	**5,480**	**0**
KFACT ≥ 0.32, Slope = 21-40%	0	0	5,418	24,954	45,570	0
Total	***7,949***	***34,308***	***13,841***	***191,630***	***124,347***	***14,811***
Alternative C						
KFACT < 0.32, Slope = 0-10%	6,217	13,160	3,139	102,450	14,769	11,621
KFACT < 0.32, Slope = 11-20%	0	0	1,097	0	1,687	0
KFACT < 0.32, Slope = 21-40%	0	5,570	0	7,999	31,877	0

TABLE 4.13.2. ACRES OF VPA ERODIBLE SOILS OPEN TO OIL AND GAS DEVELOPMENT, BY RFD AREA

Erodible Soil	Altamont-Bluebell	East Tavaputs Plateau	Manila-Clay Basin	Monument Butte-Red Wash	Tabiona-Ashley Valley	West Tavaputs Plateau
KFACT ≥ 0.32, Slope = 0-10%	**1,730**	**6,400**	**4,153**	**50,159**	**17,262**	**1,681**
KFACT ≥ 0.32, Slope = 11-20%	**0**	**854**	**0**	**3,618**	**5,195**	**0**
KFACT ≥ 0.32, Slope = 21-40%	0	0	5,419	24,954	34,937	0
Total	***7,947***	***25,984***	***13,808***	***189,180***	***105,727***	***13,302***
Alternative D – No Action						
KFACT < 0.32, Slope = 0-10%	6,054	20,409	3,244	99,575	16,900	10,923
KFACT < 0.32, Slope = 11-20%	0	0	1,092	0	1,652	0
KFACT < 0.32, Slope = 21-40%	0	5,685	6,685	7,038	35,689	0
KFACT ≥ 0.32, Slope = 0-10%	**1,855**	**5,941**	**4,153**	**48,919**	**17,290**	**1,921**
KFACT ≥ 0.32, Slope = 11-20%	**0**	**753**	**0**	**3,505**	**4,793**	**0**
KFACT ≥ 0.32, Slope = 21-40%	0	0	5,375	24,954	42,486	0
Total	***7,909***	***32,788***	***20,549***	***183,991***	***118,810***	***12,844***

Table 4.13.3 is provided to compare acreages, well numbers, and short- and long-term impacts due to alternatives and is discussed by alternative.

TABLE 4.13.3. ALTERNATIVES COMPARISON FOR MINERALS DECISIONS

	Alternative A	Alternative B	Alternative C	Alternative D[2]
Oil, Gas and CBM				
Standard Lease Terms	982,904	1,113,116	858,619	918,315
Controlled Surface Use	793,878	706,281	768,466	617,715
No Surface Occupancy	66,483	42,053	58,670	136,930
No Leasing	70,734	52,550	228,246	52,540
Total short-term impacts	5,072	5,088	28,229	26,879
Total long-term impacts	13,898	13,945	20,880	19,862
Combined Hydrocarbon/Special Tar Sands				
Standard Lease Term	51,829	61,424	43,530	116,208
Controlled Surface Use	200,836	198,238	195,566	101,279

TABLE 4.13.3. ALTERNATIVES COMPARISON FOR MINERALS DECISIONS				
	Alternative A	**Alternative B**	**Alternative C**	**Alternative D[2]**
No Surface Occupancy	10,803	3,806	3,696	11,589
No Leasing	35,044	35,044	55,720	35,045
Other Minerals				
Phosphate	87,724	87,724	63,571	84,600
Gilsonite[1]	172	173	172	168
Oil Shale - Open	298,629	305,736	292,453	290,740
Mineral Disposal - Open	415,395	430,172	378,785	387,700
Total Projected Wells[3]	**3,695**	**3,712**	**3,637**	**3,488**

[1]Gilsonite data are represented in miles.

[2]The decrease in leasing in Alternative D is due to the closure to leasing of the 188,500-acre Hill Creek Extension.

[3]Total Projected Wells data are represented in numbers of wells. All other data is represented in acres.

4.13.2.4.1 Alternative A

Alternative A would have more direct and indirect adverse impacts to water quality and soil productivity due to oil, gas, and CBM leasing, as compared to Alternative C and Alternative D – No Action. Approximately 1,776,782 acres would be administratively available for oil, gas, and CBM leasing subject to Standard Lease Terms or Controlled Surface Use, which is approximately 240,752 acres more than Alternative D – No Action. Total disturbance from oil and gas development would occur on 18,971 acres of soils, with adverse impacts to soils, which is 759 more acres more than for Alternative D.

Total wells under this alternative would be approximately 3,695, which are approximately 207 more than Alternative D, therefore more direct, long-term impacts to water due to drawdown would be expected for water resources. With respect to hydrocarbon leasing, oil shale leasing, and mineral materials, Alternative A impacts more acreage than Alternatives C and D, and therefore would have greater direct adverse impacts to soil and water resources.

4.13.2.4.2 Alternative B

Alternative B would have the greatest adverse impacts to water quality and soil productivity due to oil, gas, and CBM leasing, as compared to Alternative A and Alternative D – No Action. Approximately 1,819,397 acres would be administratively available for oil, gas, and CBM leasing subject to Standard Lease Terms or Controlled Surface Use, which is approximately 283,367 acres more than Alternative D – No Action. Total disturbance would occur on 19,033 acres, causing direct adverse impacts to soils, and affecting 821 more acres than Alternative D.

Total wells under this alternative would be approximately 3,712, which is approximately 224 more than alternative D, therefore more direct, long-term impacts to water due to drawdown would be expected for water resources. With respect to hydrocarbon leasing, oil shale leasing, and mineral materials, Alternative B impacts more acreage than Alternatives A, C and D, and therefore would have greater direct adverse impacts to soil and water resources.

4.13.2.4.3 Alternative C

Alternative C would have the least adverse impacts to water quality and soil productivity, as compared to other action alternatives and Alternative D – No Action. Approximately 1,627,085 acres would be administratively available for oil, gas, and CBM leasing subject to Standard Lease Terms or Controlled Surface Use, which is approximately 91,055 acres more than Alternative D – No Action. Total disturbance from oil and gas development would adversely affect 18,757 acres of soils, which is 545 acres more than Alternative D. This alternative also designates the largest number of acres classified as no surface occupancy or as closed to leasing.

Total wells under this alternative would be approximately 3,637, which is approximately 149 more wells than Alternative D, therefore greater direct, long-term impacts to water due to drawdown would be expected for water resources. With respect to hydrocarbon leasing, oil shale leasing, and mineral material disposal Alternative C would adversely impact fewer acres than Alternatives A and B.

4.13.2.4.4 Alternative D – No Action

Alternative D – No Action would have approximately 1,536,030 acres administratively available for oil, gas and CBM leasing subject to Standard Lease Terms or Controlled Surface Use. Total disturbance from oil and gas development would occur on 18,212 acres. The number of wells projected under this alternative would be approximately 3,488.

4.13.2.5 Effects of Rangeland Improvement Decisions on Water and Soils

4.13.2.5.1 Alternative A

Alternative A would provide 34,640 acres of vegetation treatment, which would be 5,750 fewer acres than Alternative D – No Action. Thus, Alternative A would result in fewer indirect, long-term, beneficial impacts to soil and water resources. The miles of fencing, number of guzzlers/reservoirs, number of wells/springs, and miles of pipeline planned under Alternative A would have similar impacts to Alternative D – No Action.

4.13.2.5.2 Alternative B

Alternative B would provide 50,900 acres of vegetation treatments, 368.5 miles of fencing, 1,165 guzzlers/reservoirs, and 51 miles of pipelines. Compared to Alternative D – No Action, this alternative would have 10,510 more acres of vegetation treatment and 303.5 more miles of fencing, which would result in more indirect, long-term, beneficial impacts to soil and water resources.

Compared to Alternative D – No Action, this alternative would also implement 390 more guzzlers/reservoirs and 16 more miles of pipeline, which would result in more direct, short-term adverse impacts to soil and water than Alternative D – No Action.

Development of wells/springs and the associated impacts would be similar to Alternative D – No Action.

4.13.2.5.3 Alternative C

Alternative C would provide 45,860 acres of vegetation treatments and 129 miles of fencing would be developed. Compared to Alternative D – No Action, this alternative would have 5,470 more acres and 64 more miles of fencing providing more long-term beneficial impacts to soil and water resources. Water developments would have similar impacts to Alternative D – No Action.

4.13.2.5.4 Alternative D – No Action

Alternative D would result in 40,390 acres of vegetation treatments, 65 miles of fencing, 775 guzzlers/reservoirs, 74 wells/springs, and 35 miles of pipeline.

4.13.2.6 Effects of Recreation Decisions on Water and Soils

4.13.2.6.1 Alternative A

Designating Seep Ridge, Book Cliff Divide, and Atchee Ridge Roads as BLM Backcountry Byways would have more long-term, indirect, adverse impacts to soil and water resources compared to Alternative D – No Action in the form of increased public visitation and use of these roads. Alternative D does not specify these Backcountry Byways.

Management of the White River area as an SRMA (which would include management of public use and limiting surface disturbance by designating the western portion VRM I and the eastern portion VRM II) under Alternative A would provide more long-term, beneficial impacts to water and soil than Alternative D – No Action.

Management of the Blue Mountain, Fantasy Canyon, Book Cliffs, Red Mountain-Dry Fork, and Nine Mile Canyon areas as SRMAs would limit OHV use to trails and therefore provide greater direct long-term beneficial impacts to soils and water, as compared to Alternative D. Although increased public visitation would have greater indirect, long-term adverse impacts to water quality and soil productivity than Alternative D.

Management of 52,720 acres in the Browns Park area as an SRMA, with special management attention given to enhancement of riparian and fisheries resources and limiting OHV use, would protect 34,246 more acres than Alternative D – No Action. Closing the southern portion of the Browns Park area to OHV use and managing it as VRM I would result in less surface disturbance by development; this, in turn, would have indirect, long-term benefits to water quality and soil productivity.

Under Alternative A, development or improvement of up to 400 miles of trails for non-motorized use and up to 800 miles of motorized trails would result in increased public visitation and would have indirect, long-term, adverse impacts to water quality and soil productivity. Proper placement of trails would reduce the adverse impacts to soils and water resources.

Not allowing OHV use off of designated trails for big game retrieval would limit adverse impacts to soils and water resources, compared to Alternative D – No Action, which does not restrict OHV travel.

Cabin improvement and construction proposed under Alternative A would result in surface disturbance (a more indirect, long-term, adverse impact to water quality and soil productivity) compared to Alternative D – No Action, which does not specify cabin improvements.

4.13.2.6.2 Alternative B

Designation of Backcountry Byways and improvement of up to 800 miles of motorized trails would have the same impacts as Alternative A.

Providing minimal or no management of the White River, Blue Mountain, Fantasy Canyon, Book Cliffs, Browns Park, Red Mountain-Dry Fork, and Nine-Mile Canyon would have no beneficial impacts to soils and water resources due to minimal management of OHV use, which would be the same as Alternative D – No Action.

OHV travel off of designated trails for big-game retrieval would be allowed under this alternative and Alternative D – No Action, which would result in long-term, adverse impacts to soil and water resources.

4.13.2.6.3 Alternative C

Alternative C would have the same impacts as Alternative A for SRMA designation except Fantasy Canyon (69 acres) which would be designated as an SRMA and the White River SRMA would increase in size from 24,183 acres to 47, 130 acres. Backcountry Byways, motorized trails and cabins would not be developed under this alternative. Therefore, generally, adverse impacts would be less and beneficial impacts would be more than they would be under other alternatives and Alternative D – No Action.

4.13.2.6.4 Alternative D – No Action

Alternative D – No Action would result in more direct and indirect, short- and long-term, adverse impacts than any other alternative due to lack of limits on OHV use. Other impacts from Alternative D are similar to those under Alternative B.

4.13.2.7 Effects of Riparian Management Decisions on Water and Soils

4.13.2.7.1 Alternatives A and C

Alternatives A and C would implement the same management of riparian resources. Alternatives A and C propose stubble heights of 4 inches (30% utilization) where conditions are to be maintained and 6 inches (less than 20% utilization) if conditions are to be improved. Compared with Alternative D – No Action, Alternatives A and C would foster improved riparian conditions and more beneficial impacts on water quality and soil productivity. Key herbaceous riparian species would provide more trapping and retention of sediment during high water events than Alternative D – No Action provides. Key riparian woody vegetation would be managed more under Alternatives A and C, providing both direct and indirect, long-term benefits to water quality and soil productivity via reduced soil erosion and sedimentation in streams. By contrast, no management of woody species is specified under Alternative D – No Action.

4.13.2.7.2 Alternative B

Key herbaceous riparian vegetation, other than the stream banks, under Alternative B would not be grazed more than 50% during the growing season and not more than 60% during the dormant season. In this respect, Alternative B provides more beneficial impacts than Alternative D – No Action, which does not specify percent utilization. Key riparian woody vegetation would not be used more than 50%. Thus, Alternative B provides more protection to woody vegetation than Alternative D – No Action, which has no parameters specified for woody vegetation. Alternative B would implement the same management of key streamside herbaceous vegetation as Alternatives A and C.

4.13.2.7.3 Alternative D – No Action

Alternative D – No Action has fewer beneficial impacts to soils and water than any other alternative, as it has a lower minimum stubble height after livestock grazing (Diamond Mountain-3 inches, Book Cliffs- Unspecified) and unspecified percent utilization. As well, key riparian woody vegetation use is not specified under Alternative D.

4.13.2.8 Effects of Soils and Water Resources Decisions on Water and Soils

4.13.2.8.1 Alternative A

Alternative A would use oil and gas industry slope disturbance guidelines (Gold Book) to limit surface disturbances from oil and gas activities, which would provide indirect, long-term beneficial impacts to soil and water quality by reducing soil erosion on steep hillsides, and thus reducing the potential for increased stream sedimentation. Under Alternative A, surface disturbances on slopes between 21 – 40% would require erosion control, GIS modeling, and surveying, and slopes greater than 40% would not be disturbed unless other proposed construction alternatives would cause unnecessary degradation. These actions would also provide indirect, long-term beneficial impacts to soils and water by reducing surface disturbances that cause soil erosion and subsequent stream sedimentation.

4.13.2.8.2 Alternative B

Similar to Alternative A, Alternative B would use oil and gas industry slope disturbance guidelines (Gold Book) to limit surface disturbances from oil and gas activities, and would require erosion control, GIS modeling, and surveying on slopes greater than 20% for unavoidable surface disturbances, with similar indirect beneficial impacts to soils and water quality as described for Alternative A. This alternative would not restrict surface disturbances to slopes greater than 40%, and thus would not provide indirect beneficial impacts to soils and water quality, and would not protect steep slopes from surface-disturbance-caused erosion.

4.13.2.8.3 Alternative C

Alternative C would have greater indirect beneficial impacts on soils and water quality than the other alternatives by applying the same management actions (with similar impacts) on 21 – 40% slopes as Alternative A and by prohibiting surface disturbances, and thus reducing the risk of increased stream sedimentation, on slopes greater than 40%.

4.13.2.8.4 Alternative D – No Action

Alternative D proposes restrictions on slopes greater than 40% for mineral production only. Allowing other activities with no restrictions for slopes over 40% and not specifying slope restrictions on slopes less than 40% would have more indirect, long-term adverse impacts to water quality and soil productivity, as compared to other alternatives.

4.13.2.9 Effects of Special Designation Decisions on Water and Soils

4.13.2.9.1 Alternative A

Under Alternative A, Lears Canyon (1,375 acres), Pariette (10,437 acres), Red Mountain-Dry Fork (24,285 acres), Red Creek (24,475 acres), and Brown's Park (18,475 acres) would continue to be managed as ACECs. Three new ACECs would be proposed: Bitter Creek (71,000 acres), Coyote Basin (87,743 acres),and White River (17,810 acres). The Lower Green River and Nine Mile Canyon would be expanded to 10,170 acres and 48,000 respectively. These actions would have indirect, long-term benefits to water quality and soil productivity, in the form of reduced soil erosion and sedimentation in streams. By contrast, Alternative D – No Action would not designate Bitter Creek, Coyote Basin, and White River ACECs and the Lower Green River and Nine Mile Canyon ACECs would be smaller in size; 8,470 acres and 44,181 respectively.

In addition to the existing Upper and Lower Green River segments, Alternative A recommends designation of river segments on the White River (22 miles), as a new Wild and Scenic River. This action may increase visitation but would prevent surface disturbance in the immediate vicinity and would overall have indirect, long-term benefits to water quality and soil productivity. In contrast, Alternative D – No Action would only continue recommending designation of the Upper and Lower Green River segments as Wild and Scenic Rivers.

4.13.2.9.2 Alternative B

Alternative B would propose designation of 47,659 acres in Coyote Basin as a new ACEC, which would provide more beneficial impacts to soils and water resources than Alternative D – No Action, which would not designate this area. This alternative would not designate any other new ACECs nor Wild and Scenic Rivers and therefore would have similar impacts to soil and water resources, as compared to Alternative D – No Action.

4.13.2.9.3 Alternative C

Alternative C would offer the greatest protection to soil and water resources through proposed ACEC designations. In addition to existing ACECs, alternative C proposes ACEC designation of Bitter Creek (147,425 acres), Coyote Basin, which would include Kennedy Wash, Snake John, Shiner, and Myton Bench (124,161 acres), Middle Green River (6,768 acres), White River corridor (47,130 acres), Four Mile Wash (50,280 acres), and Main Canyon (100,915 acres) and expansion of the lower Green River (10,170 acres) and Nine Mile Canyon (81,168 acres) as ACECs. This alternative would result in less surface disturbance and would have indirect, long-term benefits to water quality and soil productivity in the form of reduced soil erosion and sedimentation in streams. By contrast, Alternative D – No Action does not designate any of these ACECs except the Lower Green River and Nine Mile Canyon.

Alternative C recommends designation of new river segments on the White River (44 miles), Nine Mile Creek (2 segments – 19 miles), middle Green River (36 miles), Evacuation Creek (21 miles), Bitter Creek (22 miles), and Argyle Creek (22 miles) as Wild and Scenic Rivers. This action may increase visitation, but would prevent surface disturbance in the immediate vicinity and would overall have more direct and indirect, long-term benefits to water quality and soil productivity, as compared to Alternative D – No Action.

4.13.2.9.4 Alternative D – No Action

Alternative D proposes no new designation of ACECs or Wild and Scenic Rivers. This alternative would result in the greatest amount of surface disturbance, and would have indirect, long-term, adverse impacts to water quality and soil productivity.

4.13.2.10 Effects of Special Status Species Decisions on Water and Soils

Alternatives A and C would result in the most beneficial, indirect impacts to water and soils and are similar with respect to raptors; however, Alternative C offers slightly more protection than Alternative A. Alternative B would offer some habitat protection (and thus, soil protection), but the level of protection would be less than Alternatives A and C. Alternative D – No Action offers the least indirect protection of water and soil resources because raptor buffers for surface disturbance are unspecified in the Book Cliffs area.

Improvement and maintenance of stream habitat in Bitter, Upper Willow, Beaver, Sears, Crouse, Tolivers, Davenport, Jackson, and Sweetwater Creeks, or others as found applicable, including

tributaries, would have direct, long-term benefits to water quality and soil productivity by stabilizing stream banks and reducing erosion and subsequent stream sedimentation and salinity increases.

4.13.2.11 Effects of Travel Decisions on Water and Soils

4.13.2.11.1 Alternative A

Under Alternative A, newly permitted roads or trails would be obliterated and/or returned to their original condition when they no longer serve their permitted purpose or public interest. Roads causing resource damage would be closed if maintenance, upgrade or realignment is not feasible. In contrast, Alternative D – No Action is unspecified with respect to roads and trails.

With respect to OHV travel, Alternative A would allow open travel on 6,202 acres, limited travel on 1,643,475 acres and no travel on 75,845 acres and would designate 4,860 miles of routes. Compared to Alternative D – No Action, Alternative A would allow unlimited travel on 781,657 fewer acres, would allow limited travel on 756,200 more acres, and would allow no travel on 25,457 more acres, and would designate 4,860 more miles of routes for OHV travel. Alternative A would cause fewer adverse and more beneficial impacts to soils and water by limiting OHV use; thus, it would likely reduce soil erosion and sedimentation in streams.

4.13.2.11.2 Alternative B

Under Alternative B, newly permitted roads or trails and roads adversely impacting water and soils would not be obliterated if the road or trail serves a public interest. This alternative would have the same impacts as Alternative D – No Action, with respect to obliteration and closing roads and trails.

With respect to OHV travel, Alternative B would allow unlimited travel on 5,434 acres, limited travel on 1,659,901 acres and no travel on 60,187 acres and would designate 4,861 miles of routes. Compared to Alternative D – No Action, Alternative B would allow unlimited travel on 782,425 fewer acres, would allow limited travel on 772,626 more acres, would allow no travel on 9,799 more acres, and would designate 4,861 more miles of routes for OHV travel.

4.13.2.11.3 Alternative C

Under Alternative C, newly permitted roads or trails would be obliterated, and roads and trails causing resource damage would be closed if maintenance, upgrade or realignment would not protect resources.

With respect to OHV travel, Alternative C would allow unlimited travel on 5,434 acres, limited travel on 1,353,529 acres and no travel on 366,559 acres and would designate 4,707 miles of routes. Compared to Alternative D – No Action, Alternative C would allow unlimited travel on 782,425 fewer acres, allow limited travel on 466,254 more acres, allow no travel on 316,171 more acres, and would designate 4,707 more miles of routes for OHV travel. This alternative would provide the most beneficial and least adverse impacts to soils and water resources compared to all other alternatives.

4.13.2.11.4 Alternative D – No Action

Under Alternative D – No Action, actions related to resource damage and newly created roads and trails are unspecified. With respect to OHV travel, Alternative D – No Action would allow unlimited travel on 787,859 acres, would allow limited travel on 887,275 acres, and would allow

no travel on 50,388 acres. Alternative D provides relatively unrestricted OHV access, which would have an indirect, long-term, adverse impact to water quality and soil productivity in the form of increased soil erosion and sedimentation in streams, which, in turn, would cause increases of salinity and loss of soil productivity.

4.13.2.12 Effects of Visual Resource Management Decisions on Water and Soils

4.13.2.12.1 Alternative A

Alternative A proposes management of approximately 513,644 acres as VRM Class I and II. This designation would generally result in less development and surface disturbance than Alternative D – No Action and, thus, would result in fewer indirect, long-term adverse impacts to water quality and soil productivity in the form of reduced soil erosion and sedimentation in streams.

4.13.2.12.2 Alternatives B and D

Alternatives B and D propose management of approximately 286,801 and 286,457 acres respectively as VRM Class I and II. This designation would result in the lowest limitations of development and surface disturbance and, thus, would result in fewer indirect, long-term benefits to water quality and soil productivity in the form of reduced soil erosion and sedimentation in streams.

4.13.2.12.3 Alternative C

Alternative C proposes management of approximately 768,890 acres as VRM Class I and II. This designation would generally result in less development and surface disturbance than Alternative D – No Action and would result in the most indirect, long-term benefits to water quality and soil productivity in the form of reduced soil erosion and sedimentation in streams.

4.13.2.13 Effects of Wildlife and Fisheries Management Decisions on Water and Soils

4.13.2.13.1 Alternatives A, B, and C

Alternatives A, B, and C propose restriction of surface-disturbing activities. Qualitatively, these alternatives would likely result in less development and surface disturbance and would have indirect, long-term benefits to water quality and soil productivity by reducing soil erosion and sedimentation in streams.

4.13.2.13.2 Alternative D – No Action

Alternative D – No Action proposes restriction of surface-disturbing activities to mineral exploration. This alternative would have more indirect, long-term adverse impacts to water quality and soil productivity than any action alternative by reducing soil erosion and sedimentation in streams.

4.13.2.14 Effects of Woodlands and Forest Management Decisions on Water and Soils

4.13.2.14.1 Alternative A

Alternative A would manage up to 552,663 acres for treatments or be harvested to reduce fuel loadings and to provide salvage of products that are dying due to fire, disease, insect-kill, and/or other disturbance, and salvage operations would be conducted to harvest forest and woodland products that are dead and/or dying due to fire, disease, insect-kill or other disturbance with the management intent of promoting healthy forest and woodlands. These management actions

would have short-term, indirect adverse impacts on soil and water quality by increasing soil erosion and increasing stream sedimentation from surface disturbances during harvesting or treatments. The long-term impacts would be beneficial to soils and water by reducing the risks of wildland fire, and thus, reducing the risks of large-scale soil erosion and subsequent degradation of stream water quality. In comparison, management actions are unspecified under Alternative D and would have more adverse impacts to water quality than Alternative A, due to increased erosion and stream sedimentation.

4.13.2.14.2 Alternative B

The impacts of Alternative B would be similar to those described under Alternative A, except that 554,108 acres would be treated or harvested.

4.13.2.14.3 Alternative C

The impacts under this alternative would have the same number of acres managed for treatments and harvesting as Alternative A (552,663), with similar impacts to soils and water as described for Alternative A. Woodland and forest species salvaging, under Alternative C, would not be allowed except when woodland, forest, or other resources are threatened in proposed ACECs, which would result in fewer indirect, long-term adverse impacts to soil and water resources through reduced surface disturbance; thus limiting soil erosion and sedimentation in streams.

4.13.2.14.4 Alternative D – No Action

Alternative D – No Action provides for treatment or harvesting of up to 88,200 acres of forest and 200,100 acres of woodlands. This alternative would likely reduce the risk of catastrophic wildfire, providing indirect, long-term benefits to water quality and soil productivity. Depending on management restrictions, treatment and harvest activities would also result in short-term and long-term, indirect, adverse impacts to water quality and soil productivity due to soil erosion and sedimentation.

4.13.2.15 Summary

The primary impacts to soil and water resources from the proposed alternatives are surface disturbance and vegetation loss, which would affect soil erosion, stream salinity, and sedimentation. Other impacts are loss of soil productivity, increased road-bank erosion, localized headcutting in drainage channels from adjacent streams, and increased bank erosion from development within active channels of drainages. These processes have major impact on surface water quality and soil productivity. For this reason, almost all resource management decisions have some effect on soil and water resources.

4.13.2.15.1 Alternative A

Under Alternative A, fire management, vegetation treatment, oil and gas leasing, and land withdrawals have the greatest impact on soil and water resources because they encompass large areas of land. These activities result in long-term indirect impacts to surface and ground water quality and long-term direct impacts to soil productivity. Riparian management will have the most direct benefit to water quality, though it encompasses a smaller area. Mineral extraction also has adverse effects, including direct impacts to soil productivity and surface water quality, indirect impacts through surface disturbance, as well as potential impacts to groundwater quality.

Overall, for Alternative A, compared to current management conditions there will be direct and indirect benefits to soil productivity, watershed health, and water quality.

4.13.2.15.2 Alternative B

Alternative B will generally result in more surface disturbance and indirect, long-term adverse impacts to soil productivity and surface water quality as compared to Alternative A. However, compared to current conditions, there will likely be little overall improvement or decline in soil productivity, watershed health, and water quality.

4.13.2.15.3 Alternative C

Alternative C will generally result in slightly less surface disturbance than Alternative A, and will result in slightly greater benefit to soil and watershed health and water quality. Compared to current conditions, there will be an overall benefit to soil productivity, watershed health, and water quality from Alternative C.

4.13.2.15.4 Alternative D – No Action

Alternative D – No Action will result in no improvement or decline in soil productivity, watershed health, or surface water quality compared to current conditions.

4.13.3 Mitigation Measures

Mitigation for impacts to water and soil resources would generally take the form of avoidance of activities likely to cause major resource degradation. Under standard Non-Point Source Management policies (UDEQ 2000), activities within the VPA are required to take into account stormwater runoff controls. Best Management Practices would be used in areas where runoff, erosion, or range management could affect water quality and soil productivity. Reduction of surface-disturbing activities in and near streams and rivers would also mitigate adverse effects. Administrative actions such as halting surface disturbing activities, changes in grazing management, and increased enforcement of travel restrictions can be taken where water and soil resources are being degraded.

4.13.4 Unavoidable Adverse Impacts

Unavoidable adverse impacts from the Proposed Action include short-term, increased erosion and sedimentation and short-term nutrient release to surface waters due to prescribed burning and vegetation management; increases to surface water temperature due to vegetation treatment and woodland harvesting immediately adjacent to streams; and loss of soil productivity and water quality degradation due to proposed oil and gas facilities and infrastructure.

4.13.5 Short-term Use Versus Long-term Productivity

Construction of oil and gas facilities and infrastructure would provide a short-term mineral use that would eventually result in long-term loss of soil productivity unless well pads are effectively restored. Long-term impacts to surface water quality and soil productivity are primarily the result of vegetation removal or prevention of revegetation, which allows continued erosion of soil and its resulting impact on surface waters. All activities described are surface disturbing in nature and can result in long-term impacts due to short-term land uses. Impacts will persist as long as surface disturbance and vegetation loss continue. As oil and gas areas increase towards full field development, water quality degradation would shift from a short-term impact to one that is more long-term.

4.13.6 Irreversible and Irretrievable Impacts

All activities discussed result in short-term or long-term changes to soil productivity and surface water quality due to surface disturbance or loss of vegetation. However, almost all activities discussed are reversible with respect to surface water quality with appropriate revegetative or mitigation measures.

Soil is a finite resource, and soil productivity would experience irreversible impacts if excessive erosion were to occur without mitigative control structures or practices. These irreversible impacts would be applicable to all activities described above. Sedimentation in surface waters resulting from excessive soil erosion and loss would also be an irreversible impact.

Impacts to groundwater quality resulting from improper well construction and accidental releases of contaminated production water during oil and gas drilling would be considered to be irreversible on a reasonable time scale.